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School Actions Plans for Sustainable Development

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Introduction

Along this entry, we will present a comprehensive guide to developing school action plans for sustainable development, which could be used by Education Science students and professionals from different education levels to understand the dimensions which should be tackled whenever designing and executing action plans to promote Education of Sustainable Development (ESD).

An action plan is a tool that helps educators to prioritize the most important significant initiatives to achieve a desired set of goals and objectives. It is constituted as a structure to follow when carrying out a project.

The finality of an action plan is to optimize the management of resources, by economizing time and effort and improving performance, towards the consecution of the outlined objectives. Action plans are, as well, of great utility to coordinate and achieve commitment of people, organizations, and governments to get involved and work together within the context of the program where the action plan is followed.

There are different educational programs revolving around ESD which can be carried out depending on the resources and needs, as well as policies, of each school. Arguably, the two most popular programs applied globally are the Scholar Agenda 21 and the Eco-Schools.

As explained later in the entry, the Scholar Agenda 21 is derived from the Programme 21 (also known as Agenda 21) which was conceived in Rio's UN summit in 1992. This program reflects the commitment of UN members to act towards a sustainable social, economic, and environmental development. The scope of this program was later narrowed down with the creation of the Local Agenda 21, in which local government and institutions gather the general objectives of Programme 21 and translate them to specific action plans adjusted to the reality and needs of every participating town. The Local Agenda 21 became an ideal instrument to translate the concept of sustainable development in an urban environment by fostering sustainable management policies, institutional cooperation, and citizen participation. Schools, in their role of stakeholders of key importance in every town, developed, in turn, their own action plans which were compiled in the Scholar Agenda 21.

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The Eco-Schools program was created by the UN in 1992 Eco-Schools "as a response to needs identified at the United Nations (UN) Conference on Environment and Development" ("History of Eco-Schools Programme," n.d.); since then, it reaches over 15 million students in 59 countries worldwide.

We will, therefore, focus our analysis in the action plans which derive from the Eco-Schools program and the Scholar Agenda 21, by proposing a set of ten categories which should be followed to implement a complete plan for sustainable development in the context of schools. Within each category, we will present a series of examples of different actions which can be found in the literature to give a flavor to the readers of how to orient their interventions.

The remainder of the entry is structured as follows: both Eco-Schools and Scholar Agenda 21 programs are briefly introduced in sections "Eco-Schools Program" and "Scholar Agenda 21 Program", respectively; section "Using the CIPP Model to Shape Action Plans" presents the theoretical principles to create, or improve, meaningful and successful action plans using the CIPP model (Stufflebeam 1969); section "Main Fields of Action in Schools for the Development of ESD" describes the ten-category structure which serves as a framework to developing ESD action plans, and some examples found in the literature are also presented for each category; and finally, section "Recapitulation of Key Concepts" outlines key ideas which readers should retain as a beacon to successfully implementing ESD in their daily practice.

Eco-Schools Program

The Eco-Schools Program, from now on ESP, is "an ideal way for schools to embark on a meaningful path towards improving the environment in both the school and the local community while at the same time having a life-long positive impact on the lives of young people, their families, school staff and local authorities." (About Eco-Schools Programme n.d.).

The ESP encourages to experiment a more sustainable school environment by motivating the whole educational community to tackle environmental issues at a level in which results are tangible, and by promoting a sense of responsibility which can be instilled to cultivate a sustainable mindset which can, in turn, be applied on a daily basis.

Networks are of key important in the ESP, as they facilitate contact between both national and international participating institutions. Different forums are implemented where ESP's stakeholders can share experiences and action plans applied in different contexts.

Working Principles of the Eco-Schools Program

The ESP follows a participative methodology based on seven steps ("Seven Steps Towards an Eco-Schools," n.d.) to help schools reaching their goals and achieving an environmental certification, the green flag. These steps are listed below:

- Step 1: Form an Eco-Committee.
- Step 2: Carry out an environmental review.
- *Step 3: Action plan.*
- Step 4: Monitor and evaluate.
- Step 5: Curriculum work.
- Step 6: Inform and involve.
- Step 7: Produce an Eco-Code.

Regarding Step 3, the creation of an action plan should always be based on the results of Step 2, the environmental review, which is a helpful tool to determining the areas and themes which need from an intervention. The ESP Organization ("Echo-Schools themes," n.d.) suggests keeping a maximum of three themes, or categories, in our action plan to keep it manageable. Additionally, three points are highlighted as paramount to the creation of a successful plan:

- It should be conceived to solve or improve an identified problem. Necessary tasks must be listed specifying their time frame and assignee.
- It should be SMART (specific, measurable, attainable, realistic, and timely).
- Students should be considered active subjects and, as such, they must participate in the creation of the action plan.

Scholar Agenda 21 Program

The Scholar Agenda 21 program (from now on SA21P) aims to involve and foster the participation of educational communities in the sustainable management of schools and towns (Gutiérrez-Bastida et al. 2007).

It was derived from the popular Local Agenda 21 program which was originated in UNESCO's 1992s Rio de Janeiro Earth Summit (UNESCO 1992) which urged communities worldwide to work in favor of sustainable development from local contexts (think globally, act locally).

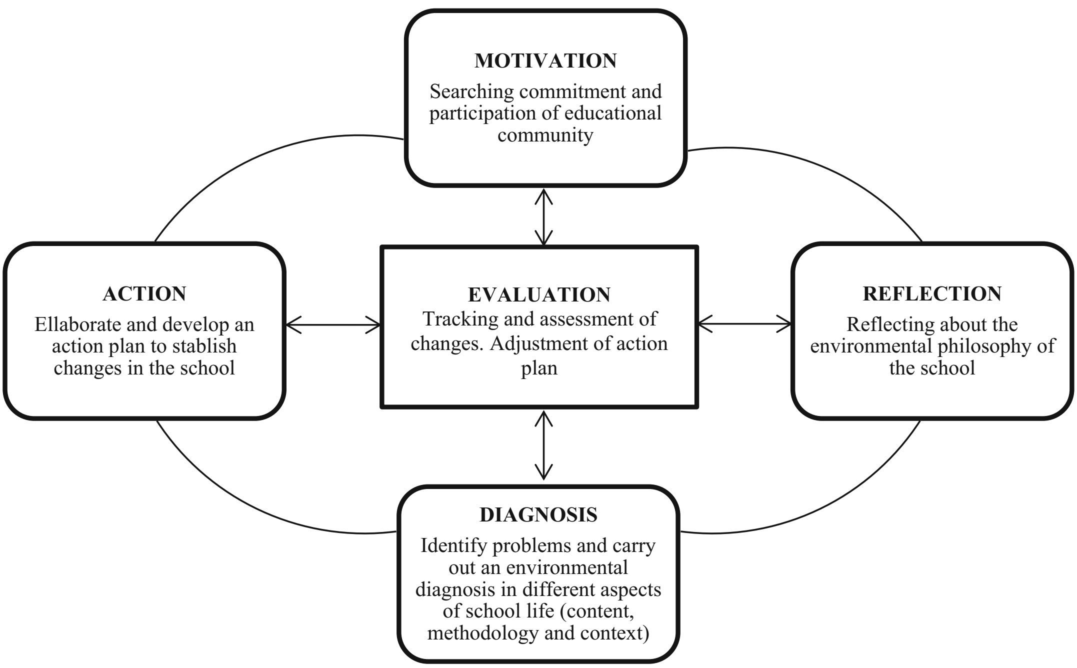
The application of SA21P offers diverse opportunities to work in real projects which favor transformation of close environments, as well as providing participants with evaluation criteria to constitute an improvement experience (Weissmann and Llabrés 2001).

Setting Up the Scholar Agenda 21 Program

The SA21P is composed of five phases: (i) motivation, (ii) reflection, (iii) diagnosis, (iv) *action plan*, and (v) evaluation as depicted in Fig. 1.

We see, then, how the creation of action plans is part of the backbone of both programs. An action plan is, in essence, a project, and any project needs to follow a series of steps, from its conception until its finalization, to guarantee its success. As aforementioned, any action plan must be preceded by different phases in which schools should define their objectives, prepare the terrain, and diagnose their current situation. These phases are highly dependent on the local context on which schools are located and may vary considerably between towns, regions, and countries.

What strategies can we follow to set up a project? Currently, there are many different approaches to project design and management and the selection of one of them depends on the school managers. Project management does not have a unique methodology exportable to any situation, and the consecution of a successful implementation of an action plan is highly dependent on the skills of the managers. However, a tendency to the use of Agile Methodologies has been proved to achieve higher rates of success (Standish Group 2016).



School Actions Plans for Sustainable Development, Fig. 1 Phases of the SA21P. (Adapted from Weissmann and Llabrés 2001)

Evaluation systems guidelines are a useful tool to shaping action plans, as long as the main objective of the action plan is not to only comply with what is expected from the evaluation and assessment of the administration. The objective of the action plan should always be oriented to creating meaningful knowledge and positive actions towards the environment and never to the obtention of recognition, awards, and high scoring during evaluation phases.

Within the context of education, the CIPP model proposed by Stufflebeam (1969) is arguably the most popular program evaluation method. It proposes a series of guidelines to the evaluation and improvement of programs starting from the conception phase, and, hence, its guidelines can be used as best practices manual to design a project and its associated action plan as suggested in Zhang et al. (2011). In general, it is a good practice to be based on evaluation models to conceive programs. Other alternative methods could be selected to design action plans such as Kirkpatrick's four-level evaluation model (Kirkpatrick 1994) and the logical model (with no clear author but traced back to the 1950s). Our proposal will be based on the CIPP model as it captures in a better way the complexity of educational programs and their associated action plans, and "it is not hampered by the assumption of linear relationships that constrains the Logic Model" (Frye and Hemmer 2012). Additionally, it offers a framework that is not mainly based on the outcomes of the action plan as Kirkpatrick's four-level evaluation. It provides, therefore, recommendations for the complete set of aspects to consider when designing strategies and action plans to achieve the desired outcomes of the program.

Using the CIPP Model to Shape Action Plans

The context, input, process, and product (CIPP) model was originally conceived as an evaluation method for educational programs in Stufflebeam (1966, 1967, 1969, 2003). It is based on the thorough analysis of four phases which can analogously be followed to create an action plan.

Phase 1: Analyzing the Context

When decided to adopt a proenvironmental philosophy, schools should start by asking themselves what needs to be done in their local context. They should assess active problems as well as surrounding opportunities. From this evaluation, a series of SMART objectives should be put on the table. During this stage, categories or themes of action should be defined.

Phase 2: Analyzing the Inputs

The analysis of inputs helps the prescription of a project which tackles the needs identified in the first phase. Within this phase, schools should determine how to carry out the action plan. Firstly, an analysis of available human and economic resources should be done. This must be followed by the design of activities inside each category, which should also be timed and included in the curricular program. A contingency plan should also be determined to propose alternatives to the initial plan and adapt properly to changes during the execution of the plans.

Phase 3: Analyzing the Process

Continuous monitoring of the execution of the action plans is of key importance to succeeding in the consecution of the objectives. Different internal evaluation mechanisms should be set up to track in real time whether we are going in the right direction. Short incremental actions should always be followed by reflection and assessment processes. Agile Methodologies offer a series of strategies and tools for such a continuous action-measurement-reflection-correction cycles.

Phase 4: Analyzing the Product

Once the project and all its associated actions are over, schools should gather all participants and carry out a final evaluation of the results. Initial objectives should be reviewed. Action plans should always be open for change. Schools should, indeed, follow a "responding to changes over following a tight plan" philosophy. Actions with poorer results must not be considered a failure but an opportunity to tuning and refining future actions.

Main Fields of Action in Schools for the Development of ESD

After presenting the theoretical principles underlying the creation and application of action plans, as well as the principles in which the Eco-Schools and Scholar Agenda 21 programs are based, we now proceed to describing a set of action categories defined by López-Alcarria et al. (2016) and Guzmán Alonso and Gutiérrez-Bastida (2009), which should be considered when schools define ESD plans. These action categories are based, in turn, in a selection of the themes proposed by the ESP ("Eco-Schools Themes," n.d.).

The theme-based action framework is based on the following ten categories: biodiversity and nature, climate change, energy, food, global citizenship, health and well-being, participation, transport and mobility, waste, and water. The description of each category will be followed by a series of examples of actions in schools from different education levels, described in different works in the literature.

Biodiversity and Nature

Actions in this category should be oriented to examine flora and fauna present in the school environment, as well as to suggest different ways to increase the levels of biodiversity surrounding the school and to improve the awareness of students about biodiversity and nature.

Kassas (2002) provides hints on how to include biodiversity in the school curricula. He defends that education for biodiversity is based on five axes: scale of limits (from local to global), perspectives, objectives, topics (which vary depending on the actors), and assimilation (evaluation of the action plans). By creating a bond between close environment, educators and students are motivated and inclined to work with familiar and surrounding topics. However, text books are not prepared to work in this dimension as shown by Da Conceição Ferreira Fonseca (2007). In this entry, the author explains how curriculum proposals by text books have universal characteristics which are not always linked to regional issues, causing a lack of up-to-date scientific basis in the biodiversity and sustainable development knowledge which is transmitted to educators and students. Also, by addressing topics which seem distant from their reality, and trying to make sense of a centralized position of environment conservation, a feeling of disaffection and demotivation can be perceived in students.

Different interesting experiences can be found in the literature. For instance, Singh (2010) presents how to address different topics related with conservation of biodiversity through collaborative learning between students and key informants of the community. The author proposes a biodiversity contest which is divided into different steps in which the final goal is to transmit biodiversity knowledge from different members of the community such as pastoralists, wisemen, children, and traditional healers.

Another recurrent way to work biodiversity when schools have limited or no direct access to natural spaces is by means of Information Technologies. Ulbrich et al. (2012) present the development of an educational software (PRONAS) directed to students from 12 to 19 years old which combines classroom theoretical work with experiences in the field through both virtual and real excursions to the nature.

Climate Change

When addressing climate change in schools, focus should be laid on assessing the impact that human beings have on the climate. The educational community should be aware of the negative effects or our actions as humans and promote positive changes in students and their social environment.

As defended by Waldron et al. (2016), climate change should be treated from a holistic, critical, and open perspective. Educators should offer multiple reflection spaces which involve students in citizenship and political action models, where social, economic, and justice aspects are tackled. Moreover, due to its multidisciplinary nature, it should be presented to students in a transversal way, addressing it in different courses and workshops. Action plans should try to avoid isolated actions which may clash with concepts and actions being taught by less aware educators in the same school.

From a practical point of view, an easy way to work with climate change topics in schools is by calculating the carbon and water footprint of the facilities of the school, as well as of the food that is served in the canteen. De Laurentiis et al. (2017) carried out a study in the United Kingdom where they found different mutual benefit strategies which can achieve the reduction of impact of both aspects. Data gathering, analysis, and tracking can be done in conjunction with students, so awareness of the impact of their actions in schools is raised, while alternatives are investigated to reduce the school environmental footprint. Such a strategy is found in Eggert et al. (2017), where they present a participative action involving students to improve the conceptual comprehension of climate change and their socio-scientific reasoning and decision-making. This is done in a learning environment based on the use of IT with a tool that maps embedded concepts to promote the learning of secondary school students about climate change and possible strategies to mitigate it.

Energy

Actions revolving this topic should be based on looking for formulas in which all school members can work together to improve awareness of energy problems and improve the energetic efficiency of the school facilities. Energy policies in schools should not be a topic limited to the school board or managers. To achieve a profound effect both in the efficiency of the energy consumption of the schools and the awareness of the effects of energy wasting, it is necessary to involve all students as active agents in the planned actions.

When treating energy in higher education, we should consider two different approaches as claimed by Perkins et al. (2014). A first approach should be created to address energy topics in the general education of all students, while a different one should be conceived for students enrolled in energy-related professional programs. This work argues the capacity of energy education to help solving climate change dilemmas and to promote sustainability. According to the authors, professors and managers face four challenges: accommodating diversity in students, rewarding teachers, creating new curricular itineraries, and integrating theory with practice.

An example of how to include energy topics in the curriculum can be found in the work by Ito and Takaki (2015) which shows how energy is addressed in a mathematics course of secondary education students. Different materials and resources were developed to use mathematical concepts such as integral calculus, graphs, and trigonometric functions to learn about the physical principles of energy. Different experiments such as creating manual energy generators were carried out and the importance of management of energy for the conservation of the environment was also addressed.

A different action is found in López-Alcarria (2016) in which a solar energy cooking workshop was carried out in a high school in Granada, Spain. Different devices prepared for cooking were used to show students the power of solar energy and how, by focusing solar beams, even an egg can be fried.

Food

When discussing food topics in educational environments, educators should focus on those proposals motivating the community to make decisions and carry out actions related to food, its responsible consumption, the use of local ecologic products, and keeping a healthy diet.

Policy makers as well as educators have an important role in this task and can help to increase the opportunities to develop a well-informed reasoning in students by addressing food issues in the curriculum. Gisslevik et al. (2018) explore conditioning factors that have influence in the learning opportunities of education related to food that are taught from a sustainable development perspective.

One of the most popular, dynamic, and participative actions to include food topics in educational contexts is the creation of a school or urban vegetable garden. Lee et al. (2016) and Duram and Klein (2015) show how to develop nutritional education programs in different educational levels (middle school and universities respectively) based on school vegetable gardens, and how to employ them as a tool to reconnect students to food grown locally, and the benefits of eating season products. Their action plan shows how to effectively involve community resources while creating a gardening environment in which students can access a positive and sustainable food environment. Some of the schools, in addition to keeping a vegetable garden, also include the grown products in the meals that are served in the canteens. This strategy can help to increase the impact of the vegetable garden as students are able to taste the products they have grown, while enjoying the positive effects of a healthy diet.

School canteens are, therefore, another important focus in which actions can be developed by integrating healthy diets and habits that can be extrapolated to student's homes. Oostindjer et al. (2017) discuss in their essay the perspectives and nutritional, social, practical, educational, economic, political, and cultural challenges related to the implementation of sustainable and healthy meals in schools. They conclude that food in schools is not considered a social welfare program anymore and that schools are starting to integrate it in their meal's education strategies as a means of promoting long-term effects in both health and proenvironmental attitudes of students.

Regarding the economic perspective of sustainable food policies, Soares et al. (2017) reflect about initiatives that promote the purchase of local food products to supply schools.

Global Citizenship

When referring to the global citizenship term in an educational constant, it should be focused on working with students to discuss their rights and responsibilities in both local and global scale, as well as on working with the whole community to reflect about the impacts that our life habits have in other parts of the world. The concept of externalities should be treated and explained to show how the slightest of our actions, when summed to the actions of our neighbors, has a direct impact in the global environment.

McNaughton (2010) proposes an educational drama strategy through art as a useful way to teach sustainable development and education for global citizenship to students from 10 to 11 years old in three schools in Scotland. This method is presented as an alternative to traditional ways of treating ESD by means of active and experiential learning and role playing.

Health and Well-Being

This category revolves around the promotion of health and well-being of students and the rest of the educational community, and to do so, a link between health and the environment must be established. Schools are, arguably, an important part of the students' environment and actions should be carried out to improve their health and emotional well-being (Deschesnes et al. 2014). Health should be promoted since early ages to build persistent and long-term durable competences in individuals (Mannix-McNamara and Simovska 2015).

Passmore and Donovan (2014) present the "Health for Life" program in primary schools. This program helps schools to promote healthy and active lifestyles by means of curricular support based on diet, food growing, physical activity, and participation of families. Schools participating in the program must develop their own action plan to achieve the goals of the program (healthy eating and cooking skills, growing food, 60 min of physical activity every day, etc.) and evaluate the results by means of an audit of the facilities, the skills, and the curriculum.

Orme and Dooris (2010) explore higher education as a key scenario to promoting health and sustainability from an integrated and coherent way. They conclude that ". . . public health, sustainability and climate change agendas are so inextricably linked that they need to be considered as one broad overarching system and that higher education is a large distinctive and hugely influential sector that has both the potential and the responsibility to lead for change regionally, nationally and globally, thereby catalyzing integrated policy and practice responses."

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Participation

As aforementioned, participation is a key concept also when addressing other ESD topics. It has been proved essential to improve the attitude towards the concepts that are being taught as students interiorize the learnings and actions in a better way and feel as an important stakeholder of the whole school ESD strategy. It is, thus, an aspect in which schools should work before embarking into the development of any further action plans. It could be considered as a tool necessary for any action plan. This fact is also maintained by Andreasen-Lysgaard and Simovska (2016) who consider participation as both an educational ideal and a learning strategy. Participation plans should be created, also in a participating way, and used as the core for the construction of action plans addressing any of the categories presented along this entry.

An example on how to use participation to improve the environmental management of higher education institutions can be found in León-Fernández et al. (2018), in which a participative process at the University of Córdoba, Spain, is developed to assess and propose actions to improve environmental policies of the university. An internet forum was created to perform a SWOT analysis of environmental policies and management. From this SWOT, a series of actions were proposed. The brainstorming process ended with the creation of a General Participative Action Plan. Such an approach in the creation of action plans can be easily exported to other organizations and institutions which desire to improve sustainability management in a participative way. The process of this approach can be divided into different phases: (i) creation of the participation tool-scenario (in this case, an internet forum. Other possibilities include assemblies, workshops, meetings, focus groups, etc.), (ii) compilation of current problems perceived by the participants, (iii) brainstorming of possible actions, and (iv) agreed selection of definitive actions to be compiled in the general action plan.

Transport and Mobility

Within this category, different actions can be envisioned to help solving transportation problems and propose practical and proenvironmental solutions to improve daily life of students, their families, and the communities surrounding schools. Different actions can be shared between different educational levels, others being more specific to young children or campus students.

Even though nowadays most trips to schools are made either by car or buses, some schools and administrations have started developing alternative mobility strategies. An example is the "Pedibus" system implemented in different countries like Switzerland and Spain in which a series of itineraries with different timed stops go across different cities to reach schools. The trip to school is made by foot, and groups of children are supervised by parents who lead and supervise them in turns. The system replicates a public transportation system (fixed and timed itineraries and stops) and two direct effects are achieved: improvement of the physical activity of children and reduction of the pollution. An insurance policy is also provided to cover for possible accidents. Another example is the "Safe Routes to School" international movement which has become now a federal program in the USA. This initiative was originated to make it safe, convenient, and fun for children, including those with disabilities, to bicycle and walk to school ("Safe Routes Michigan," n.d.). Initiatives supported by administrations and schools like the "Bike to School Day 2018," in which 40,000 students rode their bikes to school in Michigan, have shown effective in the promotion of a sustainable alternative mobility. Other examples of similar action plans can be found in "iwalk" (n.d.), "safeway2school" (n.d.), and "lifecycle" (n.d.).

Shared rides are another alternative action which can be promoted by creating different platforms in which parents can share their cars to bring their children to schools.

In higher educational stages, schools can work together with private companies and local institutions to create shared bikes, also electrical ones, so that students choose them as an alternative, healthy, sustainable, and cheap transportation way in their daily commute to the campus. On the other hand, with the raise of flipped-classrooms strategies and information technologies, different campuses offer live or prerecorded courses so that students do not have to physically be present at campuses (Vázquez-Cano and Sevillano-García 2018).

By proposing different alternative mobility actions, which are also highly dependent on the context of schools, the autonomy of the students and the energy consumption balance are improved while the emission of polluting gases and noise are reduced.

Waste

The main objective of this category is to examine the impact of the waste generated by schools, explore actions to minimize the amounts which are produced, and encourage students to adopt similar strategies at home.

The starting point of any action should be the inclusion of the waste concept in the curriculum. Students should understand different types of waste and their implications and effects in the environment. Borreguero et al. (2018) show that current legislation gives no relevance to this concept which translates, in turn, in the lack of its study in different educational stages. Before defining any waste-related action, schools must ensure that students understand the dimension of the problem and the objective of the actions that will be promoted.

Arguably, the most popular actions related to this category are those revolving around the triple R (reduce, recycle, reuse) concept. Among the three of them, recycling is typically part of most schools, in which different bins are provided to separate waste and different actions, such as workshops to create handicrafts with recycled materials, take place.

Research by Maddox et al. (2011) expose a model which uses practical activities and the participation of schools to promote waste-related actions. This document describes and evaluates the effectivity of waste education to extrapolate actions to student's homes. A group of 39 schools was included in the project in which the objective was to transmit the triple R message to families. The study shows how the intergenerational influence can positively affect the recycling behavior of the families based on a practical model of waste management education in schools. This reflects, then, the importance of the extrapolability of the actions carried out in schools as drivers of change in the attitudes towards waste management in the community.

Water

Actions within this category should be oriented to highlight the importance of water as a key resource for life and raise awareness about the effects of its negligent use and consumption. Actions should promote strategies to reuse and reduce water consumption, starting from the school and encouraging extrapolation and persistence of the acquired behaviors.

Schools should analyses whether water consumption in their facilities is optimal or different actions could be implemented to improve it (signs in bathrooms, installation of waterless urinals, filling toilet tanks with sinks' sewer water, installation of drip irrigation systems, etc.). Each of these actions should be publicized so that students are aware of them and understand the ultimate objectives.

The Sun and Water project (Gates et al. 2016) is presented as an educational action through an electronic game which is based on regional problems explored by means of virtual simulations and real-world data. The game immerses students in water management topics, biodiversity, sustainability, and human impact in the environment.

Recapitulation of Key Concepts

Along this entry, we presented two of the most famous education for sustainable development programs, Echo-Schools and Scholar Agenda 21 which can be used by schools as frameworks to develop their action plans. We reviewed the importance of following a structured methodology, such as the CIPP, to develop all the programs and actions. No action plan should lack from a series of defined SMART objectives.

We have also reviewed a set of ten themes or categories around which action plans can revolve and provided a series of examples of works which can be used as references to obtain ideas and analyses the impact of similar strategies. For each category, the reader should retain the following key aspects:

- **Biodiversity**: Link students with surrounding diversity. School trips to the nature.
- **Climate change**: Transversal approach in the curriculum. Computing schools' carbon and water footprints.
- **Energy**: Audit energy use and efficiency of schools and extrapolate actions to students' homes.
- **Food**: Grow vegetable gardens and include them in the meals served in schools.
- **Global citizenship**: Create critical thinkers aware of responsibilities and rights. Work the concept of externalities.
- **Health and well-being**: Integrate healthy diet, physical activities, and create a comfortable and healthy school environment.

- **Participation**: Both a concept to work in and a tool to use in the rest of categories.
- **Transport and mobility**: Importance of collaborative actions with the community. Use of bikes, pedibus, shared rides, flipped classroom, and virtual lessons.
- **Waste**: Work the concept of waste in curriculum before applying any actions. Actions revolving around Triple-R concept. Power of intergenerational interaction to extrapolate actions to student's homes.
- **Water**: Improvement of water consumption in schools to keep environmental coherence and extrapolate actions to students' homes.

Action plans are an indispensable step to implement with success any strategy or program based on ESD. There are multiple ways of working all the categories presented along the entry, and it is highly recommendable that educators and school management work together to treat them in a transversal way to improve the persistence of the habits that are to be acquired by students. Schools should avoid the creation of punctual actions not subject to any action plan if a model of school revolving around ESD wants to be created.

In López-Alcarria (2016), it is shown how schools with a clear and defined action plan are more successful to implement ESD programs even when the staff turnover his high. Action plans help to keep a long-term plan and homogeneity within the actions that are carried out.

Finally, it is convenient to highlight that every action plan should be tracked and monitored by a continuous evaluation process in order to optimize resources and achieve its incremental improvement.

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SDG Accord

► Global Alliance of Tertiary Education and Sustainable Development

Serious Games and Sustainability

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Synonyms

Digital game-based learning; E-Learning; Educational games; Edutainment; Games for change; Persuasive games; Social impact games

Definition

Serious games can be defined as those games that are designed with a purpose that goes beyond pure entertainment. These games are intended to convey ideas and values, facilitate learning, and practice skills. They have the purpose of influencing thoughts and actions in real-life contexts, therefore exceeding the scope of the game itself. Not all scholars agree with the adjective "serious" since these games do not exclude fun; the reason of that label is related with the theme of the contents and the use of these games in sectors such as health care, engineering, education, defense, city planning, or politics. The paradox between playfulness and seriousness can be reflected here: "what is merely play is not serious, and play itself contains its own, even sacred, seriousness" (Gadamer 1979).

An ever growing sector in which serious games are applied is sustainability. Goals of serious games on sustainability could be summarized in (a) making players aware of the challenges associated with sustainability, (b) providing knowledge and understanding with the issue of sustainability, and (c) encouraging players to take actions and develop solutions that are environmental and socioeconomic balanced.

Introduction

A growing global recognition to keep an ecologically balanced environment while still using natural resources to respond to the demands of a growing population has led governments to adopt the concept of sustainable development, defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs" (Brundtland 1987). Creating awareness and promoting attitudinal and behavioral changes on sustainable issues are crucial, and serious games can play an important role by allowing players to experience unfamiliar circumstances that are not possible in real life, for instance, being a mayor with the power to change a whole city toward a more sustainable place, balancing pollution, energetic productivity, and citizens' happiness as players experienced in the game *MyGreenPlanet*.

Such games usually present a challenge into several "missions" of increasing difficulty. Thanks to their immersive narrative and interactivity, games have the capacity to convey to young people the problems that they will be facing in the future, generally by adopting the roles of characters who have to be able to think strategically, plan, and make sustainable decisions (Ouariachi et al. 2017a).

The mechanism through which the persuasion process occurs is that "playing a game can lead to a state of flow or immersion where players are extremely concentrated and time passes unnoticed" (Soekarjo and van Oostendorp 2015: 37). This state of flow can lead to a higher awareness and understanding of relevant factors involved in the game (e.g., sustainability), and in effect, to a positive change in attitude which can subsequently trigger a change in behavior. However, there is limited empirical evidence currently available to prove effectiveness of serious games in general, and sustainability games in particular, and the findings are so far contradictory, some revealing positive effects on awareness, knowledge, attitudes, or behaviors, and others just limited or no effects (Soekarjo and van Oostendorp 2015; Yang et al. 2017).

In this entry, we are going to provide a brief historical background of the serious games movement and overview of serious games on sustainability, including a case study to offer more insights of these types of games, and present some emerging trends in this field.

The Rise of the Serious Games Movement

The widespread use of the Internet, the need to create more engaging learning experiences, and the popularity of video games in popular culture have led to the emergence of the so-called *Serious Games* movement. The creation of the term has been attributed to Clark C. Abt in 1970, but the popularization to Ben Sawyer with his paper *Serious Games: Improving Public Policy through Game-based Learning and Simulation* in 2002; later in 2007, the evidence of an established academic field became a reality with the foundation of The Serious Games Institute at Coventry University (Wilkinson 2016).

Having said that, there are other historical antecedents of "games with purposes" that are worth mentioning (Wilkinson 2016): the first manifestation can be traced back to Plato, who mentioned that "reinforcing certain behaviors exhibited in play would reinforce those behaviors as an adult," assuming that games are a "developmental imperative" (D'Angour 2013). Jean Piaget, psychologist and epistemologist, later maintained that play allows the reinforcement of previous skills and abilities through repetition, as well as the development of a sense of mastery. His work on cognitive stages of child development had a great impact of scholars who aimed at categorizing play stages (Cohen 2007; Wilkinson 2016).

Another interesting aspect in the historical evolution of serious games has to do with the military sector: the application of simulation-based learning and military experiments with computer modeling can be considered prototypes of contemporary serious games (Wilkinson 2016). Education is another sector that embraced serious games early on, because teachers recognized the potential of games: they are motivating, provide immediate feedback, can adapt themselves to the level of the learner, provide repetition to the point of automaticity, encourage distributed learning, can teach for transfer, and use other excellent teaching techniques (Gee 2003; Gentile 2011).

Overview of Available Serious Games on Sustainable Issues

Today, serious games are one of the fastest-growing areas in educational media; its market is expected to grow from 3.2 billion US dollars in 2017 to 8.1 billion in 2022 (Statista 2018). Concretely, serious games on sustainability have grown and diversified exponentially over the last years: card games such as *Keep Cool*, where players represent groups of countries that negotiate economic growth and climate change mitigation; simulations based on peer-reviewed scientific data that allow for the manipulation of variables such as energy consumption and population growth to model the effects on world climate, like those collected on the website *Climate Interactive*; or mobile games like *Climate Mission 3D*, where players learn how to reduce their carbon footprint as they play a series of mini-games (Wu and Lee 2015, Ouariachi et al. 2017a). But especially in the last decade, these types of games have experienced most progress in an online format.

Discussions have begun on the analysis of serious games in general and on the analysis of serious games on sustainable issues in particular. Liarakou et al. (2012) develop a set of criteria focusing on dimensions of Education for Sustainable Development and conduct a pilot evaluation of 34 games in English and Greek. Reckien and Eisenack (2013) analyze climate change games on board and screen developed in English or German, using indicators such as year of appearance, format of game, actors involved, temporal development, or scale of issues. The research by Katsaliaki and Mustafee (2014) proposes a review of 49 games on sustainable development produced in English and German, analyzing underlying characteristics such as game availability, number of players, their roles, their target age, game validation, graphics, or stakeholder involvement in game development. Wu and Lee (2015) provide a general overview of climate change games in English, comparing different formats and features but without proposing a systematic analysis. Ouariachi et al. (2017b) propose an evaluation tool for serious games on climate change-related issues with criteria divided in five different categories: identification, narrative, contents, gameplay, and didactics. Using these criteria, in one study, they carry out a qualitative analysis of five games produced in Spain, and in another study, they apply the tool to a set of 24 games produced in Spanish language (Spanish and foreigner productions) targeting youth.

Generally speaking, these analyses show that:

- The thematic subject that strongly dominates serious games on sustainability is climate change and the interrelated energy issue. Other popular themes include waste management, water saving, urban planning, ecosystem management, reforestation, agricultural and farm management, consumption carbon sink through replanting trees, and natural disasters.
- From the three dimensions of sustainability (environmental, social, and economic), the majority of games focus entirely on the environment, followed by the combination of environmental and economic dimensions, and then environmental and societal dimensions.
- Most of the cases aim to provide some basic knowledge on sustainable issues, developing familiarity with the topic. Also, games tend to aim at raising awareness of causes and consequences and promoting a change in attitude and behavior. To a lesser extent, these types of games stimulate the development of solutions and ideas through creativity.
- Global storylines are very diverse, but it is noticeable how many of these games portray the role of an ordinary citizen who has to take sustainable decisions in their daily lives, such as saving energy and water, recycling, buying ecological food, etc.
- Looking at the different types of player profiles, the most popular player profile is the explorer and competitor. Fewer cases are characteristic of the creator type of player and collaborator.

Different web platforms have appeared in recent years that serve as a directory of serious games and sustainability. *Games4Sustainability*, run by the Centre for Systems Solutions, offers access to free serious games targeting academics, trainers, NGOs, teachers, students, and anyone interested in this topic. *Gamepedia* also contain more than 100 sustainability games which can be filtered according to sustainable development goals. The following table shows examples of free serious games that are available online.

Table of Games

Energy		
WindMill game	Persuasive games	Strategy game about building wind farms to create clean energy profitably. Players fulfill a specified energy offset goal as quickly as possible by building turbines smartly and research locations carefully for the best wind conditions, avoiding upsetting the local citizens by building turbines in undesirable places
Energy 2020	European Commission/ Tralalere, Universe Science and France TV education	In 2020, the world could find itself in a deadlock. The player has the power to go back in time and to rewrite history. The player's objective: to reduce the consumption of energy, increase energy efficiency, and choose the best renewable energies There are three advisors – economical, environmental, and social – to help players take good decisions to improve the collective future

(*continued*)

Energy City	JASON Digital Lab	In Energy City, players will work through a selection of 6 cities; each has its own energy detail variations and challenges, as they play a 10-year normal play or a 20-year expert play. Players must watch out and observe the important 3 meters displayed on the top of their screen, providing details about the city's local air quality, environmental impact, and budget
Water		
Water alert	UNICEF	Water alert is a serious game on water, the environment, and sanitation where young people are engaged in an adventure of strategy and survival
Catchment Detox	ABC Catchment Australia	Players are in charge of the whole catchment and decide what activities to undertake – whether to plant crops, log forests, build factories, or set up national parks. The aim is to avoid environmental problems and provide food and wealth for the population. Managing Australia's waterways is a huge challenge with climate change, increased demand for water, and environmental problems putting our rivers under stress

(*continued*)

Citizen science	National Science Foundation	An adventure puzzle game where the player is taken back through time to help stop the pollution of their local lake. As the player travels back in time, they are challenged to not only learn about the overlapping and many causes of fresh water lake pollution but also the social factors and different constituents that play a role in the cause of certain pollutants. In Citizen Science, players meet characters that each plays a part in the pollution of your local lake
Recycling		
Garbage dreams	ITVS	The Garbage Dreams Recycling game invites players to take on the role of the Zabbaleen, who impressively recycle 80% of the trash they collect. Players start with one neighborhood, one factory, and one hungry goat. They have 8 months to build their recycling empire and get Cairo's total recycling as high as possible
Dumptown/ Recycle City	Environmental Protection Agency of United States	Players are given a budget and must clean up the town with up to ten programs. Each time players initiate a program, they will see the landscape change and the amount of waste that they are keeping out of the landfill

(*continued*)

Enviroborder	CleverMedia and Gamescience	Players take the role of a cartoon skateboarder, trying to pick up recyclables on a busy street. The street is littered with tons of reusable goods. There are three different items to collect: glass bottles, metal cans, and newspapers
Consumption		
Great green web	Union of Concerned Scientists Action Network	This game tests players' knowledge of how consumer choices affect the environment. As they answer questions and "shop green," the Envirometer gauges the cumulative impact of your choices. The center point on the Envirometer represents the impact of an average American household – at the end of the game, players can compare this average to their own impact on air quality, water quality, natural habitats, and the sustainability of our climate
Actúa con tu consumo	Greenpeace	Game created to promote responsible consumption and critical thinking, which encourages players to reflect about the impact of their consumption habits on the environment. There are different activities and mini-games to be completed

(*continued*)

Agriculture and farming		
3rd World Farmer	IT University of Copenhagen	Serious game featuring farming, environmentalism, and geopolitical practices in the developing world. Players experience market prices, budgeting, agricultural, and infrastructure decisions; the environment and geopolitics affect the lives of farmers. They will also experience the impact of family members developing illnesses and dying
Pipe dreams	James Hutton Institute	Game based on a fictional catchment in rural northeast Scotland. The user can select from different land uses (livestock, crops, forestry, and natural vegetation) for ten land use polygons, and then the simulation gives results for food security, economic growth, and environmental quality
Natural disasters		
Stop disasters	United Nations	Simulator of disasters such as flooding, hurricanes, earthquakes, and tsunamis. Players plan and build a safe environment for the population before the disaster strikes, estimating disaster risks and reducing the impact of the disaster

(*continued*)

Climate change		
Clim'Way	Cap Sciences.net	The game aims at showing how, in a western industrialized country like France, one can opt for sustainable life styles, beneficial to earth and its inhabitants. Players have 50 game turns (= 50 years) to set up actions that will reduce energy consumption, develop renewable energies, divide GHG emissions by four, and adapt Clim'City to climate change
Climate defense	Games for change	Climate defense is a single-player tower defense game that tasks the player with preventing global warming by absorbing carbon dioxide (CO2) before it builds up in the atmosphere. Towers, representing set quantities of trees that could be grown to absorb carbon dioxide, can be constructed by the player to destroy CO2 clouds that march along pathways from the surface of the earth to the atmosphere in waves
Climantica	Xunta de Galicia	Simulation game where the player becomes a major who has to create and manage a sustainable territory, planning actions in a strategic way and being aware of causes and consequences of climate change

Case Study: We Energy Game

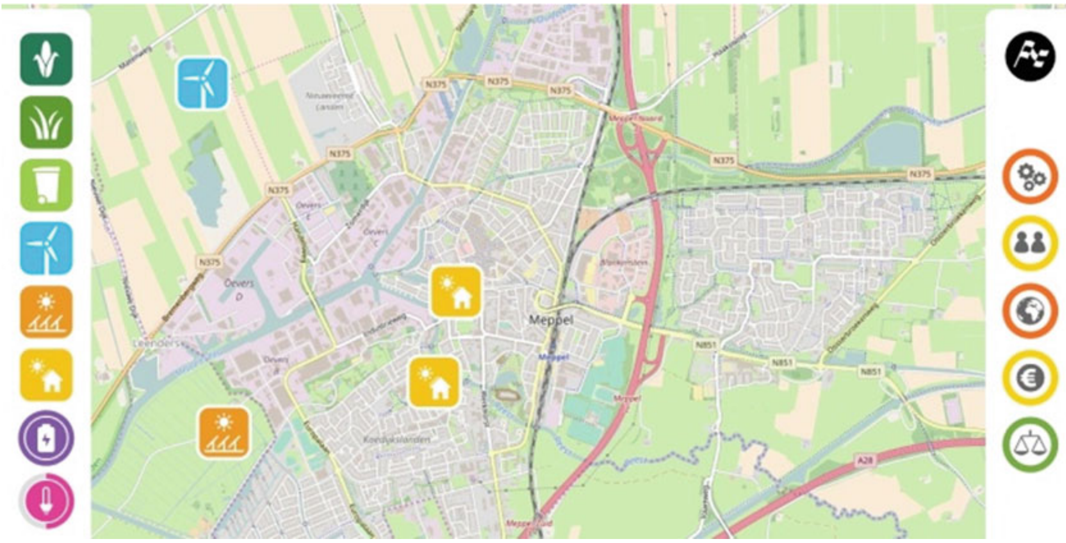
How can you make a town or city energy neutral? And how can you ensure that production, profit, people, and planet are in proportion with each other? These are some of the questions raised by the We Energy Game (developed at the Center of Expertise Energy in Hanze University of Applied Sciences in Groningen, The Netherlands), a serious game that aims to create awareness on the challenges in the provision of affordable energy from renewable sources for an entire town or city, creating an ideal sustainable energy mix (Fig. 1).

The game can be played on board or on screen by a minimum of five players. The roles to be played are:

- Production: a project leader who needs to produce a certain amount of energy
- People: the citizens of the area where the game is played
- Planet: how green/clean is the energy production
- Profit: how much profit is made by the different projects
- Balance: how easy to work with is the energy source for the network operator

The goal of the game is to make a town or city energy neutral: players negotiate from their respective roles which energy source they want to employ and on which location. Once agreement is reached, they place the icon that represents that energy source on the map, and they check the consequences for each of the roles (production, people, planet, profit, and balance).

The scores are based on realistic effects of each variable and refer to the amount of energy, emissions, and impact. The game uses four levels of difficulty by making use of four different maps in the Netherlands, allowing players to experience the challenges of making different towns with different population sizes and urban structures energy neutral: Diever (goal, 25 points), Meppel (50 points), Assen (75 points), and Emmen (100 points). The game finishes when all roles reach the total score for the selected town,



Serious Games and Sustainability, Fig. 1 Map of Meppel. (Courtesy of Hanzehoogeschool©)

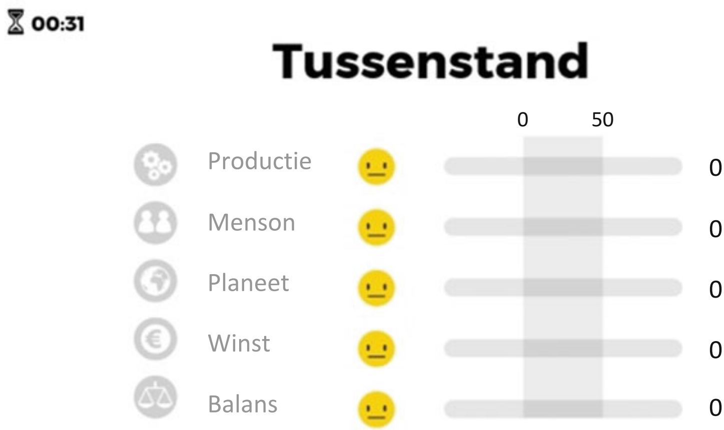
maintaining a positive balance. This is achieved by using different energy sources which each provide a certain amount of points for each role. By placing these sources on a map, players achieve these points. Most energy sources have some positive and negative scores for the roles, so the solution should be a mix of all the sources available.

In the process of playing the game, players realize that (a) there are many available solutions to reach an optimal balance taking into account the point of view from all parties involved and that (b) sustainability is not just a technical issue but a social one as well: even though there is great support for solar panels, the sun doesn't always shine so other resources are needed; wind provides a lot of energy but can also encounter protest by local residents; biomass could be a good solution, but its yields are less and its environmental footprint is greater. The We Energy Game has been played by a variety of groups such as energy cooperative members, business and municipality representatives, and students. By April 2018, the digital version of the game has been played by around 500 people and the board game by around 1500. Players found the game informing, easy to play, and very handy to start a conversation on the subject of energy transition.

Emerging Trends

With over three billion smart phone users worldwide, the power of mobile is huge. Mobile gaming opens possibilities for new formats such as location-based games, alternate reality games, or augmented reality games. This way, we bridge digital and physical spaces, extending the gaming experience into the real world and increasing the chance of behavioral engagement.

Originally released for Java-enabled mobile phones, *PowerAgent* is one of the first examples that shows how virtual and real can be merged. Each day, a boss called Mr. Q announces a mission to all players (called power agents) via their phones. The missions to be completed by a player, usually during hours of generally heavy electricity use, aim to reduce power consumption in their homes, such as adjusting heating levels and switching off standby appliances. The game is able to use actual power consumption data from



Serious Games and Sustainability, Fig. 2 Results. (Courtesy of Hanzehoogeschool©)

in-home metering devices to provide measurable feedback during play. In *Power Explorer*, action-oriented and multiplayer, players have to save their own monster blob in their phone and become the king of the castle using the electric appliances in their homes. The habitat of your own monster blob is connected in real time to your home's own electricity usage. In *JouleBug*, users have to download a free app to a smartphone, tablet, or computer and set up a profile. The app aims to make it easy and fun to save energy, water, and other resources. Using location-based hardware and 3D visuals, in the game *Habitat*, players can collect location-based pins to achieve the completion of certain missions.

Another interesting format is alternate reality games, defined by intense player involvement with a story that takes place in real time and evolves according to players' responses. *World Without*, the world's first serious alternate reality game, was played by thousands of people on blogs and other social media platforms for 32 weeks in 2007 to simulate what could happen if there was an oil crisis and oil became inaccessible. *Evoke*, produced by the World Bank Institute, is a 10-week mission aiming at changing the world. Players can earn points and power-ups by completing real-world tasks like volunteering, making business contacts, or researching an issue and then submitting evidence of their work online. Evoke was designed to empower young people all over the world, and especially in Africa, to start solving urgent social problems like hunger, poverty, disease, conflict, and climate change in a gamified way (Fig. 2).

Augmented reality games are another trendy format, especially after the boom of *Pokemon Go*. One example is *EduCycle* (Neste), an educational augmented reality game for school children based on the Paris Agreement on climate change. According to their website, "it teaches children how to reduce their personal carbon footprint by simulating their energy, food and traffic choices in the game's physical map board; the main objective is to balance human and environmental needs by making smart choices with limited resources." The game has already been used in high schools in the United States, where students showed a better understanding of the impacts of climate change and higher empowerment levels to make a difference (Fig. 3).

Lastly, from an educational point of view, virtual reality (VR) is one of the latest trends. Even though it is not yet available in every classroom, programs such as Google Cardboard aim to make virtual reality headsets cheap and accessible. VR apps allow students to visualize concepts that were confined to the pictures in a textbook, for instance, in *Cleanopolis*, students learn about CO_2 and battle along with Captain Clean to save the world.

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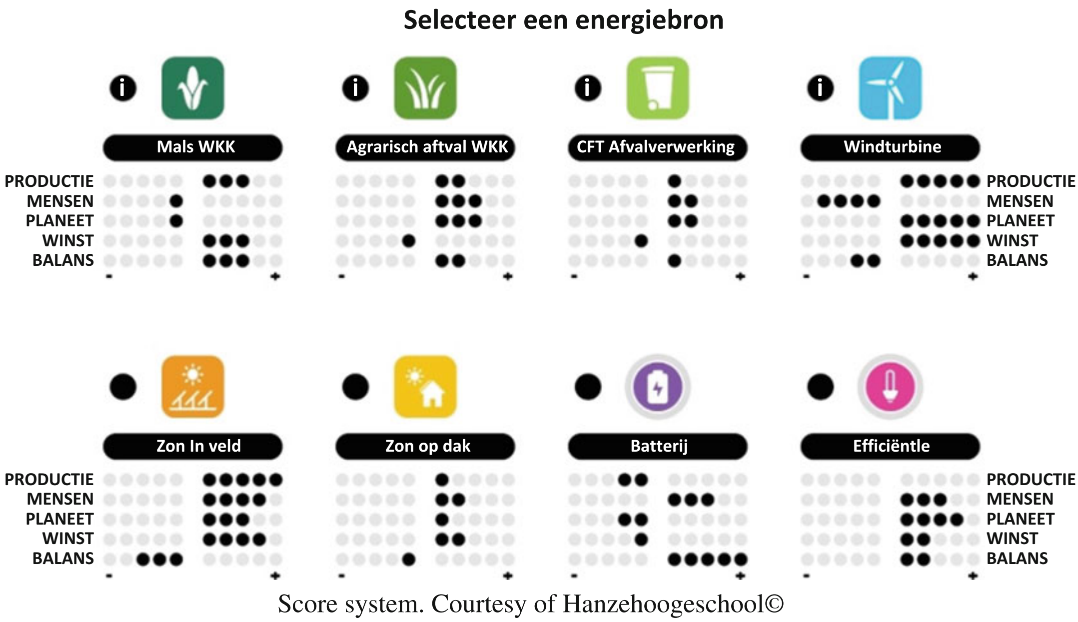

Serious Games and Sustainability, Fig. 3 Score system. (Courtesy of Hanzehogeschool©)

Cross-References

▶ Awareness of Sustainability Issues
▶ Environmental Conservation Games and Sustainable Development

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Service Learning

▶ Reflective Practice for Sustainable Development
▶ Service-Learning and Sustainability Education
▶ Work-Integrated Learning for Sustainability Education

Service-Learning and Sustainability Education

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Synonyms

Action inquiry; Action learning; Action research; Co-inquiry; Collaborative action research; Cooperative inquiry; Experiential learning; Internship; Living case study; Negotiated work-based learning; Problem-based learning; Reflective practice; Service learning; Systemic inquiry; Work-based learning

Definition

Service learning has been described as a philosophy, pedagogy, and a program underpinned by learning through experience and reciprocity (mutual development). Service learning as an approach to sustainability education adopts these ideas toward aspects of sustainable development (e.g., supporting community resilience, recycling, or local health promotion).

Introduction

In the context of higher education, service-learning has been adopted for various dimensions of sustainability education across disciplines including environmental studies (Helicke 2014), engineering (Seay et al. 2016), entrepreneurship (Niehm et al. 2015), nursing (Dalmida et al. 2016), clinical studies (Petersen et al. 2015), psychology (Bringle et al. 2016), and political sciences (Benjamin-Alvarado 2015). It has been described as a philosophy, pedagogy, and program (Jacoby 2015), conceptualized as a form of experiential education based on "reciprocal learning" (Sigmon 1979) where the "head, hands, and heart" can become integrated (Sipos et al. 2008). Here, both the learner offering service and the recipient of that service are considered equally important, and both are mutually changed or transformed in some way (a relationship signified by the use of a hyphen between service and learning, ibid). Such reciprocity, however, distinguishes service-learning from volunteering and community service (which typically tend to prioritize the recipient of the service-learner's efforts), as well as field and internship education (which typically tend to prioritize the learner) (Sigmon 1994).

Service-learning is an educational form prioritizing social justice and democracy, traced to a variety of philosophies and practices such as the work of John Dewey, the Land Grant university movement of the 1860s, the immigrant education of the 1920s, and civil rights activities of the 1960s (Wall et al. 2019b). As such, service-learning has emerged over time with an interest (and concern) for sustainability and sustainable development, organized around "integrat[ing] transdisciplinary study (head); practical skill sharing and development (hands); and translation of passion and values into behaviour (heart)" (Sipos et al. 2008: 68). Although there is now a diversity of service-learning practice in contemporary higher education (Jacoby 2015), the effects of service-learning are widely documented, with "a positive influence on student learning outcomes irrespective of the way learning was measured" (Warren 2012). Recent studies, however, highlight differential experiences and outcomes between males and females, for example, in relation to the value attributed to service-learning as a pedagogical vehicle and the learning gains experienced (Caspersz and Olaru 2017).

In the context of sustainability, Brundiers et al. (2010) highlight how service-learning is effective in developing competencies such as problem-solving and collaboration skills with experts and stakeholders in relation to sustainability and sustainable development issues. Similarly, studies have found that service-learning generates a positive effect on learner's understanding of social issues; personal insight; cognitive development

(Yorio and Ye 2012); diversity learning outcomes such as tolerance of difference, stereotype confrontation, and belief in the value of diversity (Holsapple 2012); and stress resistance (Matteucci and Aubke 2018). Such outcomes, however, seem to be shaped by student motivations/interests (Moely and Ilustre 2014), and these may change during the course of higher education studies (Pearl and Christensen 2017).

Forms of Service-Learning for Sustainability Education

There is long-standing recognition that there is a diversity of service-learning practice in higher education (Jacoby 2015), and the National Service Learning Clearinghouse in the USA categorize four main types of service-learning (Kaye 2010). Delineating service-learning types is helpful to recognize some of the subtle differences in practice which might help differentiate the respective requirements of each (Furco 1996). However, it is also acknowledged that these types are archetypical in nature, with various gray areas which do not fit neatly into the various classifications (ibid). The four types of service-learning are direct, indirect, advocacy, and community research (Kaye 2010).

Direct service-learning. This is where, through the service-learning project, the learner connects directly with the recipients of the service being provided to deliver value. This might include, for example, literacy or numeracy tutoring in hospitals or delivering educational presentations about recycling to a community group. Barth et al. (2014), for example, explain how service-learners developed and delivered "sustainable consumption" projects with local consumer organizations such as coffee shops, cafes, and cycle repair shops to help develop sustainable business practices. Similarly, Kayser (2017: 385) developed a service-learning course for medical humanities students to work directly with service users in various care settings "such as the veteran's hospital, a hospice home, and organizations that serve individuals with disabilities," developing a range of technical and social skills.

Indirect service-learning. This is where, through the service-learning project, the learner does not necessarily work or impact the recipients of their service, but work on broader issues which will deliver mutual impact and value. This might include, for example, working on a recycling project or an environmental cleanup project for a community. Goffnett et al. (2013: 161), for example, developed a service-learning experience where the service-learner defined realistic projects linked to larger humanitarian aid projects at various stages including "planning, detection, mitigation, response, and recovery... typically in response to crises including natural disaster and man-made disaster." Similarly, Coleman et al. (2017: 161) developed various service-learning courses whereby service-learners worked with a nonprofit organization which manages parks to help model how climate change might affect various species in the parks, thereby providing "tools for planning conservation activities as the landscape changes under scenarios of climate change."

Advocacy service-learning. This is where, through the service-learning project, the learner educates or teaches others about topics or issues of public interest, aiming to promote awareness and mobilize forms of action which will impact the community in some way. This might include, for example, facilitating a community forum about fracking in the local area or designing posters and other communications media to promote awareness of local wildlife in the area. For example, Ruan et al. (2015) developed a service-learning course to promote youth and community leadership as part of an adventure and youth development scheme, creating a variety of leadership, coaching, training, and other educational roles. Such opportunities reported significant increases in service-learner competencies including "character development, citizenship, diversity, global understanding" (ibid: 131). Similarly, Taylor et al. (2017) developed a service-learning course whereby nurses became involved in raising the profile of physical activity in the local area, primarily through promoting a cycling club via various channels including direct contact with local youth. Such approaches help tackling a local sustainable development issue (health) in addition to the authentic learning needs of the service-learners (e.g., nurses) to be able to understand how to connect with their patients and the issues in doing so (ibid).

Community research service-learning. This is where, through the service-learning project, the learner undertakes research (e.g., gathering, analyzing, and presenting information) on a topic or issue of interest to a community (e.g., Tyran 2017). This might include, for example, collecting and analyzing climate change information available on the internet and translating them into accessible forms for a specific community to use (Hindley and Wall 2017; Wall et al. 2017b). Similarly, Lim et al. (2017: 809) developed a service-learning course where the service-learners collected data about the "extent of payday loan use among bankruptcy filers and report [ed] results to community partners," thereby raising the profile of responsible business practices in the area. In many cases, community research is a form of service-learning on its own, but might be combined with the other forms of service-learning (direct, indirect, or advocacy) to then deliver those needs in a way which also meets the needs and aspirations of the service-learner (Wall et al. 2017a).

Service-Learning and Perspective Transformation

Evidence demonstrates that service-learning has a role in generating significant change (Shor et al. 2017), that is, where "previously taken-for-granted assumptions, values, beliefs, and lifestyle habits are assessed and, in some cases, radically transformed" (Kiely 2005: 7). Kiely's (2005) transformative service-learning model translates and adapts Mezirow's (1978) work on "perspective transformation" to the context of service-learning and remains a contemporary way to conceptualize pathways to transformative outcomes (Shor et al. 2017). This is particularly relevant in relation to sustainability given the ongoing need to (1) transform or fundamentally rethink issues of sustainability and (2) engage multiple perspectives in order to tackle sustainability issues. Fundamentally, perspective transformation is initiated by a "disorienting dilemma" which acts as a trigger for learning, and the extent to which this happens in service-learning is shaped by contextual border crossing, dissonance, personalizing, processing, and connecting (ibid).

Contextual border crossing. Service-learning can provide experiences which expose and immerse service-learners to and in contexts that embody assumptions and frames which may be different to what the service-learner has experienced and is familiar with. Within such contexts, there are "personal, structural, historical, and programmatic elements" (Kiely 2005: 9) which shape the transformative effects of service-learning. For example, evidence suggests that some international students in placements can be seen as "second-class citizens" in the workplace, linked to a history of racial discrimination and overseas student stereotyping as well as particular occupational cultures, but that some find agency through their social networks to disrupt and change such circumstances (Wall et al. 2017c).

Dissonance. In working across contextual borders, service-learning can evoke a gap "between their contextual baggage and elements of the new cultural context... [and] can include historical, environmental, physical, economic, political, cultural, spiritual, social, communicative, and technological" (Kiely 2005: 10–11). As such, dissonance functions as a trigger for other transformational service-learning processes to happen. For example, in Helicke's (2014) service-learning courses, which helped survey trees in the Saratoga Springs area as part of a wider climate change study, students became aware of how interconnected trees were to wider sustainability and noticed the "lack" of green urban spaces. This lack represents a dissonance of how things "should be" (Wall 2016c).

Personalizing. When dissonance is triggered, the service-learner will experience their own personal emotional response (as framed by their own contextual borders and locations), which "compel students to assess internal strengths and weaknesses" (Kiely 2005: 8). For example, Petersen et al. (2015) explore a range of emotional responses of clinical students working in rural Nicaragua to incidents in service-learning settings, which included (1) the "challenge" of explaining the prognoses of children to their parents, (2) the “heartbreaking” realization of the in-affordability of healthcare in developing countries, and (3) the “fun” and “laughter” that are generated when working through language differences. Such personal sense making involved “reminding myself to not feel guilty or too sad during this experience. I must remember that I am here helping as much as possible” (Petersen et al. 2015: 37).

Processing. Once service-learners have experienced dissonance and personalized a response, they make sense of these through reflective processes, on their own and with others. This includes “problematizing, questioning, analyzing, and searching for causes and solutions to problems and issues… [through] journaling, reflection groups, community dialogues, walking, research, and observation (Kiely 2005: p8). For example, in attempting to promote cycling to the local community, service-learning nurses became aware of their own beliefs, assumptions, and biases about their communities and serving in a health promotion role, which enabled them to “develop and practice cultural sensitivity, and raise awareness of social injustice” (Taylor et al. 2017: 561). Evidence also suggests that the duration of the service has a role in shaping the extent to which such reflective processes are facilitated (Eyler and Giles 2010; Yorio and Ye 2012; Dahan 2016).

Connecting. Although “processing” is an important reflective aspect of transformational learning, it has an interdependent relationship with “connecting,” whereby the learner deepens their capacities to “affectively understand and empathize through relationships… through non-reflective modes such as sensing, sharing, feeling, caring, relating, listening, comforting, empathizing, intuiting” (Kiely 2005: 8). It explains how learners can experience transformation as “an abstract intellectual shift in their understanding… as well as a profound change in their sense of moral affiliation and obligation” (ibid: 13). In Kayser’s (2017: 389) research, for example, service-learners reported learning “to value the basics of human interaction, respect, and kindness as they speak with patients and families, escort veterans, or play cards with individuals with disabilities.” Again, evidence suggests that the nature of the role and service duration has a role in shaping the extent to which these sorts of processes are available to service-learners (Yorio and Ye 2012; Dahan 2016; Shor et al. 2017).

In terms of promoting opportunities for transformational service-learning, pedagogical strategies such as integrating critical (“emancipatory”) forms of reflection (e.g., Wall 2016a, c, 2017) can help students recognize their own positions in contexts and thereby prompt some of the dimensions above. Indeed, such processes have been engaged in social innovation work which seeks to fundamentally rethink social problems with a group in and with the community group of concern (Alden Rivers et al. 2015; Rivers et al. 2015). The quality of reflective processes is a common factor associated with greater transformational effects in service-learning (Eyler and Giles 2010; Yorio and Ye 2012; Dahan 2016). The placement itself, however, such as the nature and extent of responsibilities that the learner acquires, can have a major role in shaping the opportunities for border crossing to materialize in practice (Shor et al. 2017).

Sustaining Service-Learning for Sustainable Development

Service-learning, with its sustainable community development ambitions, has been described as moving from the margins of higher education, to the mainstream (Wall et al. 2019b). In the past, the radical social justice roots of service-learning may not have sat easily in the hierarchies of disciplines and power in higher education (Stanton et al. 1999), and many programs of service-learning have either been closed down or have morphed into another form which speaks more directly to another agenda such as employability (Wall et al. 2019b). In examining the strategies and tactics which sustain service-learning in contemporary higher education, Bennett et al. (2016: 150) drew upon and extended Young et al.’s (2007) earlier research. The strategies and tactics for sustaining service-learning in higher education are outlined below.

An active, authority champion/zealot at the faculty or administrative level. A powerful individual which advocates and supports the service-learning philosophy, pedagogy, or program is the most common strategy for sustaining service-learning in higher education. This can be a lonely and frustrating role (Hindley and Wall 2017), but is driven by the unwavering commitment and passion to the value and contribution of service-learning to the community and wider sustainability and sustainable development agenda (Warren 2012; Jacoby 2015). The establishment, development, and continuation of service-learning provision, then, can be supported by people with power resources (e.g., budgets, decision-making influence, networks) in higher education institutions.

Organizational commitment, often linked to a champion/zealot. The persistence of service-learning, although often linked to the activities of a champion, is supported when there is widespread commitment to it and its agenda. For example, Ruan et al. (2015) describe a youth leadership organization which is fundamentally committed to the service-learning basis of their organization and training program. They report that "Since 1985, [the organisation] has involved over 17,000 college and university students. . . in providing child and youth service programmes in 30 countries and US territories" (Ruan et al. 2015: 134). The service-learning and its sustainability-based philosophy, pedagogy, and program are therefore fully part of the organization, strategy, and culture.

A groundswell of interest from various parties, emerging over time. As higher education have a wider variety of stakeholders, it becomes potential super-complex to service them all, to equal measure, all the time (Wall 2016c). Therefore, it can take a mass of interest in an organization and their stakeholder network to develop and sustain an activity such as service-learning which might be seen as resource intensive and shared benefit. For example, Tyran (2017: 163) developed, over time, international service-learning provision working in dialogue with a number academic staff "from the disciplines of Business Management, Sociology, Journalism and Education" and over 130 stakeholder partners in Sub-Saharan Africa. Such longer-term relationship building and partnership working helps cement a firm platform to sustain the service-learning for mutual benefit over time.

A group of student zealots, with an emerging community interest. As higher education becomes increasingly consumer driven, students' needs, preferences, and voice can play an increasing part in raising (or indeed dampening) the sustainability agenda (Wall 2017). For example, Wall et al. (2017b) found that a group of students became aware of their own impact on their local environment, particularly student-generated litter and lack of recycling, and invested their own time and energy in undertaking service work to change this. This service work was generated and driven by the group of students and then formed the basis for setting up a climate change research group, a student climate change group, presentations at various higher education conferences, and an academic journal paper, to promote the course and the agenda (ibid).

Funding, often linked to a champion/zealot. Although Young et al.'s (2007) research was set in a time where there had been various grants available for establishing service-learning courses, this was not the case in Bennett et al.'s (2016) more recent research. Rather, the focus had turned to the cost and benefit of offering such provision (ibid). Although service-learning might be seen to be relatively more expensive to administer compared to classroom-based provision (because of the administrative overheads of finding and maintaining projects or placements), there is a recognition that there are also significant reputational and community-based benefits to service-learning (ibid). Indeed, this perspective can also be adopted in a higher education organization's wider stakeholder network, when stakeholders offer resources such as training or expertise in-kind (Taylor 2017), similar to other forms of community-driven, alternative education (Wall and Perrin 2015).

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Conclusion and Future Directions

Service-learning has grown from social justice and collaborative, community development work and is therefore intimately connected to sustainable development in higher education. Champions of service-learning have driven its radical formulations and subversive character in higher education which has proven challenging in the economically driven nature of contemporary higher education (Wall et al. 2019a, b). However, service-learning champions have also re-configured it over the last 30 years to reflect contemporary agendas, such as community engagement (ibid) and social innovation (Alden Rivers et al. 2015; Rivers et al. 2015). It is expected that this trend will continue, re-configuring against the parameters of new agendas that emerge in higher education, most notably with the student employability agenda, and an increasing explicit link to sustainability and sustainable development (Taylor 2017; Wall 2016c; Wall et al. 2019a). As such developments will compete for increasing scarce resources within the higher education context, at a time when higher education seems to be trying to assert its economic value in society, it is likely that tensions within the academy will persist for some time (ibid). Evidence suggests that such tensions are likely to be the source of new creative ways of operating and forms of education (Wall 2016a, b, c), but will also promote the ways of working in higher education which prioritize the "head, hands, and heart" (Sipos et al. 2008) that service-learning seeks to deliver.

Cross-References

▶ Reflective Practice for Sustainable Development
▶ Work-Integrated Learning for Sustainability Education

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Settings

▶ Dimensions of Sustainability in Higher Education

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Simulation and Sustainability

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Definition

One can define sustainability as the capacity to preserve, sustain, and nurture, which in practical terms can be translated into identifying, developing, and promoting sustainable attitudes, practices, and strategies, preserving the natural environment without forgetting the economic and social components. In fact, sustainability has to do with the issues of distribution, following the standards of intra- and intergenerational equity. We all know that human actions have consequences, if not for the perpetrator then for others with a spatiotemporal shift. Therefore, evaluating the impact of a specific activity on sustainability is problematic for this reason and several others.

Introduction

To start with, the notion of sustainability is broad in terms of time and geographical expression. Several decisions on sustainability issues are taken far from their origins both in terms of space and time. Moreover, the time lapses involved in these decisions may vary from hundreds to thousands of years. Likewise, geographically, the scope may cover cities, countries, or even the entire globe.

Furthermore, the complexity level can be extremely high due to the huge spatiotemporal scope and especially to the multiple interactions between environmental and socioeconomic features that have to be taken into account. In addition, these interactions are frequently dynamic, non-monotonic, and within the framework of deterministic chaos. In fact, the apparent random fluctuations (i.e., non-monotonic) and the unpredictability of natural ecosystems may be due to the deterministic chaos.

Systems theory uses the notion of deterministic chaos when it refers to the deterministic and unpredictable behavior of models, conceptualizing a chaotic system as a deterministic system that is difficult to predict. The term “deterministic chaos” seems paradoxical. How can something be chaotic and deterministic at the same time? The answer is simple, it is due to the complex dynamics generated by nonlinear dynamic systems, i.e., seemingly random outcomes can be obtained from simple mathematical equations. Chaos is generated by fixed and deterministic rules and does not involve any element of random course. However, chaos is not the only form of explaining the deterministic – but completely or partially unpredictable – behavior of natural systems. There are other mechanisms that make the models’ behavior unstable and complex. The most well-known mechanisms are feedbacks, loops, and time delays.

Finally, one could have to deal with different levels of granularity simultaneously. For instance, it may be necessary to model perceptible connections among the activities of the individuals and their repercussions on earth. Most of those systems do not exist yet, but exploring the effect of the several predictable scenarios on sustainability before their real application is a good strategy.

Each of these issues is efficiently handled by simulation modelling – much more so than with any other available technique. System dynamics modelling is suitable to understand the timing that underlies the behavior of complex systems, taking into account feedbacks, loops, and time delays. Simulation is a form of modelling – usually on a computer environment – which comprises a set of methods that try to replicate the characteristics and behaviors of real systems. Classic applications of simulations aim to (i) achieve better insights and improve the understanding of a system; (ii) compare several scenarios prior to their implementation; (iii) predict system behavior; (iv) assist decision-making practices; (v) develop new tools for research; and (vi) train (e.g., toy models and games). There are plentiful methods for simulation, although three stand out: (i) system dynamics modelling and simulation (Sterman 2000); (ii) agent-based modelling and simulation (Gilbert 2008); and (iii) discrete event modelling and simulation (Law and Kelton 2014).

Sustainability and Simulation

One of the current main challenges is to achieve a high resource efficiency. This process can be called "optimization," and it is clearly target-oriented. Optimizations can be achieved through analytic approaches. Still, most analytic methods turn out to be tricky once they have to deal with more than a few variables. That is exactly when simulation is more useful – it enables the integration of the environmental and the socioeconomic perspectives in the same model, and thus it takes in consideration all three supports of sustainability.

Simulation is the process of discovering probable effects of different planning directions and diverse conditions. When a real system cannot be analyzed because it is too dangerous, it is not available, it has not been built yet, or it does not exist at all, simulation has proved to be a valid solution (European Commission 1998). Regarding these situations, simulation is the perfect instrument to conduct experiments with uncertain (e.g., counterproductive) results.

The three most applied modelling and simulation (MS) approaches in the study of sustainability are agent-based (ABMS), discrete event (DEMS), and system dynamics (SDMS) (Fakhimi et al. 2013). All these procedures have unique and common primary theoretical and methodological bases (Mustafee et al. 2010). Thus, certain modelling methods may be more suitable to model certain classes of problems. Nonetheless, the complexity of the modelled systems and their manifold relations may indicate that merging simulation approaches will reduce the restrictions and increase the capabilities of each procedure, thereby enabling synergies by using different techniques and providing better information to problem solving tasks (Fakhimi and Mustafee 2012).

SDMS is a particular kind of continuous simulation where the system's state variables change uninterruptedly over time. Usually, differential equations are used to represent these continuous changes in state variables. Theoretically, SDMS are used to model complex systems, conceptualizing them at a more aggregate level than ABMS. Contrasting with the latter, the former adopts a top-down approach.

On the other hand, ABMS intends to model complex systems by using a bottom-up approach based on individual agents. This simulation method is currently being used to model complex adaptive systems where agents are modelled in order to interact among themselves and with their environment, i.e., it consists of interacting elements (Heath et al. 2011). In ABMS, each agent is an individual with its own intellect, memory, rules, and a specific goal to reach. Thus, their characteristics and behaviors may differ, and they may learn from what they perceive from other agents and their environment and change their behavior and goals (i.e., make decisions) accordingly. Over time, this interaction results in emerging behaviors, patterns, and structures that can be used for various purposes. This procedure has emerged as a major field of application for modelling and simulation techniques (Taylor et al. 2013; Viana et al. 2014).

Indeed, as one can see, there are two major approaches in modelling: breakdown the all into parts, i.e., top-down approach, or shape up patterns, i.e., bottom-up approach. The former begins with a model, and the information is structured within it. The latter makes more sense from an implementation perspective since people and the society as an all are ruled by the bottom-up approach, progressing from the simplest to the more complex.

Regarding sustainability, the top-down approach begins by defining sustainability in a society level and then deduces recommendations for each distinct action, considering the scientific-technical context. The bottom-up approach begins by defining recommendations for each distinct action and then stretches recommendations for the society as an all, by aligning the recommendations of all pertinent actions.

ABMS' main applications focus on modelling decentralized, complex systems that consist of many interdependencies. Contrasting with other modelling techniques, ABMS can offer a more realistic view of these types of systems. Hence, possibly ABMS can help modellers to create/improve models of social-environmental systems (Hare and Deadman 2004). However, there is hardly any practical support on how to apply these techniques and how to make them work for such purposes (Fakhimi et al. 2013).

Finally, DEMS gets its name from the fact that a system's state variables only vary at both discrete and separate points in time. Some events may occur at those points originating state changes in the system. These are the only events when the system's state changes. Despite their ability to use intricate sequences and hierarchical structures, DEMS usually looks at complex systems as a list of events ordered sequentially. This approach allows modelling the uncertainty related to the events in an explicit way and thus statistically analyzing their combined consequences in the system. Currently, DEMS is one of the most widely used simulation methods in sustainability models (Nageshwaraniyer et al. 2011; Jaegler and Burlat 2012; Jain et al. 2013).

However, nowadays MS approaches point to hybrid solutions, mixing different simulation paradigms (Jahangirian et al. 2010). The hybrid approach has been used in several various combinations and solves a wide range of problems. For instance, Mustafee and Bischoff (2013) mixed analytical optimization (heuristics) modelling with ABMS to address the container-loading problem. In healthcare, Aringhieri (2010) studied ambulance management policies with an ABMS-DEMS approach based on a single simulation environment; and Nouman et al. (2013) chose distributed simulation to create an ABMS-DEMS interoperating hybrid model for the holistic analysis of emergency medical services.

With the growing interest in big data, data analytics, and data mining, there is much work that needs to be done in the area of simulation and sustainability. These relatively new features have led to coining new terms, such as "simulation analytics," i.e., the use of simulation procedures to perform a comprehensive analysis of a system. This includes input/output data analysis, visual depiction, and display of the results. Simulation analytics focus essentially on the simulation outcome. The term is mostly used to communicate the results of simulation models to stakeholders.

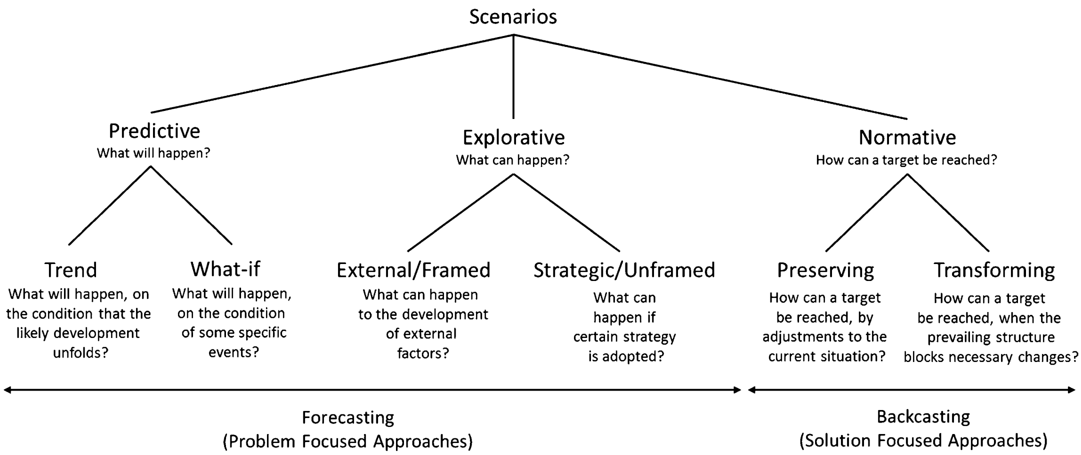
Simulation, and particularly simulation games, can play an important role in teaching sustainability, because they are suitable for designing a controlled environment for dealing with complex problems (Doyle and Brown 2000). The goal is to get the skills to resolve complex problems connected to sustainability and comprehend its inter-relational nature (Gatti et al. 2019). For this, one has to plan learning actions that allow students to get sustainability proficiencies (Molderez and Fonseca 2018), and simulation-based learning schemes give an encouraging method for teaching sustainability (Figueiró and Raufflet 2015) as they are supported by activities where people learn by experience. Therefore, they are more effective for obtaining such competencies (Holgaard et al. 2016). The main issue is that simulation games can promote the development of critical thinking skills, one of the main outcomes in learning sustainability (Sharma and Kelly 2014).

Simulation and Scenarios

Several authors have identified different types of scenarios in an attempt to create a consistent and consensual scenario classification system that facilitates communication, understanding, comparison, and development of scenarios. At this point, we do not intend to provide an exhaustive description of scenario typologies, but rather to select only the most cited in the literature that are also relevant in the context of sustainability.

Börjeson et al. (2006), after studying different typologies of scenarios by different authors, identified three main scopes based on three distinct questions – "What will happen?", "What can happen?", and "What is desirable to happen?" – which originate six different typologies (Fig. 1). The "What will happen?" scenarios are predictive and use past and present data to predict the future. The main tools used to build predictive scenarios are simulation models, where the interpretation of past data results in probabilities of occurrence in the future. In these scenarios, one assumes that the future is similar to the past, i.e., projecting historical data into the future.

Börjeson et al. (2006) divide predictive scenarios into two subcategories: trend and



Simulation and Sustainability, Fig. 1 Typologies of scenarios. (Adapted from Börjeson et al. 2006; Avadi et al. 2014; Maier et al. 2016)

what-if scenarios. The former are those that project past data into the future, and the latter show what may happen under certain assumptions. These scenarios have better results in near-future studies, because their success rate decreases with the increase of the time frame for which they have been created (Swart et al. 2004).

The question "What can happen?" generates explorative scenarios that, as the name implies, explore situations, or events, that are plausible and might happen, often starting from a diversity of perspectives. These scenarios are analyzed to encompass a wide range of possible developments and typically have the future as their starting point and are therefore created for longer time frames than predictive scenarios. Explorative scenarios are usually used when their creators have a good understanding of the system's operation and intend to explore the consequences of certain actions (strategic scenarios).

Although less frequent, explorative scenarios can also be used when the surrounding circumstances that might cause changes in the system under analysis are unknown (external scenarios). The construction of these scenarios is usually based on experts' opinion (Börjeson et al. 2006). Finally, there are those scenarios originated by the question "What is desirable to happen?" from which the normative or prescriptive scenarios ensue. These establish a desired future situation and look for ways to achieve it, starting from the present situation. When a structural change in the system is required in order to achieve the desired goal, the scenarios are called transforming scenarios. If, on the contrary, this structural change is not necessary, then the scenarios are named preserving scenarios (Börjeson et al. 2006).

These typologies are the most widely cited in the literature, and their choice is constrained by the type of scenario that the simulation intends to represent. If one wants to explore new paths of development, an explorative scenario should be used. If there is a specific path to achieve a desired goal that is constrained by it, then a normative (backcasting) scenario should be chosen. If one wishes to follow a development without interventions, a predictive scenario is the best option. And so on. Yet, depending on the type of data available and/or the options taken by technicians, one can classify the scenarios in two other types (Nakicenovic et al. 2000): those represented by narratives, i.e., in the form of a text, are called "qualitative scenarios," and those represented by numbers/models, i.e., sets of numerical indicators, are called "quantitative scenarios" (Fig. 2).

Quantitative scenarios are based on numerical data and are usually retrieved from formal/conceptual models, relying on mathematical algorithms to support the explanation of the relationships between human and environmental

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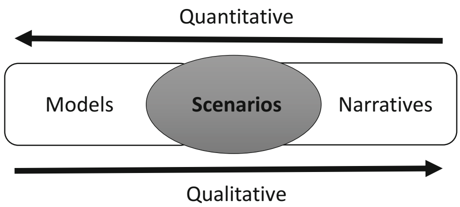

Simulation and Sustainability, Fig. 2 Scenarios, models, and narratives. (Adapted from Nakicenovic et al. 2000)

systems. Quantitative models usually follow an iterative procedure, enabling the identification of interactions, behaviors, and consequent impacts, due to the permutation of variables in the systems. Examples of quantitative models that can be applied to build scenarios and to analyze the indicators' structure are multicriteria analysis, artificial neural networks, cellular automata, Markov chains, agent-based models, and the Monte Carlo model.

Quantitative scenarios are more difficult for a non-expert to understand and often give rise to misinterpretation of the results. In addition, numerical information can lead to scenarios that are mistaken for predictions. This class of scenarios also has limitations that have to do with the availability of numerical data that will be the input data for the models themselves. The lack of such data inhibits the (re)application of these models elsewhere.

The qualitative or narrative scenarios provide information on or descriptions of the character of the elements that comprise them, such as their behaviors, uncertainties, causal interactions, traditions, and wishes/expectations by means of words, pictures, maps, and other visual elements.

Qualitative scenarios are easier to understand and can easily represent the views of different stakeholders, but often their assumptions are not explicit, hindering their rationale. Development scenarios should result from the combination of both quantitative and qualitative scenarios. The former provide the objectivity inherent to the availability of the measurable indicators and the latter the uncertainty and subjectivity necessary for the description of social systems (van Notten et al. 2003; Swart et al. 2004). Also, qualitative scenarios can simplify the communication of quantitative scenarios. Moreover, quantifying information can help to test the plausibility and consistency of qualitative scenarios, where possible. Despite being consensual, this conspicuous complementarity between qualitative and quantitative scenarios is not operational yet; the fusion between the two still represents a methodological challenge (van Notten et al. 2003).

Akgün et al. (2012) suggest other scenario typologies that fall into three different categories: descriptive versus normative, projective versus prospective, and sensory versus knowledge-based. Descriptive scenarios are essentially based on the knowledge of past and present trends, without considering any possible future changes. Normative scenarios focus on a desired outcome, which can result, for example, from stakeholder sessions, population surveys, or joint expert group decisions, allowing different scenarios to be created for the same situation. In the second category of typologies, scenarios can be projective when the starting point corresponds to the current situation, and together with the trends of future impacts, they form an image of the future. Projective scenarios are conservative, limiting the creativity of their mentors. Prospective scenarios start by describing a future situation and only then are the measures/paths that will lead from the current situation to that future one defined/identified.

These types of prospective scenarios are often called normative due to their nature, because they allow using creativity in their construction. Predominantly in normative scenarios, one can have creative, adventurous, and revolutionary possibilities, because we start with a desirable future, i.e., the future is "open." In these scenarios the future situation is not based on expert knowledge; it can be simply based on the creativity of a single person. Finally, the third category is composed of commonsense scenarios that are guided by the use of assumptions and opinions shared by the majority of the population, enabling the construction of new situations in the future.

Expert-based scenarios use the opinions of experts in areas of knowledge where they are able to develop realistic and creative images of the future, without the constraints of current ideas/occurrences. Akgün et al. (2012) state that, according to the proposed typology, the sustainable development scenarios are normative or prospective by nature. Swart et al. (2004) consider that the types of scenarios that best apply to the analysis of sustainability are mainly descriptive, i.e., scenarios that describe possible assumptions based on what is known about current trends and conditions. The mainly normative ones are the scenarios created to lead to a future, constructed with subjective values attributed by their authors.

Scenarios should contain elements of both descriptive and normative types. The choice of the type of scenario depends on the intended purposes. On the one hand, normative (backcasting) scenarios represent organized attempts to assess the feasibility of achieving certain desired futures and their consequences in order to avoid undesirable risks. Descriptive scenarios, on the other hand, try to coordinate different plausible future social developments and explore their consequences. To sum up, the different typologies described above have some similarities and may even be complementary in some cases.

Their application/selection depends on the intended purpose, and it is difficult to make an a priori choice. However, it is agreed that normative scenarios are the most widely used to create sustainable development scenarios, but they can be complemented by explorative scenarios (Börjeson et al. 2006) and/or prospective (Akgün et al. 2012) and/or descriptive scenarios (Swart et al. 2004). Explorative scenarios may be the most appropriate to complement the creation of a normative scenario (Börjeson et al. 2006). This is because sustainability is still a subject that must be explored and for which there is no definite and applicable response anywhere in the world, mainly because it integrates different systems that produce different responses to different actions. For example, what is a good action in one system may affect another system negatively, so sustainable development scenarios must result from the analysis of different explorative scenarios.

Final Remarks

The key factor when it comes to running simulation models for sustainability is to offer ancillary tools that help to understand the influence of sustainability-related subjects on decision-making. Nonetheless, despite this evidence, there is only a small number of simulation models that address aspects of the complex interplay between socioeconomic and environmental principles.

Sustainability can be addressed at national (Moffatt and Hanley 2001; Bockermann et al. 2005), group (Liu and Ye 2012; Romero and Ruiz 2014; Xu et al. 2014), or individual (Su and Al-Hakim 2010; Okada 2011; Duran-Encalada and Paucar-Caceres 2012; Nikolaou et al. 2015) levels. As developments and activities are planned and increased, the complex and interconnected issues that underlie the three dimensions of sustainable development (environmental, social, and economic) have been explored. Simulation models have emerged to provide insights into the possible combinations of factors required to meet sustainability goals, particularly by overcoming the restrictions of traditional models and tools that were usually adopted to understand sustainability resilience.

Duran-Encalada and Paucar-Caceres (2012) showed how a simulation model can be constructed. Corporate behaviors and policies are key factors, since they are influenced and/or influence the environment, economy, and other factors (Bockermann et al. 2005; Su and Al-Hakim 2010; Okada 2011; Duran-Encalada and Paucar-Caceres 2012; Liu and Ye 2012; Nikolaou et al. 2015). However, there is still a disparity when dealing with economic, social, and environmental features linked to sustainability, e.g., very few studies integrate all three aspects (Fakhimi et al. 2013). The lack of empirical models in this field may indicate that there are still some challenges for the implementation and validation of those models.

Sustainability systems can become very complex and uncertain, as they combine several subsystems comprising many elements and stakeholders with very diverse interests. Therefore, these systems have complex needs, characteristics, and problems in a wide range of contexts. Creating models to tackle these complexities involves looking into the features of sustainability and sustainable systems and (re)thinking sustainability departing from existing modelling techniques. Sustainability can involve a set of ambiguous, everlasting, and nondeterministic processes where the best parameter values are not known in advance (Bagheri and Hjorth 2005). Thus, measuring sustainability is not easy (Bell and Morse 2003). The dissimilar characteristics of the different features of a system may require a combination of modelling approaches. Moreover, analyzing the outputs of different sub-models of a theoretically large and complex model brings another degree of complexity into the equation.

In the end, assuming that it is not possible to achieve the worldwide equitable distribution of wealth, resources, and goods within a short period of time (e.g., 50 years or more) while preserving the ecosystems, the principles of intra- and intergenerational impartiality cannot be satisfied at present. Hence, the notion of sustainability must be seen as the means to accomplish intra- and intergenerational impartiality and is subsequently normative by definition.

Cross-References

- ▶ Complex Systems and Sustainable Development
- ▶ Complexity Theory Living Systems and Sustainable Development
- ▶ Corporate Social Responsibility and Sustainable Development
- ▶ Dimensions of Sustainability in Higher Education
- ▶ Resilience Thinking and Sustainable Development
- ▶ Sustainable Development Goals
- ▶ Whole-Systems Approach to Sustainability

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Social Benefit

► Externalities and Sustainability Processes

Social Costs

► Externalities and Sustainability Processes

Social Engagement Aspects of Sustainability

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Introduction

The concept of sustainable development was first introduced in the United Nations' "Brundtland" Report of the World Commission on Environment and Development: Our Common Future (1987), reported as the ability to achieve economic growth meeting the present generation's needs without compromising the future generations' capacity to fulfill their own needs. This concept is based on principals of effective resource management aligned with social organization, with the purpose to mitigate the negative effects of human activities on the biosphere. Social engagement plays an important role in pursuing this goal, once some of the key motivators towards environmental preservation are mediated mainly by the extent of human connection with nature, built through communication, knowledge, and behavior (Thomsen 2015). Those are important components of Social-Ecological Systems (SES), which refer to the relationship of humans and the environment within a scope where social and ecological boundaries merge together and are somewhat arbitrary (Berkes and Folke 1998). Further research argues that, although SES are composed of subsystems that encompass both ecological and social sciences, such fields have been treated as independent for most part, making it difficult to integrate and cumulate knowledge on the topic (Ostrom 2009).

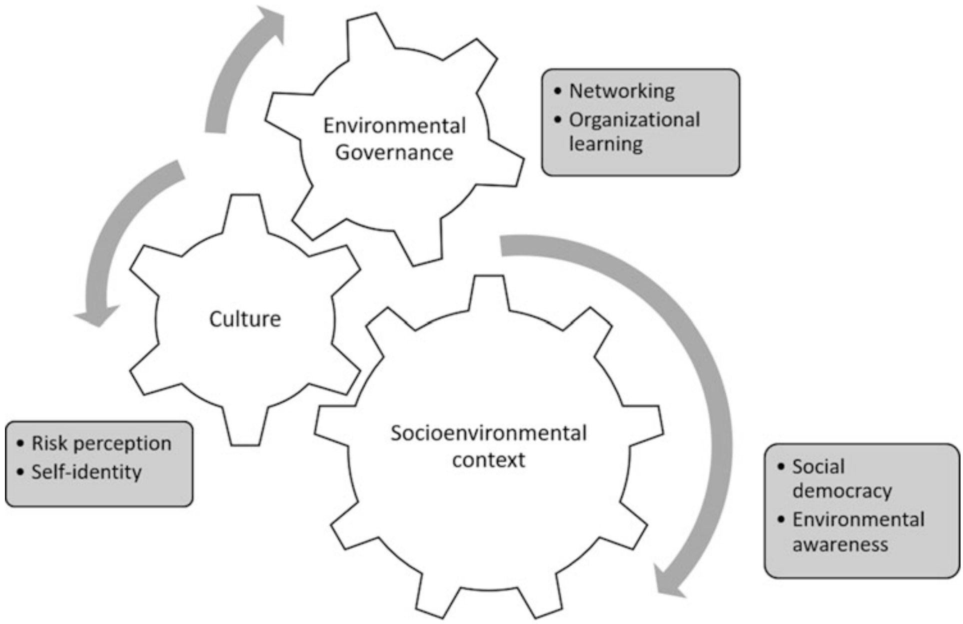
This article intends to highlight interrelated aspects grouped into three major categories: socio-environmental context, culture, and environmental governance, which are linked to both the social and ecological features of sustainability and have been noted as relevant drivers of social engagement in sustainable behavior. Such aspects are categorized as it follows: (i) socioenvironmental context: social democracy and environmental awareness; (ii) culture: risk perception and self-identity; and (iii) environmental governance: networking and organizational learning. It is worthwhile mentioning that those aspects are strongly interconnected and permeate within one another, in a way that separating them into different categories was not meant to follow a strict classification and was done mostly for didactic purposes (see Fig. 1).

The references for this article were obtained through the database Web of science, using the following keywords in a Boolean search: TS = (sustainability AND (social engagement OR social-ecological systems)). The choice of references attained to the following criteria: From 2000 to 2018, English, only articles. The search yielded 1.882 results and 189 pages. The most relevant articles were chosen. In addition to those, other productions of distinguished authors in the field of sustainability were consulted.

What Motivates Social Engagement in Sustainability?

Socioenvironmental Context

Understanding the context in which a certain group is inserted is important to assess its potential to behave towards sustainability. Here, we consider the following two aspects: social democracy and environmental awareness. With respect to the first aspect, sustainability remains an abstract goal, as it is often difficult to engage in practical solutions amid the many different interests of groups, regions, and countries holding unequal levels of development. Also, the quest for sustainable development becomes ineffective with the concept having different meanings among environmentalists, consumers, workers, and so many other actors who gather different



Social Engagement Aspects of Sustainability, Fig. 1 Aspects of social engagement in sustainability grouped into categories. The figure represents the interrelation and interdependence existent among the three categories: environmental governance, culture, and socioenvironmental context (Elaborated by the authors)

motivations with respect to sustainability (Ratner 2004). Often, those perceptions differ in groups of contrasting economic background. Ratner (2004) also reckons, in the light of other renowned authors in the field, that the discourse of sustainable development may be undermined by manipulative intentions of resourceful groups to the detriment of underprivileged ones, which often end up being denied their material share in development. Furthermore, each region or nation has a different perception of their priorities and how to resolve them – most of which are subjected to change, according to the circumstances; what explains, for instance, why the Kyoto agreement wasn't followed thoroughly after the world's prospects were altered due to the 2008 financial crisis (van der Leeuw 2014).

The second aspect in this section – environmental awareness – brings into discussion knowledge access and sharing, either through the reaching of scientific groundwork and formal education or through the transmittance of traditional and/or Indigenous knowledge. With regard to formal education, it must be noted that higher education institutions play a key role in fostering sustainable development, as they foment critical thinking and contribute to the understanding of the complexity of environmental systems and their relationship with societal dynamics, integrating different forms of teaching and learning (Leal Filho et al. 2015). In such context, Leal Filho et al. (2015) stress the need of carrying interdisciplinary teaching trainings in higher education, as to provide professionals with a holistic perspective of the role of individuals, communities and nations in achieving sustainability. Still according to these authors, it is equally important to track the progress of sustainability-related debates and activities in institutions of higher education through the creation of accessible knowledge-sharing platforms, in conjunction with the exchanging of educational experiences at an international level.

As to knowledge derived from traditional judgment, a global increase in Indigenous peoples' engagement in environmental stewardship has been noted, by virtue of the growing recognition of their rights, interests, and worth of their traditional knowledge (Hill et al. 2012). The integration of Indigenous ecological knowledge with Western science is important in acknowledging sustainable initiatives, seeing that these groups can engage in environmental management with governments, scientists, producers, conservationists, and others (Hill et al. 2012). Although there is a lack of precision regarding how such knowledge integration contributes to ecosystems resilience (Hill et al. 2012), it is of common consensus that traditional management knowledge is often linked to environmental responsibility and resource preservation. Hill et al. (2012) point out, however, that the engagement of Indigenous peoples' in sustainability differs notably from "public" engagement, as there are often complications as to Indigenous rights and the context of their socioeconomic disadvantage, which, according to the authors, have been recognized to be key determinants in accomplishing sustainable management thereunder.

Another relevant facet chosen to module environmental awareness is sensorial perception. According to Thomsen (2015), exploring the potential of visual imagery is important to connect individuals to the "impacts of environmental change at personal, relational, spatial and temporal scales simultaneously," tapping emotional bridges to foment social engagement in sustainable behavior and decision-making. Furthermore, Thomsen (2015) argues that visual communication has the power of synthetizing and promptly delivering complex ideas, and that visualization is particularly useful for anticipating consequences as to influence decisions, attitudes and processes. Thus, Thomsen's work (2015) aims at "provoking reflexive self-examination and critiques of broader, complex systems" through the development of emotional connections with groups affected by social-ecological change, incurring in precautionary behavior in the face of uncertainty.

Along these lines, environmental awareness can, therefore, be perceived as an outcome of the individual emotional response to environmental threat, which composes one's motives for behavioral change towards preservation. This leads to the assumption that the level of environmental degradation can foment and broaden social engagement in the cause. According to Masterson et al. (2017), to achieve sustainable goals, it is crucial that we understand people's motives and concerns in solving sustainability issues. The authors discuss the importance of exploring elements such as identity, morals, and world perspectives in social systems when it comes to the concept of "sense of place." The term, reported by Masterson et al. (2017) as "a motivation for stewardship and actions to care for the environment [. . .] [and] a cognitive and emotional variable that mediates how people respond to social-ecological change," emphasizes place attachment – emotional bond, encompassing dependence, and identity – and place meanings – what a place is, what it is like – as unquestionable part of the process of social engagement in sustainability. Masterson et al. (2017) review further literature on the topic, attempting to complement the definition of sense of place when stating that it is important to consider the interaction of actors with the landscape. The authors recognize, however, that social experiences are also an indispensable element of the concept.

Culture

Culture, in our understanding, relates to sustainable behavior when assessing values, self-identity, and the idea of risk shared by a given group. Values are closely related to ethical motivations, given that, as Ratner (2004) argues, people's actions and decisions are strongly shaped by what they believe, in a sense that extensively shared beliefs are generally more effective than legislation. In accordance with this assumption, an earlier conception of global ethic was brought into discussion by the Brundtland Report (1987), attempting to fetch ethical decision-making to the center of the debate on human survival and well-being through sustainable development.

Still with respect to values, it is important to consider the role of societal values regarding novel ecosystems, which, according to Hobbs et al. (2009), are systems whose composition and/or function have been drastically altered from its historical trends, where both biotic and abiotic conditions have changed. Given that human influence currently impacts most ecosystems on Earth – and considering the rapid shift in the prevailing environmental scenario, it is expected that a significant number of novel ecosystems will emerge in the next years (Hobbs et al. 2009). Thus, assessing society's acceptance of those systems is particularly relevant when considering that societal values are decisive for the implementation of conservation and restoration practices and policies (Collier 2015).

Self-identity – the first aspect of *culture* – is defined in this analysis as the pursuit of a feeling of belonging and self-assertiveness, usually grounded on cultural standards and which is often built through consumption. Responding to environmental concerns (such as deforestation, climate change, air and water pollution, soil degradation, and biota destruction) may present a challenge to many people when those ideals conflict with their attempt to build a self-identity, which often implicates abandoning a lifestyle, lowering standards, and giving up the comfort delivered by consumption. Soron (2010) argues that one of the main impasses in achieving sustainability is the difficulty of overcoming the unwillingness to give up the comfort and privileges embedded in hedonic lifestyles, considering that consumption has become a means of self-definition based on social, psychological, and spiritual motives. Thereby, Soron (2010) contends that engaging in a more sustainable behavior is attached to the decision of putting aside the urge to consume and adopting an alternative identity that mitigates individual human footprint on the environment.

As to the idea of risk, the second aspect of this section, Heurtebise (2017) states that "Global Risks emerge when the social part of the 'social-ecological system' outweighs and overrides its ecological counterpart." In other words, environmental risk is present when the relationship human-nature is unbalanced. The author regards the anthropization of nature as a major driver of global environmental risk, whose perception is linked to the magnitude of the threat posed to human beings upon what they value. We claim, therefore, that the perception of risk is closely associated to the multitude of cultural values passed on through generations in this respect – without disregarding its relation to the socioenvironmental context. Such tie implicates that the amount of effort directed at preserving resources will depend on the extension of the risk perceived by a certain group, built upon the degree of their appreciation for the environment, and the ecosystem services it delivers.

Environmental Governance

We defined networking as a key aspect under *environmental governance*, in agreement with the following thought: "adaptive governance systems often self-organize as social networks with teams and actor groups that draw on various knowledge systems and experiences for the development of a common understanding and policies" (Folke et al. 2005). In this sense, much of the concept of governance comes from the perception that the benefits of elaborating norms and policies outstrip the costs of management, favoring self-organization (Ostrom 2009). This is especially true when considering that self-organizing to maintain a resource takes considerable time and effort; therefore, it is imperative that the gains are emphasized through communication and environmental education.

Communication is a fundamental part of networking. When the resource harvesters are diverse, have different interests and do not communicate, it is likely that there will be a resource collapse, especially when failing to develop rules to manage the resource (Ostrom 2009). Also, fearing that some individuals may cheat on harvesting rules could lead users to avert changes and keep on overharvesting (Ostrom 2009). Still according to Ostrom (2009), when common knowledge is shared regarding a social-ecological system and when users perceive through communication and observation how their actions affect each other, they evaluate organization as a worthwhile alternative.

Self-organization, while an important element of governance, may cause uncertainty to grow over time (Folke et al. 2005). Therefore, it is important to learn how to adapt in the face of changing circumstances, which brings us to the second aspect under *environmental governance*: organizational learning. Folke et al. (2005)

support the hypothesis that a reason for organizational failure lies on the fact that management stakeholders often regard adaptive policy development as a threat rather than as an opportunity for improvement. According to the authors, this reinforces the need to understand adaptive governance when managing ecosystems, as well as when encouraging participation, collective action, and learning. Learning from experiences helps to develop expertise and prepare managers for uncertainty and surprise (Folke et al. 2005). For this purpose, it is important that all policies are taken as learning experiments that need to be monitored, evaluated, and adapted over time. In this respect, Ostrom (2009) points out that the long-term effectiveness of rules and policies strongly relies on users' motivations to monitor one another's practices.

In accordance with the topics previously presented, Lindahl et al. (2016) claim that the many controversies regarding environmental practices, policies, and resource management derive from the varying understandings and governance strategies adopted under the sustainability discourse, which reflect on a preferred path of development taken by an actor that may differ from the meanings held and the path chosen by others. Thus, Lindahl et al. (2016) developed a research framework that may help understand the issues underlying such controversies. The authors defend that, while sustainability is advertised as a unified concept with a common goal, such diverted interpretation reproduces the asymmetrical power distribution underlying the relationship among the different actors. Hence, the authors question which perceptions or preferences are prioritized, and which are ignored in this context.

The framework presented by Lindahl et al. (2016) proposes a means to scrutinize actors' viewpoints and perceptions regarding their policy preferences within a place-specific approach, which considers that most controversies over resource management are influenced by geographical aspects such as location, landscape, and affinities to or impressions of the region under the actors' influence. The authors recall sustainability as an essentially political process that brings up tension between competing pathways towards sustainable goals. Consequently, Lindahl et al. (2016) advocate for an approach that comprehends interactions between social, technological, and ecological processes, expecting to embrace diversity and to allow for the implementation of alternative pathways to sustainability in various resource management contexts. Essentially, the proposed framework brings five core queries: (i) who the relevant actors are; (ii) what values are prioritized for system change, what the actors' goals and perceptions are; (iii) how the actors interact and build alliances; (iv) what institutions and governance mechanisms shape the use of resources; and (v) what alternative pathways towards sustainability should be considered and which should be prioritized. In this analysis, place-based experiences, existing linkage between actors and governance mechanisms and policy leverage help shape actors' preferences and strategies chosen to engage in sustainable actions within the scope of these five questions.

Benefits of Social Engagement

In accordance with the literature reviewed is this article, social engagement in sustainability is believed to bring several benefits. First, it enhances the feeling of identity of a community with its physical surroundings, which is highly desirable, as sense of place is important to nurture motivation for long-term stewardship (Masterson et al. 2017). According to these authors, "stewardship generally refers to a responsible management or caretaking, often of natural resources or the environment". Masterson et al. (2017) elaborate on the importance of managing social-ecological systems that appeal to sense of place, as it influences people's perceptions and actions and contributes to integrate local and traditional ecological knowledge to management practices and policies.

Community bonding is another benefit of social engagement that is worth stressing. All the aspects cited here – social democracy, environmental awareness, risk perception, self-identity, networking, and organizational learning – can be thought as components of community compromise in pursuing a healthier and more resilient environment. Folke et al. (2005) argue that there is much more to social organization than a set of norms, as "social systems are structured not only by rules, positions and resources, but also by meaning and by the entire network of communicating individuals and organizations at different levels of interaction." The authors reinforce that the quality of social links and trust are key elements in nurturing self-organization and social capital generation, which are essential to a blooming process of social engagement in sustainability.

Social engagement also contributes to merge the diversity of perceptions ingrained in the ideal of sustainability, as more actors integrate the discussion, strengthening the outreach of environmental education. Leal Filho et al. (2015) presented a review on three supplementary pillars of sustainable development that enrich the debate – in addition to the prevalent trio of economic growth, social development, and environmental harmony – and which are in consonance with the ideas exposed in this article: the cultural, the political, and the spiritual pillars. The first one delivers the notion that environmental balance itself, aligned with economic growth and social democracy, is not enough to achieve sustainability; it is fundamental to consider the cultural dimension when pursuing goals that comprise peace and well-being. The second pillar – the political (or institutional) pillar – brings into discussion favorable governance strategies, and the third – the spiritual pillar – debates the role of values in prioritizing courses of action that promote sustainable development. Those pillars fully dialogue with the aspects here discussed under the categories of socioenvironmental context, culture, and environmental governance.

Conclusions

The main factors here discussed – socio-environmental context, culture, and environmental governance – have been raised and debated in higher education for decades now, but it hasn't been enough. Those discussions need to be taken further in order to reach groups that have little or no interaction with universities and nurture their interest in engaging with sustainable actions. One of the ways of further developing social engagement in sustainability within and outside higher education is to engage students and professors in extension projects (those in which academia takes on with its surrounding communities), considering that one of the purposes of producing science is that it is available to the society in an accessible language. Academics who engage in this type of social initiative not only contribute to prevent that the scientific knowledge remains enclosed within the university but also take the chance to learn from a practical perspective, which is often different from the way knowledge is presented in a classroom (one example is the practical learning involved in the implementation and expansion of community gardens in urban areas). For this purpose, it is essential that more universities commit to the challenge of discussing and implementing sustainability actions at a local level, making an effort to align such interventions with the reality and expectations of their social surroundings.

Overall, this article posed an attempt to approach the main aspects that, in general, motivate an individual to engage in sustainable behavior towards society's well-being. Though it can be difficult to trigger action under this framework – as there are many controversies involved, it is critical that individual motives are considered when building strategies to reach further in the pursuit of sustainable development. Therefore, we conclude that, although the collective aspect is a recognizably indispensable element of social engagement, individual motivations for social and environmental change are determinant in shaping social engagement in sustainability. At all events, social engagement is an indispensable tool in achieving the Sustainable Development Goals, especially since the human dimension is intrinsically present in all 17 of them.

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Social Impact Games

► Serious Games and Sustainability

Social Impact Investment

► Value-Based Investments in Sustainability

Social Investing

► Value-Based Investments in Sustainability

Social Justice in Sustainable Development

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Definition

Social justice in sustainable development is understood as the ability for societies to change and create situations that are equally accessible to all, including marginalized and oppressed individuals within different communities, and for societies to include people of different races, ethnicities, gender, class, and other axes of difference that create inequality, in decision making and efforts in sustainable development. Social justice in sustainable development includes diversity. That diversity includes different aspects of differences needed to maintain life (Martusewicz et al. 2011), including all the contextualized aspects of ecological justice such as food justice. Diversity is the strength within society and is needed to create sustainable systems in our communities.

Introduction

Since sustainable development refers to ideas and actions invested to meet the needs of the present without marginalizing the future (Waghid 2014), it not only focuses on environmental concerns but also on social structures and developments that contain "features of oppression, domination, exploitation, and injustice" (Evans 2012, p. 12). One of the purposes of sustainable development is to create sustainable communities. Martusewiz et al. (2011) argue that these developments are the basis of our community, needed to protect the future of our children and the expanded life systems within our planet.

The term social justice alone, as stated by Griffiths and Murray (2017, p. 44), is a “complex-and contested-notion that is constantly evolving because the world is always in a process of becoming something else.” Nolet (2009) defines social justice as “fair and equitable distribution of resources” (p. 14). Agyeman et al. (2017) believe that social justice involves a form of cultural identity. For example, they make a connection from this belief to Hmong families in California who farm and widen this work amongst extended family members and that this practice runs opposite of California labor laws requiring farms to have workers’ compensation insurance.

In these sections, sustaining social justice in policy and management through the lens of critical pedagogy is explained in three different sections. The first section focuses on sustainability development residing within critical pedagogy. The next section focuses on social justice in higher education within the policy and management realm. Finally, the last section discusses social change through policy and management curriculum.

Sustainability Development Resides Within Critical Pedagogy

The United Nations Development Programme (2017) integrates social justice in sustainable development and explains it as a means to “promote inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.” The relationality of social justice in sustainable development to society is critical because for a societal transformation to occur, equitable education and resources should be within reach to all from within the community. In agreement, the United Nations Development Programme promotes inclusive societies for sustainable development, providing access to justice for all and build effective, accountable, and inclusive institutions at all levels. Societal transformation cannot be annexed from social justice as it requires the equal and full participation of those in the community (Waghid 2014). A societal transformation involving social justice can help build more balanced, sustainable, and inclusive communities, hence the need to integrate critical pedagogy in policy and management practices of adult learning and higher education institutions as well as in sustainable development efforts in society. These systems (adult learning, higher education institutions, and society) within policy and change have the ability and rare opportunity to begin a dialogue at the core of higher education in preparing students and members of society for this societal transformation.

Critical Consciousness of Society

Sustainable development cannot succeed in its sustainable form without addressing the social inequities and situations of human struggles (Kolan and Sullivan TwoTrees 2014). Agyeman et al. (2001, p. 78) tell us that for a society to be truly sustainable, it has to “ensure a better quality of life for all, in a just and equitable manner.” Still, with the growing need to integrate challenges and efforts of sustainable development to include social justice, those in the field continue to practice within a paradigm shift that ignores the need of integration of sustainable development and social justice, hence overlooking and neglecting that privilege and power play a critical role through systematic implications (Littig and Griessler 2005).

Liberation of Society

In analyzing social justice in sustainable development within critical pedagogy, it is important to recognize several factors: (1) who the oppressed or marginalized groups and the oppressors are, (2) situations of oppression, (3) the awakening of critical consciousness, (4) and (5) the liberation process (Freire 1970–2005; Evans 2012; Lange 1998). Using the different segments of critical pedagogy, the assessment of oppressed or marginalized groups are those of different races from the majority group, ethnicities, gender, class, and other categories of difference that create inequality. The oppressors can be described as those who may be in a position in leading, co-leading, or involved in efforts of sustainable development. Another proponent of an oppressor can be described as situations and preferred norms created by society that do not allow a pathway for those involved in or leading sustainable efforts to include marginalized or oppressed groups in these movements and in decision making.

Even in times of uncertainty, Freire (1970–2005) believed that educators should still trust that learners can bring about change, that each person can be an agent of change, and that they are not slaves to their social environment. He viewed education as a means of liberation. In the process of liberation, Freire wrote that the oppressed is the one to lead the cause of the liberation process because the oppressor is not adequately equipped to lead this strife, for he is dehumanized by dehumanizing others. The oppressor does not lead because liberation threatens his freedom to oppress.

Transformation of Society

For a transformation to happen and for social justice to be restored and included in sustainable development, the oppressed or marginalized groups must look at their situation critically in a dialogic manner (Freire 1970–2005). Freire states that once this has been reached the oppressed will gradually come to understand the social truth and the conflicts within it. Ensuing this realization, according to Freire, the oppressed can begin to become awakened, therefore, becoming critically conscious. Being critically conscious is closer to the process of liberation. They (oppressed and marginalized groups) lead in this quest to become liberated as they seek to be included in sustainable development efforts. As the oppressed and marginalized groups liberate and create a passageway for their oppressors to understand the need to include them in efforts of sustainable development, they act with a sense of humility and "radical love" (Lange 1998, p. 89) as they see and "understand the necessity of liberation" (Freire 1970–2005, p. 45).

Paulo Freire worked with the illiterate poor where he empowered them to be self-conscious of their situation in having critical consciousness. Critical consciousness, according to Freire (1970–2005), is when one is awakened of his own conscious and begins to assess his social discontents as they indicate an oppressed situation. He believed that through the guidance of teachers, learners go through a process of change, realizing their own thoughts and perceptions of the world as they begin evaluating new revelations, challenging their own thinking. Freire concluded that the dominant social structure creates a culture of silence which overshadows the dominated and abolish the self-image of the oppressed.

Social Justice in Policy and Management Within Higher Education

Tina Evans (2012), author of *Occupy Education,* writes that society has created, delineated, and prescribed norms for society and that society goes about these daily norms, contributing to systems that lead to destruction which cripples personal growth, needed to create healthy and equitable systems. And yet, society goes about their daily life as if the world revolves around them, as if there is nothing society needs to contribute in sustaining what it has and come in contact with. It is this very thinking and the failure to address this ecological crisis in policy and management "that have promoted the very crises we now face" (Dentith and Griswold 2017, p. 53). In fact, it is people who are highly educated, who graduate from the world's best colleges that "are leading us down the current unhealthy, inequitable, and unsustainable path" (Cortese 2003, p. 16).

Restorative Paradigms of Thinking

When policy and management in adult learning and higher education respond to "these challenges will there be the possibility of altering the course of our current environmental and cultural crisis" (Dentith and Griswold 2017, p. 53). Lange (2004) tells us that for change to take place in a worthwhile and relevant fashion the cemented understandings of thinking need to be disturbed. Policy and management have an important and critical opportunity in being a vehicle for the much needed transformative change in social justice and ecological justice in the responsibility to prepare society ready to engage in sustainable developments (Dentith and Griswold 2017). Critical pedagogy serves as an instrument in this important framework to help entangle unsustainable paradigms (Cajete 2015) and to include marginalized populations in the important aspects of policy and management in adult learning and higher education. The intention of critical pedagogy is to foster a critical awareness of the different developments that can help create equitable situations for all and together create a liberation pathway to help transform from old paradigm thinking into a restorative place (Freire 1970–2005).

Policy and management in adult learning and higher education institutions have the flexibility in their decision making to generate an educational framework integrating critical pedagogy that includes participation in the liberation process after being critically aware of who the oppressors or oppressed may be and of the situation of oppression. This effort must come after the analysis of one's worldview, as every adult has a different "worldview that includes perspectives, attitudes, and values" (Dentith and Griswold 2017, p. 13). Policy and management can be a part of a system in encouraging society to "develop sustainability-oriented worldviews" (Evans 2015). It is these different individual worldviews that contribute in the awakening of critical consciousness and, as a result, create a liberation process to restoration.

Deep Cultural Shift

If policy and management in adult learning and higher education institutions have the ability and capacity to integrate critical pedagogy in connecting social justice in sustainable development efforts, then why doesn't it occur? If it is to develop a world of individuals who understand "concepts of justice, inclusion, and peace" (Education for Sustainable Development Goals 2017, p. 43), then why not act upon these yearnings (Cortese 2003, p. 17)? Meadows (1997) was cited in Cortese (2003) in which she argued that it is difficult for adult learning and higher education institutions to take on this responsibility at a deeper level because of a "deep cultural shift" which is the "most important leverage points for institutional transformation." This "deep cultural shift" requires adult learning and higher education institutions to truly reflect on their thinking and transform critically in ways that will integrate a shift in how policy and management is executed. In reflecting on the deliverance of policy and management, adult learning and higher education institutions need to contemplate on practices in this effort to transform this "deep cultural shift." It requires these institutions to be vulnerable and humble in their new way of thinking. This according to Lange (2004) is an alarming experience that challenges the "consciousness" of recognizable patterns and customs. This is a shift harder to accept than one would think as policy and management in adult learning and higher education institutions will need to become critically conscious of the oppressed, oppressor, situations of oppression, and the liberation process.

Equity in Education

An argument might be made that there is a push towards the policy and management changes at the adult learning and higher education institution levels. But as Morgenstern (2012, para. 5) tells us, these facts may suggest that there is effort regarding policy and management developments; however, he argues that these efforts are from only one frame of mind asking the question of "is it also devoutly eco-centric?" He continues to state that "campus sustainability has long been premised on the 'three legs of the stool': environmental protection, fiscal equity, and social justice" (Morgenstern 2012, para. 3). He points out 92% of staff members in the policy and management sustainable development field are white individuals. Dylan Ruan (2016, para. 14) writes about his fellow professor, David Pellow, who argues that the "lack of diversity is holding us back" from sustainable developments.

For policy and management sustainable development efforts to create a more equitable integration of the different aspects of sustainability (environmental, social issues, economic), people of color need to be included in the conversations and actions needed in developing these efforts. In reflection of the importance of including people of color in the dialogues of sustainable developments, Julian Agyeman stated in an interview conducted by Abrokwa and Carter of the Harvard Journal of African American Public Policy (2008, p. 71), that along with environmental protection, social justice is also a prerequisite "for a truly sustainable community." Unless action is taken seriously and an integration of social and economic equity is sought, the objective of obtaining a more sustainable world cannot be achieved (Agyeman et al. 2001).

Policy and Management Curriculum for Social Change

Critical pedagogy stems from critical theory and is a belief that the cultivation of learning in policy and management in adult learning and higher education institutions is interconnected with all aspects of society to secure "greater social justice" (McArthur 2009). McLaren (1994) states that people do not stand apart from our social connections but that they are a part of it. For this to occur, we can focus on developing policy management curriculum within a lens of critical pedagogy.

The Association for the Advancement of Sustainability in Higher Education, also known as AASHE, has put out "A Call to Action" for policy and management in adult learning and higher education institutions to instill learning in the preparation of students in ways that will strengthen and equip them ready to take on the challenges of sustainable concerns such as "climate change, loss of biodiversity. . ., limited water resources, global health issues, and extreme hunger" (Sustainability Curriculum in Higher Education A Call to Action 2010, p. 3). In addition, according to the United Nations Fund for Population Activities' website, there is currently a world population of over 7.5 billion. It is estimated to increase at a rate of 1.2% each year reaching an estimated 11.2 billion in the year 2100. This population increase contributes as another piece in the challenges of sustainable development. AASHE states that the instilling of transformative policy and management education to equip learners and society ready to work on these challenges is a "significant" issue and it can be developed and sustained through the teachings of those who have firsthand contacts with students. ". . .it is going to depend on the expertise and ability of approximately 1.2 million faculty in the United States who write course syllabi, sit on curriculum committees, develop student learning outcomes, and create new academic programs to integrate sustainability into their teaching as they see fit" (AASHE 2010, p. 3).

Critical pedagogy requires a curriculum within a framework focusing on social change. "It is both a philosophy of education and a social movement that aims to dismantle oppression by placing communities at the center of awareness, decision-making, and action" (Cajete 2015, p. 121). Policy management curriculum through the lens of critical pedagogy for social change can be examined with the work of Gregory Cajete, Elizabeth Lange, Tina Evans, and Paulo Freire. Cajete creates curriculum that is culturally responsive connecting it with the indigenous knowledge of education. Elizabeth Lange (2004) researches and writes about curriculum through a lens of restorative and transformative learning. Tina Evans (2012) discusses critical action and solutions for empowerment in her research and books. Paulo Freire's (1970–2005) work with critical pedagogy was defined as a means to liberate and not just simply a system of "banking" information. As stated by McArthur (2009), Paulo Freire, author of Pedagogy of the Oppressed, believed that assessing the world is not enough to change it, instead there needs to be opportunities and pathways of moving forward, hence liberation. Lange (1998, p. 83) explains in further detail Freire's meaning of liberation as "a change in heart" as she cites him stating that, "Conversion to the people requires a profound rebirth."

Final Remarks

This summary outlined social justice in sustainable development in policy and management through the lens of critical pedagogy. Within critical pedagogy, this entry explores that sustainability development resides within critical pedagogy, policy and management curriculum for social change, and social justice within higher education in policy and management. These three key ideas support the framework for social justice in sustainable development through policy and management.

Cross-References

- ► Cultural Sustainability in Higher Education
- ► Experiential Learning
- ► Transformative Learning for Sustainability

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Social Responsibility and Sustainability

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Definition

Social responsibility is a duty borne by every individual and organization to be accountable for the impact they have on the environment and the well-being of others. It is an ethical framework that outlines the obligation for every entity to act for the benefit of society at large.

Introduction

The origins of social responsibility are relatively modern. Before the twenty-first century, the notion that organizations had any responsibility other than the financial duty to the shareholder was not widely recognized. In 1970, Nobel Prize-winning economist Milton Friedman wrote "there is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud" (Friedman 1970). Friedman suggests that the only responsibility an entity has is to maximize profits within the bounds of the law. The concept of recognizing human rights and the well-being of the society and the environment was not introduced until 1994, when John Elkington coined the phrase "triple bottom line." The triple bottom line is an accounting framework focused not just on economic value alone but on the environmental and social value that businesses add or destroy (Elkington 2013). Elkington challenged Friedman's view that corporation's only duty is to maximize profit and shareholder value, asserting that measuring social, human, and environmental capital is equally important to achieving sustainability (Slaper and Hall 2011).

Presently, social responsibility has largely been mobilized by civil society, consumers, and corporations through the corporate social responsibility (CSR) movement. Through transparency, accountability, and ethical decisions made throughout the supply chain, organizations can conduct business in a way that promotes the welfare of the environment and society at large (Ramasamy et al. 2010). *ISO 26000: Guidance on social responsibility* published by the International Organization for Standardization (ISO) established an international standard for organizations to access the impact of their decisions and activities on society (ISO 2010).

ISO 26000: Guidance on social responsibility defines seven core subjects of social responsibility:

1. Organizational governance
2. Human rights
3. Labor practices
4. The environment
5. Fair operating practices
6. Consumer issues
7. Community involvement and development

Additionally ISO 26000 also identifies seven key principles of socially responsible behavior:

1. Accountability
2. Transparency
3. Ethical behavior
4. Respect for stakeholder interests
5. Respect for the rule of law
6. Respect for international norms of behavior
7. Respect for human rights

While neoclassical economics defines the objective of the firm as profit maximization, civil society is seen as the primary actor for "the common good" (World Economic Forum 2013). The discussion that follows will present advantages and limitations of corporations and civil society engaging in social responsibility, possibilities for bridging the apparent gap between these two groups, as well as shed light on the consumer's role in contributing to social and environmental change.

Social Responsibility in Multiple Contexts

Corporate Social Responsibility

CSR has emerged as a global trend as consumers have demanded that companies be active in social justice, human rights, and environmental issues (Sahlin-Andersson 2006). The connection between CSR and consumer loyalty has led businesses to recognize that CSR is not only an ethical and social imperative; it also has a strong business case in today's world (Ho 2017). Although most countries lack regulation on corporate best practices, voluntary sustainability reporting has become commonplace for leading multinational companies. Transparency into corporate decision-making is desired by consumers, although this revolution did not come without its own cost. In modern society, technology is a conduit to information sharing. With this comes an increased awareness of social, environmental, and human rights issues. Insufficient social responsibility has been discussed in the media as Apple came under attack for high suicide rates at Foxconn, and thousands perished in an industrial explosion at a Union Carbide pesticide plant in Bhopal, India (Morrison and Bridwell 2011; Browne and Milgram 2009). Consumers have responded to public scandals involving unfair working conditions, pollution, and racial discrimination and have begun to hold companies to a higher standard. As a result, it is difficult to discern whether CSR arose for multinationals to utilize their platform for the greater good or as a damage control tool (Torres et al. 2012).

Multinational corporations have increasingly taken measures to demonstrate CSR. Annual CSR reports are common among Fortune 500 companies, outlining social activities, charitable work, and corporate governance. Multinationals also set targets for supply standards and sustainability; however, CSR often does not persist throughout the entire supply chain. In 2005, the media exposed that Walmart Supercenters, the world's largest retailer, was using child labor in Bangladesh. Responding quickly to the public backlash, Walmart immediately ceased business with the two factories where child labor was reported (Torres et al. 2012).

Shortly after in 2005, Walmart published its first annual "Global Responsibility Report" that outlines its progress and goals for environmental, social, and governance (ESG). In the decade following the 2005 scandal, the retailer has set some ambitious targets in reducing waste, promoting diversity, and committing to 100% renewable energy by 2025 (Walmart 2018). While the corporation's initial deployment of CSR coincided with the child labor expose, it is difficult to discern if the movement was utilized as a risk management tool or whether it was an opportunity to reevaluate ethical standards throughout the supply chain.

Corporate social responsibility is not an ideology well aligned with the current economic expectation for firms. Firms act as profit-maximizing, cost-minimizing agents, causing a conflict between corporate strategy and social responsibility (Weyzig 2008). Garriga and Melé (2004) identified four main CSR theories: (1) instrumental theory where social responsibility is merely a means to achieve economic results, (2) political theory where firms wield their political power, (3) integrative theories where decisions are driven by social demands, and (4) ethical theories based on moral responsibilities of the firm to society. These theories are not mutually exclusive, nor does one theory entirely explain a firm's approach to CSR; rather the CSR movement is comprised of many diverse actors with competing interests. Sahlin-Andersson (2006) found that both the success and fluidity of the CSR movement are attributed to its multiple origins, identities, and trajectories. This also highlights that if CSR is being utilized as a tool to ultimately increase economic and political power under the guise of social and environmental justice, then the intentions behind the movement are not being properly realized.

Corporate Social Responsibility: The Sustainable Development Goals

It is impossible to neglect the political and economic power that corporations have in shaping our society. However, it is important to recognize that this influence has the opportunity, and moral obligation, to extend to social and environmental issues. "Business, much more than governments or non-governmental organizations (NGOs), will be in the driving seat" (Elkington 2013). Corporate social responsibility when used as a tool to make ethical decisions throughout the supply chain could act as a conductor to achieving the United Nations Sustainable Development Goals (SDGs). A case could be made that CSR could help make progress toward nearly all of the SDGs; however, there are a few goals that require commitment from corporations to come to fruition.

The operations of multinational corporations impact society at every level of the supply chain. The production of consumer goods ties into SDG (3) good health and well-being, (8) decent work and economic growth, and (11) responsible consumption and production (United Nations 2015). CSR is a potential channel to providing transparency into the safety of consuming products and also accountability for negative health impacts caused by producing the good. Additionally, decent work and responsible production can be promoted by creating higher standards for working conditions, environmental protection, wage growth, and gender equality (Venkatesan and Luongo 2019, forthcoming). The challenge that arises under our current economic framework is that corporations are not incentivized to make progress toward these goals unless it adds value through their brand proposition (Sen and Bhattacharya 2001).

Consumer Response to Corporate Social Responsibility

A growing number of surveys attest to the positive response consumers have to CSR (Nielsen 2008; Öberseder et al. 2014). Sen and Bhattacharya (2001) found that CSR positively affects consumer's product purchasing decisions and that consumers are more sensitive to negative CSR information than positive CSR information. Additionally, companies that are perceived to have intrinsic motives have a positive effect on brand evaluation (Parguel et al. 2011). The widespread exchange of information that occurs through the Internet, media, and social media in real time has applied pressure to corporations to exercise transparency. This presents an opportunity for CSR as information asymmetries between production and consumption impacts continue to decline with the increased spread of knowledge and transparency (Venkatesan and Luongo 2019, forthcoming). As social and environmental justice continue to grow as crucial elements of consumer decision-making, corporations will find that CSR can become a value-add for end-use consumers and financial market investors (Öberseder et al. 2014).

Greenwashing

In 2017, 85% of Fortune 500 companies published sustainability or social responsibility reports; this number increased significantly from 53% in 2012 (Governance and Accountability Institute 2018). With the CSR movement increasing picking up traction among multinationals, there is some concern over the legitimacy of CSR initiatives. "Although an increasing number of corporations publish environmental, health and safety reports, many are simply token efforts – greenwashing – and few address the full range of social issues necessary to assess adequately a corporation's behaviour" (Laufer 2003). Greenwashing occurs when a corporation misleads the consumer about their environmental performance or the environmental impact of their product or service (Delmas and Burbano 2011). Greenwashing has a serious consequence on consumer and investor confidence in green products or companies (Delmas and Burbano 2011). Additionally, greenwashing can erode the intentions behind the CSR movement. Laufer (2003) proposes that the legitimacy of sustainability and social responsibility reporting can be effectively managed through social accounting. Independent third-party monitoring and assurance of corporate social and environmental disclosures, as well as regulatory punishment for greenwashing, will be necessary tools to preserve consumer confidence and the integrity of CSR (Delmas and Burbano 2011).

Civil Society and Social Responsibility

Although corporations have the most progress to make in practicing social responsibility, civil society has been dedicated to social and environmental justice long before the CSR movement. Civil society or the “third sector” operates separately from the state and the market and is a general categorization of the collective action of NGOs, charities, social enterprises, and clubs (Taylor and Corry 2011). The vision, methodology, membership, and philanthropy of these organizations are vast; however, groups dedicated to social justice and sustainability have persisted around the globe since the late nineteenth century (Nash and McCormick 1991). Civil society is in a uniquely different position from corporations to create social change. Corporations’ primary duty to its shareholder is to maximize profit, while charities and NGOs’ duty is drive collective action around shared values, independent from government and commercial for-profit actors.

Role of Nongovernmental Organizations

Gemmill-Herren and Bamidele-Izu (2002) identify five major roles that civil society, namely, NGOs, could play in global environmental governance: (1) collecting, disseminating, and analyzing information; (2) providing input to policy development processes; (3) performing operational functions; (4) assessing environmental conditions and monitoring compliance with environmental agreements; and (5) advocating environmental justice. NGOs role in environmental governance is seen at the local, regional, national, and international level. This diversity allows them to be well equipped to address a variety of social and environmental issues the society faces today (Gemmill-Herren and Bamidele-Izu 2002). NGOs have mobilized around the SDGs and are key actors to translating international commitments to specific localized action (Hege and Demailly 2018). Spitz et al. (2015) define four major roles that NGOs can have in implementing the SDGs at the national level: (1) watchdog, (2) partner, (3) implementer, and (4) communicator. As many SDGs cannot be achieved without a commitment from the commercial sector, these roles provide a pathway for collaboration between civil society and corporations to mobilize on social and environmental issues.

NGOs are taking specific action on the SDGs; however, they face obstacles that limit their ability to foster social change without the role of partnerships (Spitz et al. 2015). NGOs operating in the role of watchdog can help to establish a system of checks and balances on corporations engaging in social responsibility. As identified earlier, the limitations faced by CSR stem from the economic expectation that the firm’s priority is profit maximization. This profit-maximizing mindset combined with increased societal pressure for socially and environmentally friendly goods has led some corporations to engage in greenwashing practices (Lin-Hi 2010). Parguel et al. (2011) found that sustainability ratings have a large impact on corporate brand evaluation; specifically, the use of independent evaluation of information helps consumers decipher CSR communications more accurately. NGOs can play an important role in bridging the gap between consumers and corporations by legitimizing and evaluating CSR initiatives. Laufer (2003) introduces the concept of tripartism, integrating an independent third party into the arena occupied by the regulator and the private sector. “If for no other reason, with accusations of greenwashing and evidence of its practice, decisions to defer third party auditing or to forgo the requirement entirely strongly undermine an appearance of legitimacy” (Laufer 2003). Raising the demand for accountability and credibility for CSR will not only foster partnerships between civil society and corporations, but it will increase consumer confidence and make legitimate social responsibility the norm for corporations and their investors.

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Consumer Social Responsibility

Social responsibility is ultimately seen as a duty borne by corporations and civil society to make decisions that are ethically and socially validated. Corporations have a responsibility to supply CSR; however, CSR initiatives must also be demanded by consumers in order to create effective social change within the current economic framework. “By design, profit maximizing firms will not be genuinely socially responsible, unless there is an explicit advantage that it can exploit now or in the future. It is the stakeholders who would need to ensure that the firm acts in a socially responsible manner" (Ramasamy et al. 2010).

Numerous market surveys have shown that ethical and social motives have a growing importance on consumption behavior (Memery et al. 2012). Ramasamy and Yeung (2008) found that Chinese consumers are generally very supportive of CSR initiatives and consider the broader economic responsibilities of the firm to extend beyond profit maximization. Ramasamy et al. (2010) found that various factors contribute to Asian consumers increasing demand for CSR including altruistic and egotistical motivations. This suggests that not only are firms struggling to balance people and profit but consumers are also facing an internal conflict between supporting CSR because it is good or because it looks good.

Consumer social responsibility was a term coined as "the other CSR" by Devinney et al. (2006). The ideology is based off of the premise that an onus lies with consumers to help corporations make meaningful social and environmental change. While firms have the moral duty to conduct business in a socially responsible way, consumers play a large role in incentivizing firms to integrate social and environmental concerns into their brand. Pigors and Rockenbach (2016) discuss the divergence between stated preferences and actual consumption. Market research has shown that consumers are willing to pay more for socially responsible goods and services (Öberseder et al. 2011; Ramasamy et al. 2010; Sen and Bhattacharya 2001). However, Pigors and Rockenbach (2016) found that the opaqueness of social responsibility in the production process has an impact on consumption behavior. The market veil that exists between production and consumption prevents consumers from instilling accountability into their own consumption choices. In the research, when consumers were given information on workers' satisfaction, including wage and other workplace conditions, this triggered social concerns and led to a higher wage (Pigors and Rockenbach 2016). Increased transparency effectively reduces the social distance between the consumer and production operations.

Interconnectedness of Social Responsibility

Corporate social responsibility is often framed as a trade-off between economic growth and social welfare. Pigors and Rockenbach (2016) found that CSR can increase profits through product differentiation. "Social responsibility can be used as a profit enhancing means in product differentiation. With supplier competition, socially responsible production positively influences consumers' buying decisions and suppliers offering socially responsible products achieve significantly higher profits, as long as their price is not too high." CSR has the capability to become an economic and social imperative if consumers integrate social responsibility into their decision criterium. The role of corporations, civil society, and consumer behavior on social responsibility are all interconnected. Each group has vastly different motivations, incentives, agendas, and capabilities for effecting social change; however, widespread, social responsibility cannot be realized by one group alone. Emphasis on the first two key principles of socially responsible behavior as identified by ISO 26000 will develop a system of checks and balances between these groups. (1) Accountability allows for civil society to act as an independent third party to validate CSR initiatives and sustainability reporting and also places some responsibility on the consumer to infuse social responsibility and morality into their decision-making (Micheletti and Stolle 2007). (2) Transparency is crucial to lowering the veil that exists between resource extraction and production and consumption, as this asymmetry has led to the lack of social progress and emergence of greenwashing (Delmas and Burbano 2011). Increased transparency will not only promote honesty and ethical behavior but also build trust between corporations and consumers (Kang and Hustvedt 2014).

The Triple Bottom Line and Social Responsibility Today

Elkington has revoked his initial definition of the triple bottom line, as the term, which is now common business lexicon, was meant to portray more than an accounting framework but instead a more holistic approach to how corporations conduct business. Fundamentally, we have a hardwired cultural problem in business, finance, and markets. "Whereas CEOs, CFOs, and other corporate leaders move heaven and earth to ensure that they hit their profit targets, the same is very rarely true of their people and planet targets. Clearly, the Triple Bottom Line has failed to bury the single bottom line paradigm" (Elkington 2018). Elkington identifies the need for corporations to not just buy into the idea of the triple bottom line, but to make tangible changes to their operations with the society and the environment in mind. This systematic change is challenging under the modern economic structure; however, ethical consumerism and independent validation will continue to increase the effectiveness of social responsibility (Devinney et al. 2006).

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Social Responsibility of Organizations

► Corporate Social Responsibility and Sustainable Development

Social Solidarity and Sustainable Development

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Definition

Social solidarity refers to cooperation between individuals in the quest for the welfare of all, promoting a more solidary and equitable society. This process is fundamental for sustainable development, since it must, in addition to conserving natural resources and promoting a less environmentally predatory economy, ensure a society with quality of life for all human beings.

Introduction

Given the socio-environmental framework that characterizes societies nowadays, it can be noted that human actions on environment are causing increasingly complex impacts, both quantitatively and qualitatively. In this context, the concept of sustainable development emerges as an integrating force to qualify the need to think about another form of development (Jacobi 1999).

Considering the reflection on the dimensions of development and the alternatives that can contribute to promote equity and to articulate relations between global and local level, sustainability issue plays a central role. In this context, social area is currently where the greatest challenges are, once it aggregates the different interests at stake regarding the search for sustainability (Jacobi 1999).

According to Sachs (2000), concept of development is multidimensional and cannot be the same as economic growth. Sachs argues that there may be growth, but growth that generates large social and ecological costs leads to poor development. Thus, criteria for development must consider social, ecological, and economic factors. Specifically from the social point of view, the aim should be to enact welfare of all based on ethical principle, social justice, and solidarity.

Often, when talking about environment, external nature of human being is considered in general terms. However, considering the current concern of seeking an environmentally healthier alternative for human development, it is imperative to consider human society as a part of the environment (Foladori 2002).

On this matter, it should be emphasized that the concept of sustainable development was born incorporating environmental sustainability into a social and economic sustainability. During the last three decades, the issue of social sustainability was centered on poverty and population growth. Social sustainability programs were focused primarily on reducing poverty and limiting population growth (Foladori 2002).

The perspective of sustainability has evolved, for example, to emphasize the importance of social participation and the increase of potentialities and qualities of people in the construction of a more just future. However, there are certain barriers, posed by capitalist system functioning logic, which limit the viability of social sustainability (Foladori 2002).

Thus, action discussions and proposals that seek to understand and overcome these barriers are urgent and fundamental for sustainability quest. In order to do so, it is no longer possible to work on environmental issue under the prevailing individualistic vision throughout modernity. Society can be reconstructed from the rescue of fraternity, respect for others, and social solidarity (Vasconcellos 2007).

Considering social solidarity concept, the individual has the duty to cooperate to achieve a common good, in a process that promotes the link between the subjects. For Vasconcellos (2007), "solidarity implies the conscious participation in an alien situation, it means the bond between people. Awareness goes through all individuals, considering their different realities – and reality is increasingly complex" (Vasconcellos 2007, p. 92).

This complexity is also present in environmental problems faced nowadays. It is not the nature that is in crisis, but the values that guide society – and they generate the threat to environment. In this way, this is an ethical issue and depends on human beings changing their postures to ensure a harmonious and balanced relationship with environment (Vasconcellos 2007).

Therefore, it is necessary to seek for a new ethic, governed by a feeling of mutual belonging among all beings and based on responsibility and solidarity with future. In this perspective, cooperation becomes an indispensable element for human society, since it is based on solidarity and works toward a common end (Vasconcellos 2007).

Considering the cooperation, based on solidarity, it is worth mentioning cooperativism as a contributor to the promotion of sustainability, considering that it is a movement, a philosophy of life, and a socioeconomic model capable of gathering economic development and social well-being. Cooperativism foundations are democratic participation, solidarity, independence, and autonomy (Organization of Brazilian Cooperatives – Organização das Cooperativas Brasileiras 2018a). To Fonseca et al. (2014), this concept has convergence with the concept of sustainability in which economic development and social welfare are aligned with environmental conservation.

In view of the above, this paper seeks to present a discussion and reflection about the relationship between social solidarity and sustainability, highlighting mainly the social aspect of this concept. For this, the case study, which is developed through a research carried out at the University Center UNIFAAT, is presented in a solid waste cooperative in an inland city of the state of São Paulo, Brazil.

Solidarity and Social Sustainability

The concept of sustainable development emerges as an alternative to developmentalism, trying to respond to social and ecological critiques that had repercussions on a world scale. The concept tries to reformulate developmental ideas that had been formulated in the 1940s, in a post-WWII period, which sought the reconstruction of war-affected societies based on a perspective of unlimited growth supported by Western industrial society (Scotto et al. 2007).

In 1984, at request of General Secretary of United Nations, World Commission on Environment and Development (WCED) was created. In 1987, this commission published a document entitled *Our Common Future*, also known as the Brundtland Report (Leff 2001). Thus, the concept of sustainable development was presented as one that seeks to meet "needs of the present without compromising the ability of the new generations to meet their own needs" (WCED 1987).

Although the concept of sustainable development emerged in 1987, it was only after United Nations Conference on Environment and Development held in Rio de Janeiro, in 1992, that the discourse on sustainable development began to be officially attended by the conference (Leff 2001).

It is important to mention that the Brundtland Report still presents the idea of sustainable development based on economic growth, even recognizing social problems as a fundamental part of environmental problems. The report analyzes society with a thought driven by economic logic. Thus, the document allows us to perceive the difficult conciliation between economic growth, overcoming poverty, and attention to environmental limits (Scotto et al. 2007).

Over the last 30 years, the issue of social sustainability has had as its central theme poverty and population growth, as well as other issues such as equity and quality of life, which have been superficially addressed. At the same time, there was an idea of improving quality of life but simply as a means of achieving the goal of ensuring a better environment for future generations. Toward the end of the last century, international community began to realize and understand that the goal should be the current quality of life, not just something for the future (Foladori 2002).

Considering the relationship between social issue and sustainability, it is worth mentioning Agenda 30 for Sustainable Development, which came into force in January 2016. The document presents 17 goals – successors of the 8 Millennium Development Goals – and 169 targets. These objectives are integrated and indivisible and mix the three dimensions of sustainable development: economic, social, and environmental (United Nations 2015).

Agenda 30 considers goals and targets that will stimulate action in areas of crucial importance to humanity and to the planet over the next 15 years. Among these areas are the people, about whom document mentions that "We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfill their potential in dignity and equality and in a healthy environment" (United Nations 2015, p. 3).

Among goals that can be more directly associated with search for a fairer, equitable society that guarantees the quality of life for individuals, it is possible to highlight:

Goal 1. End poverty in all its forms everywhere.
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Goal 3. Ensure healthy lives and promote Well-being for all at all ages.
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Goal 5. Achieve gender equality and empower all women and girls.
Goal 10. Reduce inequality within and among countries.
Goal 12. Ensure sustainable consumption and production patterns.
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (United Nations 2015).

Analyzing these goals, it is possible to notice that the challenges are huge and that a new posture is necessary and fundamental in the way human being has interacted with natural environment and among its peers. According to Pontes (2006), it is worth mentioning the concept of social solidarity, which is the present interdependence between each individual and other members of society in order to promote equality of opportunities and search for well-being of all. For that, there must be mutual cooperation.

According to the author, social solidarity should be something that really emancipates economically those who find themselves in conditions of needs and not as a palliative measure. There is no guarantee of equality of opportunity without this emancipatory character of solidarity measures. "Only through solidary and manorial measures it will be possible to achieve a more solidary society, solve the problems of social inequalities and overcome poverty" (Pontes 2006, p. 118).

For the effectiveness of social solidarity, it is necessary to raise awareness and mobilize the individual, who must participate effectively in protecting the environment. Thus, it depends on individual changes and actions. However, it is very difficult to become aware of and mobilize for solidarity when one is inserted in an extremely competitive system such as capitalism (Vasconcellos 2007).

Often, alternatives to fight poverty, for example, go against the macro policies imposed by institutions such as the International Monetary Fund, the World Bank, demands of the International Trade Organization, and even the macro-recommendations of bodies from the United Nations, such as FAO (Foladori 2002).

One of the most radical elements of social sustainability proposal is social participation, since it is an indicator of democratic freedoms, equity in decisions, and also a decisive element in the empowerment of productive efforts. Since the 1980s, social participation has been placed by international agencies, nongovernmental organizations, and international institutions as a necessary goal of development and sustainability programs. However, for a real change, it is necessary to review the current production system; otherwise nothing will change the distribution of social wealth that occurs according to the rules of competition established by the market nor its consequences on social differentiation and poverty (Foladori 2002).

In this perspective, it is important to emphasize once again that three criteria are generally pointed out so that development is considered sustainable – it must be economically viable, socially equitable, and ecologically balanced. For this, the question of social solidarity, in theory and in practice, should be considered in the application of this concept.

Analyzing the concept of sustainable development, and the three criteria that are necessary for it to occur, one can conclude that the present model of development of the world is not sustainable. Rattner (2009) states that the concept of sustainability cannot be reduced to the economically viable and ecologically correct. Thus, in addition to ecological and economic issues, the social and ethical dimension must also be prioritized, ensuring equality, human rights, and social justice for all.

Ecological sustainability (ecologically harmless) corresponds to the concept of conservation of nature as if this nature was not part of human being. This way, this concept considers nature to be external to human being, trying to follow a preservationist ideal of a nature untouched by humans as something ecologically sustainable (Foladori 2002).

Economic sustainability (economically viable) is somewhat controversial, since unlimited economic growth and productive efficiency are intrinsic to capitalist dynamics. Even by correcting production processes and transforming them into ecological production processes with zero pollution and renewable natural resources, the issue of unlimited growth does not allow sustainability for the economy (Foladori 2002).

Social sustainability (socially equitable) is linked to improving quality of life, democracy, and human rights without affecting the relations of ownership or appropriation of resources, as well as social relations of production. However, its concept can be considered the most confusing of the three, because there is a great conceptual problem in the differentiation between this concept and the one of ecological sustainability. Often the concept of social sustainability has been and is used as a mean to achieve ecological sustainability, and when social (un)sustainability is discussed, often the true interest lies in the ecological (un)sustainability that the social problem causes (Foladori 2002).

The environmental issue is a problem of an eminently social nature. Quality of sustainable development lies in the way society appropriates and uses the environment as a whole. In this way, the discourse of sustainable development requires different groups of citizens united to build a common future, as a strategy of social participation in environmental policies. Therefore, without social solidarity, the divergence of interests is imminent, making sustainable development very difficult (Leff 2002).

It should also be noted that resources scarcity and exhaustion are due to production and consumption patterns of industrialized countries and privileged groups of society. If the predominant emphasis is placed on productivity, competition, and individual consumption, then social and cultural dimensions of personal identity, responsibility, and solidarity will be neglected (Rattner 1999).

Thus, sustainable development must seek to generate consensus and solidarity on global environmental problems, erasing opposing interests of nations and social groups in relation to the usufruct and manipulation of natural resources for the benefit of the majority populations and marginalized groups of society (Leff 2002).

To achieve social sustainability and build a sustainable society, it is essential to understand that a healthy environment is a necessary condition for the well-being, equality and quality of social life, ecological sustainability, and economic functioning. It must be sought in addition to cooperation, compassion, and solidarity, which are vital values for survival and quality of life (Rattner 1999).

In this perspective, models such as cooperativism can collaborate in the difficult task of overcoming barriers imposed by the current model of socioeconomic development for pursuit of sustainability. It is a task that should not be based only on economic growth or conservation of ecosystems, whose challenge has to address a fairer society that guarantees fundamental conditions of life for all human beings.

Cooperativism, Social Solidarity, and Sustainability

Cooperativism is a business model that, in addition to economic goals, seeks social progress through union of people around a common goal, mobilized in an organization where everybody can be considered the owner of the business itself (Rossés 2015; OCB 2018a).

The genesis of this movement profile occurred in 1844, in a town in the hinterland of England, Rochdale, Manchester. At the time, a group of 28 workers who struggled to buy the basic necessities for survival came together to set up their own warehouse. The proposal was based on the idea that the purchase of food in large quantities would enable the purchase of the products at lower prices and that there would be an equal division among members of the group regarding everything acquired. It was born what would be considered the first modern cooperative, called "Rochdale Proboscis Society" (OCB 2018b).

According to Smith (2014, p. 19), a cooperative is defined as an "autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise." From this concept, Dale et al. (2013) consider that the principles of cooperatives are directly associated with the concept of sustainability.

Completing this view, Bridi and Medeiros (2018) mention that the concepts of cooperativism, environment, and natural resources, as well as sustainable development and sustainability, have strong links of interconnection. The authors mention that in all of these concepts, it can be identified a concern regarding the establishment of equilibrium relations between the agents in the interaction process, be it economically, socially, or in the same environment.

"In 2009, the United Nations General Assembly declared 2012 as the International Year of Cooperatives (IYC), highlighting the contribution of cooperatives to socio-economic development, particularly their impact on poverty reduction, employment generation and social integration" (Smith 2014, p. 24). Until then, there had never been a United Nations year focused on a particular form of enterprise. With the theme "Cooperative enterprises build a better world," IYC has as one of its objectives to encourage growth and establishment of cooperatives around the world, providing an important opportunity for the sector. A large number of international conferences and summits have been held around the world generating agreed and cooperative statements (Smith 2014). The General Assembly resolution is available in all six official UN languages.

In this context, International Co-operative Alliance has developed the document Blueprint for a Co-operative Decade, which mentions that cooperatives have always set out to enable people to access goods and services without exploitation, thus involving a set of values based on sustainability. By placing human need at its core, cooperatives respond to today's sustainability crises. A cooperative is a collective search for sustainability (International Co-operative Alliance 2013).

For Bridi and Medeiros (2018), cooperativism and sustainability are increasingly discussed around the world, especially within organizations and in academic research. Thus, considering the importance of cooperatives and sustainability in the present day, Bridi and Medeiros (2018) developed a study to verify the characteristics of academic production in the last 20 years (1998–2017) through analysis in the Web of Science. The research resulted in 792 papers that addressed the topic of cooperatives and sustainability. The results obtained evidence a growing concern with this theme over time, going from 8 works in the year 2000 to 119 in 2016. Most of the studies were published in the form of a scientific article (596), among which it is identified that the United States of America stands out with 207 works; Australia, Canada, China, and Spain are included in the survey results with 55 articles published each. Brazil occupies the 11th position in the ranking, with 33 works (Bridi and Medeiros 2018).

Besides the approach in academic world, it should be emphasized that UN believe that cooperative model can be understood as a motor of sustainability. There is a clear and direct relationship between sustainability and how cooperatives are defined. Their links with social dimension of sustainability are stronger than links with environmental and economic dimensions, but all three are present (Dale et al. 2013).

One of the initiatives to know and understand how cooperatives contribute to sustainability is the digital platform (www.sustainability.coop). It is a platform developed by the Sustainability Solutions Group for the International Co-operative Alliance to assist the Blueprint for a Co-operative Decade. The platform is a global map that allows cooperatives to present a description of how their cooperative projects have contributed to sustainability.

The platform seeks to highlight evidence of cooperative commitment to sustainability (Dale et al. 2013). This commitment is related to the fact that cooperatives and solidarity economy can collaborate with the adoption of sustainability actions that contribute, in medium and long term, to a planet in good conditions for the development of the diverse forms of life, including human. They contribute to preservation of natural resources necessary for the next generations (forests, rivers, lakes, oceans), ensuring a good quality of life not only for the present generations (Schneider 2015).

In the scope of solid waste management, this voluntary union of people also begins in an informal way, giving rise to cooperatives for collection, sorting, and commercialization of waste. They are collectors of recyclable materials who note that when they organize, they increase their bargaining power with scrap dealers and industries that sell this waste (Pinhel 2013).

In Brazil, the legal regime of cooperative societies is established by Law No. 5764, dated December 1971, which defines the National Cooperative Policy (PNC), according to which a cooperative society contract is entered into by "persons who mutually undertake to contribute with goods or services for the exercise of an economic activity, of common advantage, without objective of profit.” Still according to the PNC, “cooperatives are societies of persons, with their own legal form and nature, of a civil nature, not subject to bankruptcy, constituted to provide services to members [. . .]” (Brasil 1971).

In this sense, Dale et al. (2013) and the Organization of Brazilian Cooperatives (OCB) (2018a) consider that the act of cooperativism is governed by seven principles, namely:

1. **Voluntary and free membership**: Anyone can participate in the cooperative as long as he/she shares his/her goals and accepts the responsibilities inherent in the members of the organization.
2. **Democratic management**: All members control the cooperative, participating in policy-making and decision-making, and there is an election of official representatives.
3. **Economic participation of members**: cooperative’s capital is structured by equitable contributions of members, who receive remuneration limited to the paid-in capital of the organization. If there is a surplus, this amount can go to members, to cooperative development, or to support of other activities – The decision occurs democratically.
4. **Autonomy and independence**: Agreements signed by a cooperative with other organizations – Public or private – Cannot compromise members’ democratic control of the organization or its autonomy.
5. **Education, training, and information**: Members and employees of the cooperative receive education and training so that they can actively participate in the development of organization’s business.
6. **Intercooperation**: Joint action of cooperatives in local, regional, or national structures makes possible the strengthening of cooperative movement, benefiting the cooperative.
7. **Community interest**: Act of cooperativism is intrinsically associated with sustainable development of communities, and this relationship occurs through policies approved by the cooperative.

Cooperatives can be categorized according to their size and the objectives they seek, which is divided into three grades:

First degree (singular) – Cooperatives for people, whose purpose is to serve members. It has a minimum of 20 members.

Second degree (central or federation) – Considered a cooperative for cooperatives, responsible for dealing with the organization of the affiliated services. It consists of at least three unique cooperatives.

Third degree (confederation) – Cooperative oriented to the federations, with function similar to the ones of second degree. However, they are formed by three federations (central) or more (OCB 2018a).

Cooperatives have a fundamental role for sustainable development, which, as mentioned earlier during this work, depends to a large extent on the social issue. Cooperatives, by their own equality structure, can collaborate on the issue of social solidarity, distinguishing themselves from structural methods of joint ventures. More than that, they have the capacity to allow a new beginning or a new life for the member, generating inclusion and social participation for those who were previously in precarious conditions. Together with social issue, cooperatives that carry out segregation and disposal of recyclable waste contribute strongly to environmental issues, mainly through minimization of extraction and use of natural resources, as well as through reduction of waste that is sent to landfills, where they accumulate.

In order to highlight and reflect on the relationship between social solidarity and sustainability, a case study was carried out at the Cooperativa Recicle, in the city of Bragança Paulista, São Paulo. This cooperative has 10 years of existence and allocates 75 tons of recyclable waste per month to the recycling industry. Approximately two thousand residences are located in condominiums. Most of cooperative’s income (60%) comes from paper separation and sale. It currently has 16 members, 8 men and 8 women, who receive between R$ 500.00 and R$ 700.00 per month when the recyclable market is low and above R$ 1,000.00 when the market is on the rise.

To better understand the reality of aforementioned cooperative, three field visits and interviews with two members were carried out, among them the promoter of the proposal. According to Gil (2011), the type of interview by guidelines shows some degree of structuring, since it is guided by a list of points of interest that the interviewer is exploring throughout his course. The guidelines should be ordered and have a certain relationship to each other.

On *field visits* it was noted that the people who are part of the cooperative are needy, often with family problems, with bad financial situation, and excluded from society in general. Thus, participation in the cooperative can be considered a mean for social inclusion of these people, since, according to the founder of the cooperative itself, cooperative's role is to bring people who are in street conditions or with personal problems and who are often illiterate or disqualified to get some other job.

Many people living in condominiums served by the cooperative came to understand and respect the role of this organization. It is possible to perceive the valuation of the individuals who work in the cooperative collecting and giving an appropriate destination for the waste generated by these condominium residents. Thus, it contributes to a change of vision process, from prejudice to one that involves recognition of society.

However, in many cases those who do the waste separation inside houses are the employees of homeowners. Thus, an outsourcing of responsibility regarding this stage of waste management is noted. Considering that in social solidarity individual has the duty to cooperate to achieve the common good, in a process that promotes the link between the subjects (Vasconcellos 2007), it is necessary to go beyond the scope of the cooperative so that this issue can be internalized by individuals. Regarding the interviewees, both are male. The interviewee A (founder of the cooperative) has been in the cooperative for 10 years, is 68 years old, and has completed higher education (Mechanical Engineering). Interviewee B has been in the cooperative for 8 years, is 45 years old, and has elementary school incomplete (seventh grade). The training of interviewees demonstrates the difference of social classes, which should be minimized when thinking about sustainability. On the other hand, when it comes to social solidarity, it implies, among other factors, the participation of individuals with different realities, since it means a link between people.

The following are the analyses of four more specific guidelines that relate to the theme proposed in this work: changes generated through participation in the cooperative, role of the cooperative, concept of environment, and concept of sustainability.

Guideline 1: Changes Generated Through Participation in the Cooperative

Interviewee A: "Changed to carry out social and environmental work to care for the people, who cannot get a job because they are illiterate or not qualified. The cooperative is theirs and will be for them."

Interviewee B: "Changed 100%, now there is room to live, money, support... if you need some medicine."

From the interviewees' answers, it can be observed that the cooperative brought changes for both. The perspectives are differentiated, but complementary. In the case of Interviewee A, change is more related to benefits for the community, for the other, thus demonstrating one of the fundamental principles of social solidarity, cooperation for the common good rather than an individualistic view (Vasconcellos 2007). Interviewee B, on the other hand, is able to achieve, through his participation in the cooperative, better living conditions and social inclusion. Thus, immersed in a system in which individuals are interdependent, the individual, with his participation and involvement, collaborates to maintain and strengthen cooperativism. According to Sachs (2010), a collective action provided by cooperatives, which also seeks the interaction between people, can directly contribute to social sustainability, which involves improving income distribution and reducing social differences.

Guideline 2: Cooperative's Role

Interviewee A: "Social and environmental, it is part of the cooperative's statute. Bringing people that are on the street."

Interviewee B: "Eliminating things that go to nature, and employment."

Regarding the cooperative's role, it can be seen that, for both interviewees, social and environmental issues are mentioned. However, there is a slightly greater emphasis on the social issue, given that the cooperative seeks to reintegrate excluded citizens, giving dignified living conditions to those who need it. This process, in addition, is reflected in contribution to environmental conservation, through segregation and destination of materials that can be recycled. Making a reference to Agenda 30 for Sustainable Development, the activities carried out by the cooperative can contribute to elementary areas in achieving the objectives and goals proposed in this document. These areas refer to people, seeking to ensure that all human beings can realize their potential in dignity and equality; to the planet, promoting environmental conservation; to prosperity, ensuring that human beings can enjoy a prosperous life and full personal fulfillment; and partnerships, which are fundamental in the quest for sustainability (United Nations 2015).

Guideline 3: Environment Concept

Interviewee A: "Where you live and everything around us, the planet Earth is our environment."

Interviewee B: "Unpolluted river, well-kept forest, do not set fire to the bush, take care of animals because they are in extinction."

The interviewee A presents a vision of environment that includes human being when he mentions the place where we live, planet Earth. Considering the sense of belonging – human being in the environment, this understanding can be an important step toward development of an environmental responsibility, in which human being learns to be protective of environment, as well as to use resources in a balanced way and build a responsible and shared relationship with nature (Sauvé 2002).

Interviewee B, however, relates his perception of environment to attitudes that seek to minimize negative impacts in natural environment. Given this view, it is necessary to develop skills that make it possible to become aware that environmental problems are essentially associated with socio-environmental issues linked, for example, to games of interest and power and to choices of values (Sauvé 2002).

Guideline 4: Sustainability Concept

Interviewee A: "Decrease consumption, they are things that come and go; to reuse; to preserve the environment."

Interviewee B: "Virgin forest, which most place does not have."

Analyzing the respondents' responses, it is interesting to note that even when inserted in a context directly related to the promotion of sustainability – such as cooperatives – they understand this concept mainly considering the ecological aspects of environmental conservation. In this sense, there is a reflection about how people, and populations, understand the concept of sustainability and sustainable development, widely debated and disseminated in scientific, academic, and public policy-making. Carvalho (2012) points out that the socio-environmental view constitutes a field of dynamic interaction between culture, society, and the physical and biological basis of the vital processes, being thus oriented by a complex and interdisciplinary rationality.

Thus, there is a more intuitive view of how the cooperative can, through social solidarity, contribute to sustainability. However, a deeper understanding of the concepts of environment and sustainability is lacking. This issue shows, as explained by Foladori (2002), that social sustainability is one of the great challenges with regard to sustainable development. Social sustainability, among other factors, should promote solidarity, participation, and empowerment of individuals. However, it seems unlikely that communities can achieve sustainability without fully understanding the meaning and scope of this proposal.

In view of the above, it is important to emphasize that in order to live in a society where there is a development model that brings economic benefits, justice and social equity, and a balanced and conserved environment, a change in the consumption and production process is necessary, as well as the posture of individuals, who must interact with each other and with society in order to reach the collective well-being in a collaborative vision.

Final Considerations

Today, humans are embedded in a society that prioritizes productivity, competition, and individual consumption, favoring the predominance of an extremely individualistic thinking and, consequently, ignoring the social and cultural dimensions. This way, several problems arise, among other factors, because of patterns of consumption of privileged groups in society, which end up using more intensely natural resources, contributing to scarcity of these resources and leaving less to those who already have little.

With this dynamic of economic and productive growth, development becomes unsustainable, as it generates scarcity of natural resources and social inequality, disregarding two of the three main aspects of sustainable development – social and environmental dimensions.

As seen in the case study, Cooperativa Recicle Bragança was founded by a person who had no financial interest in recycling but who, in an act of solidarity, allowed the cooperative to transform lives of people who needed help. Thus, there are examples, even within this capitalist panorama, that seek to unite social solidarity, ecological sustainability, and economic development in an egalitarian way, in order to achieve sustainable development.

In order to do so, it is fundamental to meet the needs of present generation, making sure that the needs of future generations will not be compromised. In this sense, it is necessary to adopt a different way of thinking and acting. A way that considers solidarity and whose basic characteristic involves individuals thinking and acting as a whole, emphasizing solidarity, ethics, cooperation, and compassion as fundamental factors to guarantee more equality, human rights, and social justice, avoiding the divergence of existing interests, and allowing sustainable development with quality of life for all.

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Social Welfare and Sustainability

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Synonyms

Benefit; Health; Progress; Prosperity; Well-being

Definition

Social welfare refers to physical and mental well-being, while sustainability references the balance that exists between the economic, environmental, and social aspects of a social and economic system. Together these attributes define a society that promotes sustainable outcomes in consideration and inclusive of individual and communal satisfaction.

Introduction

Conversations about energy conservation, green building, environmental concerns, waste management, and water consumption, among others are very common in any sustainability discussion. Generally speaking, the social dimension of sustainability does not appear at first glance, even though social welfare and sustainability are closely related.

Society is developing very rapidly; this development has generated significant concerns due to the depredation of the natural environment as well as the increment of social problems due to the extraction of value from nature instead of giving it value. The main reason for this degradation is that the primary goal related to economic development is the generation of employment instead of the formation of healthy societies providing satisfying and healthier lives. Hawken et al. (1999) state that the economic growth limits and technology do not work but natural and social capital. However, how is this social capital related to sustainability and Higher Education Institutions (HEIs)?

The purpose of this discussion is to review how social welfare is integrated into Higher Education Institutions through sustainability. Firstly, it presents the dimensions of sustainability and how the concept is related to HEI. Then, the welfare concepts are outlined in order to provide a better understanding of how individuals and their interactions have an impact in overall development, and, finally, it identifies the relationship between sustainability, education, social welfare, and higher education sustainability through important indicators.

Sustainable Dimensions in Higher Education Institutions

The Brundtland Report defines sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987). However, it is essential to recall that sustainable development refers to sustaining the natural systems on Earth as well as providing more significant opportunities for a better life and not just to meet the basic needs. Additionally, the World Commission on Environmental Development (1987) states that sustainable development is based on ethical principles of social justice, including a concern for equity within and between generations. Hence, sustainability refers to the integration of a combined system which includes an economic, ecological, and very importantly an integrated social perspective (Hediger 1999).

Therefore, sustainability is a high-level, complex, and multidimensional concept. According to Atkisson (2011), it refers to the capacity of making a world that works for everyone; it describes the concept as a system which includes four dimensions in any organization: nature, society, economy, and well-being.

The importance of sustainability is due to the necessity to find better relationships between sustainability elements. For this reason, social, educational, and government organizations should deeply analyze these phenomena and design sustainable solutions to improve current lifestyles considering social concerns as primarily changing agents. Therefore, Higher Education Institutions should use sustainability concepts to strengthen their mission and improve quality learning processes.

According to the Association of University Leaders for a Sustainable Future (ULSF) of the Talloires Declaration (1990), the purpose of universities is to provide instruction to most people who establish and administer society's institutions. Henceforth, universities have profound responsibilities to raise awareness, knowledge, technologies, and tools to create this sustainable future. As a result of these considerations, one of the most important influencers of society at present is Higher Education Institutions, mainly because they hold all the necessary expertise to develop the intellectual and conceptual framework to achieve this goal.

Likewise, sustainable and committed HEI should provide students with the basic knowledge of environmental degradation, encouraging them to search for better sustainable practices while considering today's injustices in full integration with modeling justice and humaneness (Clugston and Calder 1999). Also, Velazquez et al. (2006) state that in order to fulfill their purpose of teaching, research, outreach and partnership, and stewardship, a sustainable university should minimize the environmental, economic, social, and health impact involved in the use of its resources.

It is relevant to acknowledge that no other social institution could take the role as a force for change, because education is the strength that would guide, activate, and motivate all future decisions. Therefore, HEIs have become sustainable models as a result of their genuine commitment to the ethical and moral responsibility of contribution to local, regional, and global sustainability.

In order to move toward any sustainable path, HEI should find the equilibrium between several dimensions; implementing the Atkisson Sustainability Compass (Atkisson 2011), it is possible to find each of them at any university, for instance:

- *Nature* refers to the impact an institution could have on the natural environment, such as energy consumption, CO2 emissions, solid waste, operational management as well as academic research developed in schools, academic programs, and curriculum.
- *Society* alludes to government, culture, and commitment as well as social responsibility. It could be described as the impact the institution has on the outside, e.g., its influence among the community.
- *Economy* presents concepts such as profits, production, and investment as well as the correct use of the economic resources of the institution.
- *Well-being* points out the individual quality of life, personal development, employment, as well as faculty members or staff and student's health, in other words, inward of the institution.

With these dimensions considered, it is easier for any institution to determine sustainable

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practices. For instance, waste management and energy savings would not find any resistance due to the economic and environmental impact of their nature. However, the social dimensions (including social and well-being) are not receiving the same attention; practices related to affective attributes such as values, attitudes, and availability to participate in institution's sustainability results are much more difficult to apply.

Institutional sustainability is mostly focused on environmental sustainability, specifically energy, resource management, and waste reduction. Since the financial barrier is the most often reported as a significant hurdle to achieve institutional sustainability, and it is not tending to disappear in the future, much work has to be done to enlarge the conceptualizations of sustainable development. This argument is consistent with the findings of Wright (2010), where university presidents and vice-presidents favored the environment over social and economic factors when discussing sustainability. They focused on the physical impacts relating to sustainability, as the facilities management stakeholders mostly deal with the physical aspects of the campus and have the most control over the environmental factors of the institution (Sonetti et al. 2016).

Social Welfare Concepts

The World Health Organization, and Zubieta and Delfino (2010) describe that health refers not only to the full state of physical and mental well-being but also the social one, which integrates harmony with the environment as a crucial need for welfare. From a psychological and social perspective, welfare or well-being is not only the absence of symptoms or positive emotions. From this perspective, having mental health would also imply that the individual respects and values his self, which has positive relationships with others or receives adequate social support. It would also prove that he believes that he dominates and controls his environment, that he feels autonomous of the environment, and that he brings meaning and positive purpose to his life, as well as he believes that he is growing as a person (Bilbao 2008). Psychological and social welfare has been widely used as a measure of mental health.

Psychological Welfare

According to Zubieta and Delfino (2010), one of the most replicated works is the one carried out by Ryff (1989) and Ryff and Keyes (1995), in which they propose a structure of six factors conforming psychological welfare:

1. *Self-acceptance*. Where people try to feel good about themselves even while being aware of their limitations.
2. *Positive relationships with other people*. Where people need to maintain stable social relationships and have friends they can trust.
3. *Autonomy.* To sustain their individuality in diverse social contexts, people must enjoy self-determination and maintain their independence and personal authority. Autonomy is associated with resistance to social pressure and self-regulation of behavior.
4. *The domain of the environment*. The personal ability to choose or create favorable environments to satisfy one's desires and needs. It is related to the feeling of control over the world and influence on the context.
5. *The purpose in life*. Goals and objectives that allow endowing life with a particular meaning.
6. *Personal growth*. Interest in developing potential, growing as a person, and maximizing one's abilities.

According to Atkisson Sustainability Compass, these elements could be considered in the well-being dimension; they are part of the personal internal development. All of these aspects should be treated as relevant agents to university development, not only students but also the entire university community including staff, faculty members, and administrators.

Social Welfare

On the other hand, individuals are part of a more extensive system; universities are small cities which evolve through their members; social welfare is also a critical component because all humans need to interact with each other to seek sustainability. According to Keyes (1998), several social challenges constitute possible dimensions of social welfare.

1. *Social integration* refers to the evaluation of the quality in terms of an individual and his/her relationship with the community. It is based on concepts such as social integration, cultural breach, social disassociation, and class division.
2. *Social acceptance* is the latency of trust, positive attitudes, and acceptance to others. It is an attribute of honesty, kindness, and the awareness and embrace of the positive and negative aspects of life.
3. *Social contribution* refers to the evaluation of the individual's value, the worth every member of society has and shares with the world. Social contribution is a reflection on how people feel about their contribution to the commonwealth and how this is valued by society.
4. *Social actualization* is the evaluation of society's potential and trajectory through its citizens and institutions.
5. *Social coherence* is the self-consciousness of the quality, management, and actions of the social world. It refers not only to understand the world but to recognize what happens all around.

Social welfare is associated with incorporation to associations and prosocial behavior. It is related to the general satisfaction of life, with participation in activities that have as a framework the voluntary aid and the generous collaboration in the solution of problems that affect us and concern everyone and trust in others.

Social Welfare and Higher Education

Education faces two specific challenges:

1. The *ecological challenge* implies contributing to train and form not only young people and children but also managers, planners, and decision-makers, to guide their values and behaviors toward a harmonious relationship with nature.
2. The *social challenge*, in a world in which wealth is undoubtedly unfairly distributed, forces us to radically transform the structures of management and redistribution of Earth's resources.

Hence, environmental education implies that, without disregarding the problems of individuals, it extended its objectives to the context, incorporating the relationships between subjects and nature as well as with other human beings, linking the local with the global. This assertion generated considerable commitment to knowledge and placed environmental education as a matter of rethinking our relations with the biosphere, as well as an instrument of social transformation and empowerment, all in pursuit of more harmonious and equitable societies (Novo 2009).

Most compelling evidence shows that UNESCO (1976) in "The Belgrade Charter" states, as one of the environmental education guiding principles, that "environmental education should consider every development and growth in an environmental perspective," which makes clear two of the main inspiring ideas of environmental education:

1. Economic and social inequalities, the quality of life, and all the social aspects of development are considered environmental issues with the same rank as the themes of the physical environment.
2. Social and physical problems are understood in an intimate relationship, as elements of the same system that must evolve harmonically (Novo 2009).

Also, one of the pillars of the 2000 Lisbon Strategy which aims "turning Europe into the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion." is investing in human capital and setting an active welfare state. To achieve this, European countries pledged to reduce the rate of the population with basic secondary education, thus increasing investment in human capital. Furthermore, countries promoting social integration include specific groups such as minorities, children, the elderly, and people with disabilities. Recently, higher education is considered one of the leading approaches to the Europe 2020 Strategy for employment and growth (Zapata and Ramirez 2015).

As has been noted, social welfare is directly related to education, therefore, connected with sustainable development and HEI. Moreover, social capital refers to the values and norms of any society, the preferences, human capital, and environmental knowledge. It also relates to human health and life expectancy as well as cultural and social integration (Hediger 1999). Henceforth, the social capital must be considered as a central development hub of any HEI to pursue sustainability. In this matter, universities should offer a quality education considering all the variables involved in the teaching-learning process. In this sense, it is essential to identify the obstacles and facilitators that students find in the fulfillment of their tasks and their relationship with psychological welfare and academic performance (Salanova et al. 2005).

According to Hediger (1999), human health, literacy and life expectancy, cultural and social integrity, and social cohesion are components of human welfare. These factors of social capital should be considered in a social welfare function; in fact, all of them are identified inside the structure of any HEI.

Social Welfare Indicators

Over the past 15 years, there has been an astounding growth in the sustainability progress in higher education. This growth has shown the need for strong measurement standards to assess headway toward achieving sustainability that many claims. Indicators are measuring information representing a phenomenon broader than its quality or value immediately. The indicators tend to meet three primary and practical requirements: must be measurable values, should be obtained from simple methods, and should be able to monitor (Ruiz-Gutierrez et al. 2014).

Unlike environmental, sustainable development indicators provide higher value information; they are crosscutting measures that report on social, economic, institutional, and environmental areas of the organizations. In addition to allowing managers to establish goals and measure their progress, indicators allow evaluating the sustainability of the campus, so that institutions can acquire numerous advantages.

In this case, indicators are closely related to the personal and particular characteristics of all university community as a social and living world. There are two main aspects of welfare inherently related to HEI sustainability; both provide happiness.

1. *Values* respond to individual needs as biological organisms, as well as social interaction and the proper functioning of the groups. They are social reasons acquired in socialization and therefore linked to desirable goals and objectives of the cultural group belonging to the individual. The values promote, direct, and intensify the action, thus establishing relatively stable action tendencies built on norms of evaluation and justification of the action (Zubieta et al. 2012).
2. *Social inclusion and equity* in Higher Education Institutions in Europe do not only foster equity in access, fair treatment, and improved results (Baye et al. 2005) but also increase the general level of education. They also have a positive impact on the social environment, foster social cohesion, and create new opportunities for development (Zapata and Ramirez 2015).

As an illustration of this measurement, it is possible to mention one of the most critical sustainability evaluation systems for the HEI worldwide at present, STARS from the Association for the Promotion of Sustainability in Higher Education Institutions “AASHE.” The sustainability, tracking, assessment, and rating system consist of a voluntary self-reporting tool that helps HEIs track and measure their progress in sustainability. STARS aim to translate this inclusive vision of sustainability into measurable objectives applied at a campus level including social factors.

With attention to social welfare indicators in HEI, for instance, STARS version 2.1 updated in July 2017 has social welfare implicit in four subcategories for evaluation: campus engagement, public engagement, diversity and affordability, and well-being and work.

Campus engagement indicators aim to engage students in extracurricular activities related to sustainability; these allow them to integrate and apply their knowledge about the principles of sustainability outside of their formal curricula. Also, it supports the commitment of teachers as well as staff in the development of training programs on sustainability issues.

Another critical point in the integration of social welfare in HEI is *public engagement*. Again, AASHE seeks to recognize those institutions that collaborate with the community through engagement with the public and partnerships with the community and service.

Likewise, *diversity and affordability* subcategory recognizes HEI that works to improve these elements on campus. In order to generate a sustainable society, the various groups need to be able to work and live together collaboratively. Higher education opens the doors to the opportunities created to a more equitable world, and those same doors are opened through affordable programs without importance of race, gender, religion, socioeconomic status, and any other difference.

Equally important, *welfare and work* indicators could strengthen its community by offering benefits and other assistance to compensate its workers respectfully. In the same way, it does so by protecting them and favoring their health, safety, and well-being.

Final Comments

From the conceptualization of sustainability during the 1980s by the Brundtland Report, sustainability was conceived as the capacity to meet existing needs without compromising the needs of future generations. This concept was later incorporated into higher education by the Talloires Declaration where its essential role as a sustainable development contributor was prominent, thus educating most of the people who will lead future societies. As one of the main challenges of any institution, welfare is also one of the main pillars of institutional sustainability, as it includes not only the self-acceptance and autonomy of any individual but the influence and contributions to their social environment.

Even though welfare often appears behind environmental concerns such as energy conservation, built environment, and waste management, among others, it is not conceived as an essential part of sustainability. However, it is the essence to develop new strategies for sustainable development as it represents the nature of the human being, to live and enjoy life on Earth.

The integration of the welfare concept in sustainability is crucial for the future generation. Understanding the importance of welfare is essential to achieve substantial changes in the way economic development is considered nowadays. As can be seen, beyond the economic dimension, higher education plays a vital role in social growth; these two elements in addition to natural environment represent the roots for sustainable development. However, it is crucial that HEI considers social welfare as a critical agent to generate change which conducts to a sustainable path.

Cross-References

▶ Social Welfare and Sustainability
▶ Sustainable Facilities Management in Higher Education Institutions

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Socially Responsible Investing in Sustainable Development

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Definition

Linking Socially Responsible Investing with Sustainable Development

Socially responsible investing is largely considered as investments that would enhance environmental, social, and economic sustainability. These investments into projects or legal entities typically allocate resources into the development and offering of products and services that are deemed socially responsible with a focus on long-term economic interest. Institutions engaged in socially responsible investing are meant to avoid businesses that are ethically questionable and involved in products and services that would result in unsustainability of the environment and society. Certain business activities in particular cause pollution to the environment and adversely affect human health. These activities would generate external costs or adverse impacts to the health and sustainability of the society, however, not incurred internally by these entities (Sovacool and Linnér 2016).

Socially responsible investing has a direct and long-term linkage with sustainable development as it determines how financial resources are converted into economic and business activities for sustainable developments of the world that we live in. Socially responsible investing is also often referred to as sustainable investing. These investments take into consideration issues pertinent to environmental sustainability, social responsibility, and governance (ESG). Such integrated consideration enables investors to seek investments that are synergistic with both financial objectives and intrinsic values of ESG (Hopwood et al. 2010).

Introduction

There are growing interests among the stakeholders around the world in dealing with concerns about on-going unsustainability of our world. First, the environment continues to deteriorate resulting in worsened air quality and quality of the living environment; further, climate change continues to create more immediate risks to the stability of the living environment in the near term also make rethink sustainability (Landrigan et al. 2017). However, under our existing financial system, financial resources continue to be attracted to generate maximum financial returns for the funding providers. Such initiatives are dominated by short-termism among the international financial markets which continues to result in investments that are likely to have an adverse impact on sustainability of the world (Gray et al. 2014). Such socially and environmentally unsustainable investments, for instance, include the business dealing of alcohol, fossil fuels, gambling, and tobacco, etc.

It is noticeable that, the investment communities have become aware of the risks associated with unsustainability that affect business operations, financial results, and economic performance of business entities. Investors are conscious about management taking initiatives in dealing with climate change issues through prudent mechanisms as a fiduciary approach in response to the concerns of their investors (Robins 2008). Further, corporate social responsibility (CSR) has been considered as essential approach for companies to manage their reputation risk (Bebbington et al. 2008). Over time, there are growing acceptance of the concept of sustainability that results in the ESG reporting initiative among companies in their seeking accessibility to equity and debt in the financial markets (Hopwood et al. 2010). Such an association with investment decision making is viewed as an enabling factor with risk in debt financing as well as the overall cost of capital for a company (Ghoul et al. 2011).

International Trend and Standard: PRI

An international trend for socially responsible investing for sustainable development gathers over the past decade subsequent to the global financial crisis that took place in 2008. In 2005, the United Nations invited some of the largest institutional investors in the world to jointly develop the Principles for Responsible Investment (PRI) (UNPRI 2018). The initiative has been corroborated by the professionals in the financial sector as well as stakeholders from the international financial institutions and intergovernmental organisations. Since its establishment in 2006, there have been over 1,800 bodies in support of this global initiative (UNPRI 2018).

Through engaging policy makers, this network has focused on the mandate to promote understanding about the implications of ESG among PRI signatories for their investment decisions. It advocates long-term, responsible investments in enhancing financial returns with managed risks. PRI (UNPRI 2018) has identified six main principles as highlighted in Table 1.

Socially Responsible Investing in Sustainable Development, Table 1 The six principles for responsible investment (UNPRI 2018)

Principle 1	*Incorporating ESG issues into investment analysis and decision-making processes*
Principle 2	*Being active owners and incorporating ESG issues into our ownership policies and practices*
Principle 3	*Seeking appropriate disclosure on ESG issues by the entities in which we invest*
Principle 4	*Promoting acceptance and implementation of the Principles within the investment industry*
Principle 5	*Working together to enhance effectiveness in implementing the Principles*
Principle 6	*Reporting on activities and progress towards implementing the Principles*

In fact, PRI has been considered as a very significant responsible investment initiative on a global scale by the fund managers (Sandberg 2013; Woods and Urwin 2010). Such increasing recognition of PRI among its signatory bodies is expected to make socially responsible investing as the mainstream in the investment sector (Majoch et al. 2016). The application of the PRI with synergistic alignment with the ESG criteria would moderate the risk concerns over the investment opportunities (Häßler and Jung 2015).

Acceptance of Socially Responsible Investing in the Financial Market

There are limits as to the extent that public finance can promote socially responsible investing as the financial market ultimate drives the most amount of resource allocation into such investments. With growing social awareness, interest in socially responsible investments is expected to expand and be accepted by various stakeholders in the financial market (Ghoul et al. 2011; Attig et al. 2013). There are in fact business cases of PRI that demonstrate positive potentials of investments into socially responsible businesses (UNPRI 2017). Such an important business case reflects that the mainstream investments realize the significance of social and environmental risks (Louche et al. 2012). In some prior studies, it has also been found that there is emerging linkage between socially responsible investing and long-term financial performance and social goals (van Dijk-de Groota and Nijhof 2015). Some other studies also demonstrate the association between long-term performance and corporate sustainability of business organizations (Wut and Ng 2015).

Socially responsible investing approach enables the principals to ascertain that their invested assets are aligned with their beliefs and value system (Auer 2016). Certain conservative pension funds have incorporated investment strategies that take into consideration the environmental, social, and governance factors in making their investment decisions (Robins 2008). Various primary stakeholders in the financial market have now become aware of the significance of socially responsible and sustainable investing when assessing risks associated with long-term investment opportunities.

Development of ESG Reporting Guideline

In order to provide adequate information for the investors to evaluate socially responsible and sustainable claims among companies, development of ESG reporting guide has become a noticeable initiative for disclosure of pertinent corporate information. There have been policy interest groups that develop and release guidelines and standards in relation to corporate social responsible and sustainability reporting. In particular, the Global Reporting Initiative (GRI) guideline was established by the Coalition for Environmentally Responsible Economies (CERES) with the support of the United Nations Environment Program (UNEP) (Crane and Matten 2016). It guides organizations on disclosures about social and environmental performance on a voluntary basis (Global Reporting Initiative 2015). GRI also takes a multistakeholder approach for inclusion of issues pertinent to operational, financial, and labor aspects within various types of organization, including publicly listed companies (Global Reporting Initiative 2015). The International Federation of Accountants on the other hand published the Sustainability Framework as a guide on issues associated with sustainability and corporate governance (IFAC 2011). Throughout this course of development for ESG reporting, there are growing interests to examine issues related to sustainability adopting an integrated approach so as to synthesize information considered by stakeholders being relevant to the overall performance (Blowfield and Murray 2014; Perrini and Tencati 2006; Schaltegger and Wagner 2006).

Development of Financial Instruments for Socially Responsible Investing

In order to facilitate substantial allocation of funding into socially responsible and sustainable investing activities, there is a need for the international capital market to develop financial instruments to enable various types of investors to place investments that uphold such principles. In recent years, international financial institutions that manage pension funds actively take ethical issues into consideration as they seek long-term, viable returns for their clients (Woods and Urwin 2010). These fund managers would research on a company's ESG performance when assessing overall equity returns from the investee companies. Besides, new financial instruments, such as green bonds, have been developed as a global initiative to formulate long-term debt instruments that are attached to compliance requirements on sustainability performance. For green bond issuers, there is a certification process that requires them to report on a regular basis about their use of proceeds into investment projects that would have positive impacts on environmental sustainability with measurable performance and goals (Climate Bond Initiative 2018). This interest in the development of green bonds has gained interests among the financial professionals around the world echoed with considerable initiatives in China for the need to renew and refinance its existing infrastructures into more sustainable ones on a grant scale. It is estimated that the potential of this green bond market is approximately US $100 trillion, which proceeds can be used in projects for developing climate change solutions (Climate Bond Initiative 2018).

Global financial centers that facilitate financial service development and international capital flows are expected to have a significant role in developing the necessary infrastructure for the development of financial instruments for socially responsible and sustainable investing activities (Financial Services Development Council 2016). These activities include managing associated financial risks as well as matching investors with qualified investment opportunities.

Concluding Remarks

The scope of socially responsible and sustainable investments is to embrace projects and businesses that would enhance sustainability of our world. The United Nations Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development is a global initiative to identify areas of sustainability performance that require allocation of resources for such developments (UN 2017). This emerging emphasis is developed in alignment with the global concerns over climate change and related issues with environmental sustainability (Leal et al. 2017). It has become apparent that there is need to broaden the scope of socially responsible investing in order to achieve these SDGs. These areas concerning sustainable development should include education for all, health, responsible technologies, as well as sustainable infrastructure and energy as we face these global challenges highlighted in the SDGs. In particular, investment in sustainable infrastructure needs timely commitments to reverse the legacy of the unsustainable infrastructures long causing emission of greenhouse gases in the past (Ng and Nathwani 2018).

It is, however, worth noting that effectiveness of these investments needs to be evaluated, assessed, and reviewed on a regular basis in order to ensure the funding is well spent towards socially responsible activities for sustainable developments of the world. This concern is not unfounded for moral hazard occurs in the financial market where agents could take advantage of information asymmetry.

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▶ Principles for Responsible Management Education (PRME) Initiative
▶ Sustainable Development Goals
▶ Sustainable Investing

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Socially Responsible Investment

▶ Value-Based Investments in Sustainability

Soft Competences

▶ Soft Skills and Sustainable Development

Soft Skills and Sustainable Development

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Synonyms

Education for sustainability; Education for sustainable development; Generic skills; Inter- and transdisciplinary competences; Soft competences; Sustainable education; Transferable skills

Introduction

Institutions of higher education are considered to be very dynamic and competitive on regional, national, and international levels and are among the first to react and adapt to the challenges of globalization. Creation of new knowledge and technologies on national and international levels, continuous development of new and advanced teaching/learning methods, as well as changes in institutional management let the institutions of higher education to be in avant-garde of society and its progress. Higher education plays a key role in the promotion of skills that allow graduates to be successful when dealing with the challenges of sustainable development (Wiek et al. 2011). The concept of soft skills, as noted by Kamin (2013) was a common term in 1960s and 1970s. It mostly encompassed skills that "form the foundation for building relationships" (p. 8), namely, listening, empathy, interpersonal communication, team building, group dynamics, sensitivity to others, compassion, integrity, and honesty. Nowadays, soft skills are considered to be critical for professional and personal success as well as "one of the most significant factors in a country's continued prominence in the global economy" (p. 8). Sustainable development highlights the significance of pursuing skills like critical thinking, understand complex systems, imagining future scenarios, and collaborative decision-making (Restrepo et al. 2017), which is in line with the increasing interest in the development of soft skills not only in institutions of education but also in lifelong learning, social participation, and success of employment.

Soft Skills and Sustainable Development

Defining the Significance of Soft Skills

A progressive definition of soft skills proposed by Kamin (2013) identifies these skills as "interpersonal ones that demonstrate a person's ability to communicate effectively, build relationships with others in one to one interaction as well as in groups and teams. Skills include listening and responding in a receptive way to other's point of view; cooperation, and the ability to be flexible and take positive actions in situations that require understanding of the circumstance, environment and the culture of other person, organization, team. The practice of soft skills aids in communication and promotes problem-solving negotiations, conflict resolution and team building" (p. 12). While Tulgan (2015) argues that soft skills are mostly associated with psychophysical features and social skills with primarily focus on human behavior, attitudes, and lifestyle. Often such skills are included into requirements of qualifications not only for consultants, managers, or sales but also for engineers, IT, or accountants. Soft skills are "character traits, attitudes, and behaviors—rather than technical aptitude or knowledge" (Robles 2012, p. 457). Furthermore, soft skills may be seen as "the intangible, non-technical, personality-specific skills that determine one's strengths as a leader, facilitator, mediator, and negotiator" (ibid.).

It is evident that soft skills became inevitable for effective functioning in various professions. Hernández-March et al. (2009) note that one of the most important aspects for institutions of higher education when designing or redesigning their academic programs is identification of the competences that university graduates should obtain in the education process. These competences should be the ones that "will guarantee life long learning, behavioural abilities that will foster social interaction, as well as specific competences that will ensure adequate entry into the labour market" (p. 2), to name a few. Soft skills are thought to be comparatively easy as they constitute behaviors, are not conceptually difficult, and may be acquired through experience. However, as argued by Chell and Athayde (2011), the successful execution of soft skills is very challenging as it depends on understanding of a particular social context.

As argued by Gibb (2014, p. 456), a variety of sets of soft skills may be used in different contexts for the same purpose – to structure, enable, and enhance personal development, participation in learning, and successful employment. Azim et al. (2010) emphasize the importance of soft skills in project management. They argue that skills in communication, teamwork, leadership, conflict management, negotiations, human resource management, lifelong learning, and similar help to manage complex projects successfully more often than just employing hard skills as people are the driving force in managing the project, performing the work, and influencing the outcomes. Monteiro de Carvalho and Rabechini (2015) also highlight the significance of soft skills in project management especially when dealing with unforeseen issues or uncertainty in risk management during complex project implementation.

Countries, such as the USA, have developed frameworks and guidelines for institutions of higher education in particular fields, e.g., ABET, SDIO, and other, to define, monitor graduates' skills in the curricular. As Nair et al. (2009) note the increasing global mobility for particular professions require acquisition of soft skills for working in multicultural and multinational working environments. ABET (Accreditation Board for Engineering and Technology) grants accreditation to degree programs in engineering, computing, technology, and applied sciences worldwide ensuring that accredited programs develop students' abilities to work in multidisciplinary teams, develop understanding of professional ethical responsibility, provides broad education necessary to understand the possible impact of engineering solutions for society in general as well as in local context, develop the ability for lifelong learning, etc.

In Europe, the Bologna Process defines technical competence and soft skills including the four categories: knowledge related, methodological, personal and social, into the latter (Kohler 2004). While in the UK, the concept of graduateness is favored and includes knowledge, understanding, dispositions, attitudes, and values (Dearing 1997; Glover et al. 2002). UNESCO Declaration for Education for Sustainable Development (2014) emphasize the importance of university educators to be ready to transform themselves, their students and society by fostering knowledge, skills, attitudes, and values essential to teach and develop critical thinking, problem-solving, creativity, collaborative work, and decision-making under uncertainty. In Western Europe, as argued by Lambrechts et al. (2017), higher education has become competence based and competence oriented due to political initiatives on national and international levels as well as integrated competences in policy frameworks. Sustainability competences, defined by Lambrechts et al. (2015), are knowledge, skills, values, and attitudes which could help graduates to overcome complex and multifaceted sustainability issues in society.

Issues of Soft Skills in Sustainable Development

Education, or the transmission, acquisition, creation, and adaptation of knowledge, skills, and values is a key factor of sustainable development (UNESCO 2015). During the last two decades, institutions of higher education (HEI) have developed a number of declarations and initiatives to provide guidelines or frameworks for implementation of sustainable development (SD) into their systems (Lozano et al. 2013) and as Karatzoglou (2013) notes, many of them have been implementing SD in their systems, ranging from regional development to academic leadership commitments including SD in their missions and vision statements, especially European HEI have been leaders in this process.

Lozano et al. (2015) proposed to expand HEI system with the elements such as making SD an integral part of the institutional framework, collaborating with other higher education institutions, encouraging on-campus life experiences, and "Educating-the-Educators" programs (p. 3) as the research of sustainable development in higher education was usually connected to one or several elements of academic system while holistic and systemic thinking approaches should be the core elements for the SD implementation. The current research on SD implementation shows that more and more institutions of higher education are constantly raising their understanding of recognizing their responsibility to pursue sustainability as an integral part of their missions.

Sustainable development has been typically defined as an approach that seeks to balance the environment, society, and economy, although, as Giddings et al. (2002) highlights, it should be perceived as a single entity, though, often the economic part is given priority over the other ones. Rodriguez-Andara et al. (2018) are in line with this point of view and suggest that "educational programs should be tailored to this viewpoint. Decision-makers need the appropriate knowledge, skills and values to address the complexity that holistic sustainability issues imply and this should be done by considering sustainability transversally across the curriculum subjects" (p. 414). Active learning methodologies, when students are involved in their learning process and presented with challenging situations where collaborative and professional skills are the keys for resolution, might be a valuable tool in addressing this problematic issue. Innovations in designing the curriculum as well as active and participatory teaching and learning experiences could be one of the ways of considering education for sustainable development. As Tilbury outlines "often learning is interpreted as the gaining of knowledge, values and theories related to sustainable development but [...] it also refers to learning to ask critical questions; learning to clarify one's own values; learning to envision more positive and sustainable futures; learning to think systemically; learning to respond through applied learning; and, learning to explore the dialectic between tradition and innovation." (2011, p. 8).

Sustainable development as described by Lehmann et al. (2008) represents a complex challenge requiring skillful and multidisciplinary professionals capable of dealing with a number of possible problems. The development of sustainability skills has a direct, positive impact on professional decision-making and, ultimately, on the environment (Rodriguez-Andara et al. 2018). On the other hand, the increasing knowledge of sustainability could influence a personal beliefs, values, and attitudes (Perloff 2016; Tang 2018). As Brunders and Wiek (2017) argue, although there is no doubt that soft skills are one of the successful professional career elements, usually undergraduates pick them up in internships, volunteering or working part-time, but "such opportunities are on their own insufficient to acquire these skills, as on-the-job training often leaves little time for reflection, peer mentoring, and adoption of evidence-supported practices" (p. 2).

Albareda-Tiana et al. (2018) argue that although the concepts of sustainable development and education for sustainable development are used on a daily basis, they are often understood in a "reductionist way, as environmental and economic perspectives are considered separately rather than together [...] and the social aspects of sustainable development [...] are hardly ever taken into account" (p. 474). Despite the popularity of the concepts, sustainability and education for sustainable development are "novel concepts in the higher education system, criteria related to curriculum content linked to the sustainable development goals and adequate educational methodologies for its implementation have been found wanting" (p. 474). Rieckmann (2012) identifies inter- and transdisciplinary competences as the main concepts in education for sustainable development framework as "issues of sustainable development cannot be adequately addressed by a mono-disciplinary approach" (Di Giulio and Defila 2017, p. 631). Transdisciplinary approach could be a value added aspect in solving issues which cannot be solved by monodisciplinary approach. Feng (2012) notes that these competences cannot be acquired neither theoretically nor by "learning by doing" approach, students rather need appropriate spaces for practical experiences and at the same time well-structures reflections of such experiences. Dallaire et al. (2018) highlight the significance of interdisciplinary for sustainable development by arguing that "sustainability has a crucial role in the transition towards sustainability by fostering new leaders, citizens and scientists equipped with the tools required to meet the complex, global challenges faced by society now and in the future." (p. 840). Moreover, the development of inter- and transdisciplinary skills could be seen as one more possibility to increase sustainability literacy in higher education as well as chance to shorten the gap between academia, industry, and public policy.

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Final Remarks

Institutions of higher education have made a significant efforts in implementation of sustainability as well as educating for sustainable development. Yet, transformation is a complex and long-term ambitious task. As Albareda-Tiana et al. (2018) notes, it should start with a paradigm shift in education acknowledging sustainable development agenda calls by not only transforming institutional responsibility but also curriculum reorientation to better fulfil the needs of current and future generations. Adaptation of holistic educational approach accounting for cognitive and affective dimensions of learning could increase the meaningfulness and necessity of soft skills for undergraduates. Institutions of higher education could expand career pathways and soft skills development for students for successful professional career and sustainability. Universities play a crucial role in advancement of sustainable development by creating new knowledge and technologies in this area. Joined efforts of institutions of higher education and educators could lead to changes in attitudes and behavior of current and future generations towards sustainability playing proactive role in education for sustainable development. Students' awareness of how society could benefit from the knowledge they possess could raise their motivation to internalize sustainability as well as contribute to the society's well-being.

Cross-References

▶ Assessment of Sustainability Competencies
▶ Education for Sustainability
▶ Learning Activities for Environmental Education for Sustainable Development
▶ Multidisciplinary Approach to Environmental Problems and Sustainability
▶ Participative Teaching Methods for Sustainable Development
▶ Transdisciplinarity and Sustainable Development
▶ Transformative Learning for Sustainability
▶ Value Creation and Sustainable Development

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Stakeholder Analysis Through Sustainability Issues

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Definition

Stakeholder analysis through sustainability issues may be defined as the means via which different stakeholders perform analyses and appraisals of situations and contexts according to the principles of sustainable development.

Introduction

Sustainability-related challenges represent some of the most complex and interdependent systems of the contemporary world and, therefore, need to be governed at multiple levels and across different space and time scales. The challenges cover a wide range of complex, interconnected and overlapping issues that include: marine governance, climate change, deforestation, desertification, biodiversity loss, urban development or natural resource management. It goes without saying that sustainability is a broad concept, and that there are numerous stakeholders to be identified in the context of sustainability. Whereas some of them may be obvious, there are individuals or groups who are often excluded from decision-making processes, and yet they carry disproportionate environmental, social or economic burdens (Mathur et al. 2007). Therefore, the management of social-ecological systems takes place at multiple levels of decision-making, thereby facilitating the formation and strengthening of relationships among stakeholders for mutual learning (Prell et al. 2007). What is more, the sustainable governance of complex social-ecological systems entails bottom-up rather than top-down approaches to the implementation of sustainable solutions, which requires the involvement of local and regional stakeholders (Hauck et al. 2016).

As might be expected, there are numerous definitions of the term "stakeholder," which reflects the multitude of perspectives and contexts. In his seminal work on stakeholder theory, Freeman has provided the generally accepted definition of "stakeholder" as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (1984: 46). Stakeholders may also be defined as persons, groups, or institutions with interests in a policy, program, or project as well as divided into two groups: primary stakeholders (immediate communities of interest) and secondary ones (intermediaries in the process, including local authorities and other institutional bodies) (Allen and Kilvington 2010). The composition of stakeholder groups is subject to change throughout the participatory process as the interests of stakeholders may be represented by different individuals (Prell et al. 2007). It is noteworthy that embedded in a particular context, the term "stakeholder" may refer to people, communities, neighborhoods, societies, institutions, organizations, or the natural environment (Mathur et al. 2007).

The multidimensional nature and scope of various sustainability-related initiatives underscore the need for cooperation between management agencies and a diverse range of stakeholders to ensure that the process of decision-making for sustainability integrates different forms of knowledge and perspectives (Mathur et al. 2007; Allen and Kilvington 2010). Such a great diversity of actors and sectors involved in sustainability-related issues and driven by their own perceptions, interests, and resources as well as varying expectations from any collaborative initiative (Allen and Kilvington 2010) may result in numerous conflicts regarding natural resource use and environmental conservation, particularly when the same resource is used by stakeholders having divergent values and conflicting interests (Hauck et al. 2016). In order to address these challenges, a number of multiple collaborative approaches have been developed:

- Adaptive management, multilevel governance, community-based natural resource management, network governance, collaborative governance. These approaches entail: collaboration across organizational boundaries between diverse stakeholders, including governmental actors, nongovernmental actors, and/or citizens; better coordination between authorities and more integrated management; a shift from state-centered, hierarchical top-down government towards less formalized bottom-up governance by networks of interdependent stakeholders (Fliervoet et al. 2016).
- Participatory processes and co-management (more inclusive decision-making and policy implementation to boost the legitimacy of recommendations and the social outcomes of management) (Hauck et al. 2016); public participation, local decision-making, and enhanced stakeholder participation; the incorporation of stakeholders' values; stakeholders to monitor and evaluate progress and to negotiate a clear vision (Mathur et al. 2007).
- Shared learning, interactions among stakeholders, institutional diversity, and multiscale governance; community-based conservation (Palomo et al. 2014).

Of course, all of these approaches are so interconnected and complementary that there are significant overlaps between them. The aim of the bullet list is to present a wide array of the concepts related to new modes of sustainability governance and categorized by the above-mentioned authors. In the context of governance and its focus on a bottom-up approach to sustainability issues, it appears to be crucial to identify key actors and stakeholders (Hauck et al. 2016). However, paying inadequate attention to their profile, interests, or characteristics may result in the failure of many conservation initiatives. Therefore, stakeholder analysis, also called actor analysis, has found its way into the process of identifying stakeholders and is now an integral part of many participatory initiatives for natural resource management (Prell et al. 2007; Calvet-Mir et al. 2015).

Taking the above into account, the aim of this entry is to demonstrate the development of stakeholder analysis and its application as well as to underscore both the opportunities and challenges inherent in this complex procedure. To do so, this short overview will focus on how stakeholder analysis has developed over the course of time, with the concept of stakeholder gradually expanding beyond its narrow and instrumental definition to include a wide variety of stakeholders. Next, an attempt will be made to highlight the importance of this type of analysis as used by various stakeholders in multiple settings and of its continued application throughout a given project as well as to present normative and instrumental approaches to conducting stakeholder analysis. Then, this entry will present various stages of, and methods for, performing stakeholder analysis to be selected according to the type of a specific sustainability issue. Particular attention will be given to both the challenges and opportunities inherent in this type of analysis. The former include problem framing, research subjectivity and unreliability, stakeholder categorization, (mis)representation, and influence, as well as the type of their engagement, while the latter tend to emphasize trust and relationship building as well as the capacity to eliminate undue influence over the decision-making process. Finally, this short overview will include lessons learned from various stakeholder analyses and identified by the relevant authors to highlight those areas where improvements should be made to ensure the effectiveness of the complex stakeholder engagement process. As sustainability-related governance challenges share numerous characteristics, it may be safely assumed that the rules for performing stakeholder analysis specified in this entry are applicable across the board.

Stakeholder Analysis in the Context of Sustainability

Development of Stakeholder Analysis

Stakeholder theories have tended to provide us with various definitions of stakeholder, ranging from a narrower and more instrumental definition of stakeholders as those groups or individuals crucial to the existence of diverse organizations to a broader and more normative view of stakeholders as entities affected by their operations, including living and nonliving entities as well as past and future generations (Reed et al. 2009). According to Friedman (1962), the only duty of business managers has consisted in maximizing the profits of company stockholders as the only legitimate stakeholders. Therefore, the field of business management has been primarily using stakeholder analysis to mobilize, neutralize, or defeat stakeholders in order to meet a company's strategic objective and to understand how their perceptions and interests may influence its performance. As a consequence, the business management community has tended to take a relatively static approach to stakeholder analysis, which has resulted in their failure to acknowledge that stakeholders, organizations, interventions, and issues do interact and change over time (Reed et al. 2009). In contrast, within the area of policy, development, and natural resource management, the role of stakeholder analysis has been broadened to include the understanding of power dynamics, to solicit the views of civil society groups, and to empower marginal, underprivileged, and disadvantaged stakeholders to influence decision-making processes (the focus on inclusivity) as well as to gather information on relevant stakeholders to understand their behavior, interests, agendas, and influence on decision-making processes, which has led to the enrichment of its theoretical basis and analytical methods (Reed et al. 2009).

Application

Growing in popularity among a wide range of organizations, stakeholder analysis is used by policy-makers, regulators, governmental and nongovernmental organizations, businesses and the media (Reed et al. 2009). The increasing application of stakeholder analysis in natural resource management reflects a rising awareness that stakeholders can – and should – influence environmental decision-making (Prell et al. 2007). What is more, this type of the analysis appears to be a response to the failure of many past conservation plans caused by paying insufficient attention to the interests and characteristics of stakeholders (Calvet-Mir et al. 2015). It is noteworthy that stakeholder analysis is the first step in establishing the relationships needed for the success of a participatory project or policy, the so-called starting point of any sustainability-related initiative. Not only does it facilitate the assessment of the social environment in which project-initiators will operate but it also helps determine the appropriate type of participation by different stakeholders at successive stages of the project cycle, e.g., informing, consulting, forming partnership (Allen and Kilvington 2010). In other words, the aim of stakeholder analysis is to identify relevant persons or organizations, to design stakeholder participation processes, and to determine the kind of stakeholder to be engaged in them (Hermans et al. 2011). Essential at the beginning of any multi-stakeholder initiative, stakeholder analysis facilitates ongoing assessment of the effectiveness of key relationships and communication strategies (Allen and Kilvington 2010). Starting before the project and lasting at least to its very end as well as serving as the basis for stakeholder management, stakeholder analysis is far from being a one-off activity. Quite the contrary, it is updated whenever new insights become available, including changes in the roles or motivations of relevant stakeholders, in the socioeconomic environment, or due to different modes of work in different project phases. Accommodating such changes requires a continuous openness for different stakeholders' inputs and different ways of involving them (Spangenberg et al. 2018). Approaches to stakeholder analysis have undergone tremendous change, with analytical tools being progressively adapted from business management for use in policy, development, and natural resource management (Reed et al. 2009). Apart from a descriptive approach to stakeholder analysis rarely used for its own sake, the most significant distinction is made between normative and instrumental approaches. While the former approach emphasizes the legitimacy of stakeholder involvement and empowerment in decision-making processes and uses stakeholder analysis to legitimize decisions made through involving key figures and determining their moral responsibility toward others, the latter one (more pragmatic in nature) is largely devoted to understanding how organizations, projects and policy-makers identify, explain, and manage the behavior of stakeholders to achieve desired outcomes (Reed et al. 2009).

Stages and Methods in Stakeholder Analysis

Basically, stakeholder analysis can be described as a process (1) defining aspects of a social and natural phenomenon affected by a decision or action; (2) identifying individuals, groups, and organizations who are affected by or can affect those aspects of the phenomenon, including non-human and nonliving entities and future generations; and (3) prioritizing these individuals and groups for involvement in the decision-making process (Reed et al. 2009). This description is clearly in line with a suggestion made by Prell et al. (2007), according to which it is first necessary to define the aspect(s) of the system, problem (s) or issue(s) under study before the identification of stakeholders as well as to revise the issues in a more iterative process over the course of stakeholder analysis. According to Allen and Kilvington (2010), stakeholder analysis is a three-step process:

- Step 1: Identifying major stakeholder groups. The step performed by an agency directing the analysis with the help of a small group of people to identify individuals, groups, communities, organizations, etc., and then break these stakeholder groups into smaller units (subgroups); stakeholders not usually participating in this process but included later in the process as their interests become apparent.
- Step 2: Determining interests, importance, and influence. Listing key interests for each stakeholder group and asking helpful questions to uncover their interests and expectations regarding a given project.
- Step 3: Establishing strategies for involvement. Planning some strategies for approaching and involving individuals, a group or representatives of the group (Allen and Kilvington 2010).

However, Reed et al. (2009) proposed three phases through which stakeholder analysis may typically proceed:

- First phase: Understanding the context in which stakeholder snalysis is to be conducted; the necessity to identify a clear focus (e.g., issue, organization, or intervention) as well as clear system boundaries for stakeholder analysis; participatory approaches to stakeholder analysis requiring the involvement of stakeholders in the identification of foci and boundaries and necessitating an iterative approach; if a thorough knowledge of the issue at hand already available, participation in stakeholder analysis not necessary (nonparticipatory approaches to stakeholder analysis).
- Second phase: The application of stakeholder analysis methods to perform the following:
  - To identify stakeholders and their stake (focus groups, semi-structured interviews, snowball sampling)
  - To differentiate between and categorize stakeholders (top-down analytical categorization: interest–influence matrices and radical transactiveness as well as bottom-up reconstructive categorization: stakeholder-led stakeholder categorization and Q methodology)
  - To investigate relationships between stakeholders (actor-linkage matrices, social network analysis, knowledge mapping)
- Third phase: Actions. Recommending future activities and stakeholder engagement; stakeholder analysis leading to the design of strategies and processes; feedback loops between stakeholder analysis methods as well as between the analysis of stakeholders and their context (Reed et al. 2009.

There are distinct techniques for the identification of stakeholders: using a generic list (stakeholders as those who affect the project; those who are affected by the project; others who may be interested), asking a set of questions (e.g., Who are the voiceless but affected by the project? Who has the ability to represent the interests of those unable to participate, i.e., future generations, nonhuman entities?), using snowballing technique (already identified stakeholders expressing their opinions regarding who they perceive as being stakeholders in the project), and stakeholder mapping (Mathur et al. 2007). The first three kinds of techniques are primarily oriented towards identifying stakeholders whereas stakeholder mapping, although useful for identifying stakeholders, serves a more strategic purpose in terms of designing and planning their subsequent engagement. In other words, the activity of mapping the stakeholders may start during the early stage of stakeholder identification but continue further into the later stages where appropriate engagement techniques are identified and used (Mathur et al. 2007). The choice of methods depends on the purpose of stakeholder analysis, and the skills and resources available. The methods used may range from the highly technical ones, e.g., social network analysis with its complementary visual and statistical elements (Springer and de Steiguer 2011), to those used expeditiously with little technical expertise or resources (e.g., interest–influence matrices and actor-linkage matrices) (Reed et al. 2009). What is more, participation in stakeholder analysis also spans various levels: from passive consultation (stakeholders simply providing information for the analysis) to active engagement (a two-way exchange of information between stakeholders and analysts as equal partners; with stakeholders helping direct research aims and objectives) (Reed et al. 2009).

Challenges

There are numerous challenges connected with the performance of stakeholder analysis. Defining the aspect(s) of the system, problem(s) or issue (s) under consideration appears to be an important initial step in the process. However, it is rarely considered explicitly in stakeholder analyses partly due to a complicated relation between issue framing and stakeholder identification, i.e., the difficulty to establish whether the phenomenon under investigation should dictate which stakeholders are involved, or whether the reverse is true (Reed et al. 2009). Failure to frame the issue at hand hampers the identification of relevant stakeholders and results in the issues being usually identified in a top-down manner by those leading the stakeholder analysis and shaping it in accordance with their interests and biases (Prell et al. 2007). It is also important to ensure that a sample of organizations or individuals from each category represents the overall stakeholder population. Another challenge is linked to a stakeholder-derived stakeholder categorization which may fail to adequately distinguish distinct categories as there are diverse perceptions about how each stakeholder should be selected, classified, and assigned to different subgroups (Reed et al. 2009). Identifying and involving relevant stakeholders for participatory processes may also cause difficulties because certain stakeholder groups have been historically marginalized from management decisions. Then, a lack of representativeness may become an obstacle in participatory processes as they tend to focus on small groups for in-depth deliberation and mutual learning. Stakeholders are often misrepresented in the course of stakeholder analysis as the process of their identification and categorization is carried out through a subjective assessment of their relative power, influence, and legitimacy. What is more, the methods used for stakeholder analysis tend to overlook the role communication networks may play in categorizing and understanding stakeholder relationships (Prell et al. 2009), so failure to perform a systematic process of identification and mapping of stakeholders could result in the selection of inappropriate techniques for engagement (Mathur et al. 2007). However, even if central actors are located according to the frequency of their communication, the analysis runs the risk of potentially overlooking how some stakeholders might derive their influence from sources other than their communication roles in the network. For example, statutory bodies may not appear as very central in the network, but have, nonetheless, considerable influence over the ways policies are designed and implemented (Prell et al. 2007). Furthermore, any preexisting conflicts between different groups may prevent individuals from joining deliberative processes (Prell et al. 2007). It is often claimed that involving multiple stakeholders may be counterproductive on the grounds that it may generate conflicts and slow down the implementation of a given project (Vogler et al. 2017). In general, stakeholder analysis is criticized as often done on an ad hoc basis and lacking in analytic quality and academic rigor – a situation further exacerbated by considerable confusion over the very concept and its practice (Reed et al. 2009; Lienert et al. 2013). There exist serious doubts regarding the question of research objectivity as those who undertake the analysis may do so from a particular perspective or with particular outcomes in mind. Additionally, the credibility of stakeholder analysis as a stage in participatory processes is further undermined by the perceived lack of knowledge, skills, or resources to perform the analysis, concerns over derived results, and fears that it may lead to destabilization or manipulation, as well as some ethical concerns about representing the views of other people (Reed et al. 2009). While participatory approaches to stakeholder analysis tend to generate high costs in terms of researcher and stakeholder time, they have the capacity to build trust and relationships, and to uncover potential biases (Reed et al. 2009). Although the integration of conflicting and diverse agendas in the context of sustainability has added to the complexity and difficulty of the whole governance process, the absence of stakeholder analysis may result in particularly powerful and well-connected stakeholders having undue influence over the decision-making process (Reed et al. 2009).

Lessons Learned

Performing stakeholder analysis entails looking at both the stakeholders and the relationship between them and the project. Regardless of whether they are quite specific and geographically identifiable groups of individuals or a more amorphous entity (e.g., a community), the management of these relationships is a time-consuming and skill-based process which requires a creative approach to the following collaborative processes (Allen and Kilvington 2010):

- Constructive discussion and planning: multiple stakeholders learning about each other, overcoming differences, and speaking the same language; resolving problems and disagreements; managing conflicts by facilitators

- Face-to-face negotiations allowing different parties to more fully explore the issues and collectively come up with solutions that work; being involved in the development of a solution increasing the likelihood of active participation by relevant stakeholders
- Ecological objectives not to be considered in isolation from community social and economic needs; these social and economic needs to be identified with local involvement; considering all the issues raised in these discussions
- Monitoring and evaluating the nature of the collaboration, which is as important as measuring specific policy or project outcomes
- Research and quality standards on stakeholder assessment and management (Allen and Kilvington 2010)

When performing stakeholder analysis, the definition of stakeholders should cover not only individuals with power to influence but also a wider range of individuals and groups, including those having little or no influence on a given project (the powerless ones) but possessing different knowledge sources, e.g., experimental or scientific knowledge, experiential or local ecological knowledge, common sense, knowledge gained through experience, moral and normative values based on individuals' perceptions (Mathur et al. 2007; Palomo et al. 2014). Including nonstate actors, members of the public or organized stakeholders as well as the so-called hidden stakeholders (those whose livelihoods depend on the use of a natural resource, but whose participation in public stakeholder decisions is not normally considered at any stage of natural resource management and biodiversity conservation) may result in the adoption of legitimate solutions, reduce potential conflicts between different stakeholders, and provide varied information, as well as neutralize powerful interests (Calvet-Mir et al. 2015; Vogler et al. 2017). As the wide range of participatory and non-participatory methods used for stakeholder analysis pose various challenges and limitations, some new tools and combinations of methods (e.g., classical social network analysis with a qualitative analysis of stakeholder knowledge) are needed to more effectively identify and categorize stakeholders as well as to help understand their interrelationships (Reed et al. 2009; Hauck et al. 2016). The importance of combining various methods within the framework of stakeholder analysis cannot be overestimated as it may overcome various weaknesses related to stakeholder analysis which – if performed in isolation – may lead to simplistic decisions about stakeholder involvement in sustainability-related governance issues (Prell et al. 2007). To cite a few examples, it is recommended that stakeholder analysis be combined with social network analysis (SNA), and the interests and influence of each stakeholder be treated more qualitatively. As for the former suggestion, SNA is a systematic and quantitative analysis of the relationships among actors. Thanks to its rigorous approach, one may address research questions that cannot be analyzed in adequate depth by stakeholder analysis, and then incorporate the insights from SNA into stakeholder analysis. The combination of stakeholder analysis and SNA can help identify stakeholder groups, prevent the marginalization of key groups, and specify representatives that are well connected with and respected by the groups they represent. This is done by identifying which individuals and categories of stakeholder play more central roles, which ones are more peripheral, and by gaining an overall understanding of the shape of a given network. Such information is also crucial for natural resource management initiatives that aim to influence the behavior of stakeholder groups through key players. However, it is noteworthy that while SNA brings precision and a deeper understanding of social relations among stakeholders, it may lead to simplistic decisions about stakeholder involvement in natural resource management if used in isolation from other data (Prell et al. 2007; Calvet-Mir et al. 2015). As regards the interest–influence matrices presenting quantitative information about the interests and influence of different stakeholders, they need to be complemented by information about stakeholder relationships and suggestions about how best to get each stakeholder group involved, i.e., qualitative information about why different stakeholders have a particular interest (and specifically the nature of the interest), and why certain stakeholders have more influence than others (and in what contexts). The data gathered in this way is likely to be more useful and replicable since it is possible to extend such matrices by adding various questions and make them more flexible to accommodate numerous case-specific needs (Reed et al. 2009). In sum, stakeholder analysis may be improved by the incorporation of systemic methodologies and social actor approaches (Lienert et al. 2013). Therefore, stakeholder analysis should be complemented by various methods of analyzing stakeholder interests and performed in parallel with other techniques, including those involving multiple criteria as well as addressing policy disputes in the case of conflicting objectives (Lienert et al. 2013). Taking into account the fact that many practitioners lack the time to include stakeholder analysis in their sustainability-related governance processes, it appears to be of paramount importance to develop tools that can streamline stakeholder analysis methods, thereby making them more widely and easily accessible (Reed et al. 2009). In order to capture the multifaceted nature of sustainability-related challenges and the diversity of perspectives on sustainability, it is necessary to combine scientific assessment tools with democratic participation methods (Mathur et al. 2007). What is more, it is also strongly recommended that there be on-going and evolving involvement of stakeholders beyond stakeholder analysis, at every stage of the project cycle, which corresponds to the dynamic nature of stakeholder priorities and interests that need to be captured throughout the duration of the project and even beyond that (Reed et al. 2009).

Final Remarks

In the context of sustainability-related challenges, the process of identifying and categorizing stakeholders as well as investigating relationships between them is facilitated through stakeholder analysis, however imperfect or arduous it may seem. The aim of this brief overview has been to embed the analysis in the context of sustainability challenges, to trace its development, and to present the ways in which such an analysis may be performed. However, it is noteworthy that the list of the stakeholder analysis methods presented here is by no means exhaustive. The ultimate selection of relevant techniques should depend on the nature of a given sustainability challenge since it entails the engagement of stakeholders in projects characterized by issue-specific, system-bound, and context-dependent properties (Mathur et al. 2007). While stakeholder analysis needs to be combined with other methods to be effective and relevant, it should be part and parcel of every stakeholder engagement process. If performed in a systematic, critical and sensitive manner, stakeholder analysis may facilitate our understanding about the identity of those having a stake in an initiative, and about the nature of their claims and inter-relationships with each other, which may result in the effective involvement of appropriate stakeholders in environmental decision-making (Reed et al. 2009). Future stakeholder analysis research needs to investigate the potential for combining existing methods to get more useful results, which would enable more sophisticated categorization and provide information about important “knowledge brokers” to be prioritized for involvement in participatory processes (Reed et al. 2009).

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Stakeholder Mapping and Sustainable Development

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Definition

Stakeholder mapping is a visualization tool used to understand relevant parties in a system or affected by a social issue. Sustainable development refers to improvements in systems that positively impact the trajectory of humans' environmental impact. The two are intertwined because sustainable development is more effective when solutions reflect the needs and concerns of stakeholders.

Introduction

When approaching the topic of sustainable development, it is easy to be overwhelmed by the broadness of the concept, unable to navigate where to start thinking about how to enact it. One reason for this is that the definition is not always the same, and sustainability itself takes on so many different meanings in different contexts. One strategy to breaking down the complex idea of sustainable development is to identify who it affects, and who has the ability to spark a movement toward positive change. This is the main idea behind stakeholder engagement. It is identifying and collaborating with all relevant parties involved in an issue, and its goal is to introduce a wider range of perspectives to research and potential solutions by empowering those who are part of the affected system (Bell et al. 2012). Doing this enhances efforts to think beyond embedded economic principles that perpetuate unsustainable behaviors. While the concept of community voice is quite popular in social science research, there are some important problems with this approach. It is difficult to organize and sustain participation, and to transfer expert knowledge when implementing a solution for a lasting impact. However, it is still important in understanding systems, and can be used effectively to understand sustainability's hurdles in a community.

Stakeholder Engagement

Many societal issues are tackled with a top-down approach. Either academics choose a field of research to explore, policymakers see a diluted problem and attempt to fix it with one sweeping solution, or businesses make quick fixes to avoid public relations issues and continue operations. However, many of the issue areas identified by those in power do not reflect the concerns of the affected community (Cvitanovic et al. 2016). This fact is the cornerstone of the idea of stakeholder engagement. Creating effective policy as well as effectively understanding complex societal issues requires not only buy-in from, but the actual influence of stakeholders. Stakeholders are those who affect or are affected by an issue. They include people and institutions from all sectors and levels of wealth, and it is important to break down these parties' interests and how they interact with problems overall, in policy, and with each other (Venkatesan 2019).

Stakeholder engagement deals not only with breaking down problems in context of the community that they are relevant in, but also in creating solutions that would be reasonably implemented by that community. To do this effectively, incentives of relevant stakeholders must be apparent and solutions must address them – there must be multiple solutions and not a reliance on a singular, sweeping innovation (Parnphumeesup and Kerr 2011). Currently, the most popular method of people in power to understand stakeholders and their behaviors is to include them in research in participation. In theory, this is a simple idea, but in practice, introduces even more complex questions in getting to the bottom of social problems including those that concern the environment and resource usage.

Stakeholder Participation

Wider participation in research efforts is often viewed as positive due to the increased number of opinions and views outside of the specific interests or expertise of researchers, however, it is more complex a concept than it may seem. Group participation is often viewed as a method to integrate the members of populations that are being researched, serving to intertwine expertise and experience (Sedlacko et al. 2014). The purpose is to remove elitism from the research methods of social scientists, introducing joint ownership and spreading out the power over a certain issue among relevant parties. It is a popular concept when attempting to understand sustainable development and particularly natural resource management in a population. Principle 10 of the 1992 Rio Declaration of Environment and Development identified participation as necessary in impact assessment, understanding, and decision-making (Bell et al. 2012). Sustainable development has long considered participation as a method of research, creating case studies on its usage and effects on research and program development. One conclusion from this research and these considerations is that each project must decide what kinds of outcomes they are looking for.

Desired outcomes can be difficult to determine when engaging in stakeholder participation because the research itself is dependent on individuals, who have inherent biases. Researchers must strike a balance between knowing what they are looking for and being open to the responses of the community (Ruiz-Frau et al. 2011). Stakeholder participation can introduce a level of authenticity, possibly identifying issues and levers of change that researchers would not traditionally find. However, qualifying responses of community members is a nuanced process. Finding, sustaining, quantifying, and justifying responses are necessary in upholding the objectivity of research, but extracting this from an individual's complex life experiences is nearly impossible to do effectively (Sedlacko et al. 2014). At this point, the research would default to an expert to make judgments about the data collected from participants, which adds yet another level of internalized conscious and unconscious biases to the landscape.

When outcomes are determined, they can potentially account for biases and nuance by being flexible and having contingency plans. Managing these plans and the research methods is another challenge of stakeholder participation. Populations, especially those who are affected most by complex societal issues, are often transient. Consistency in data collection is not necessarily a reality of stakeholder engagement, and knowing the signs of which community members are at risk of leaving or halting their engagement in research is another layer of management itself. Furthermore, reasons for transition could be relevant to study in the community (Suárez-Eiroa et al. 2019).

It is clear that creating an effective system for stakeholder participation is extremely complex. The underlying issue of this research method is understanding which aspects of a stakeholder's experience are relevant to the issue at hand. The reality that social problems are a result of inefficient and inequitable integrated systems results in the need for informed decision-making, and basis for doing so. This way, the facilitation of knowledge brokerage can be evaluated based on predetermined assumptions of the community, and judged against a flexible framework, ultimately influencing initiatives for social improvement (Bell and Morse 2011).

Stakeholder and Systems Mapping

One way of thinking about complex societal issues is through the systems that perpetuate them. Systems thinking was developed from several engineering theories (Senge 1990) as a framework for holistic thinking and understanding the drivers of dynamics in systems. An early user of systems thinking in the context of natural resource management and sustainable consumption was Limits to Growth (Meadows et al. 1972). This approach to analysis is connected to a tool called systems mapping. Systems mapping uses causal loop diagrams to understand where knowledge transfer occurs, and what aspects of a system affect the different stakeholders involved (See Fig. 1). Causal loop diagrams not only show the ways in which different institutions and individuals are related, but also the correlation of their relationship (i.e., if someone has better education, they are likely to have higher income, which is a positive correlation). Ultimately, they paint a picture of the incentives, resources, and constraints that regulate human behavior (Sedlacko et al. 2014).

An important limitation to causal loop diagrams is that they are snapshots of a system at certain times, so the assumptions made when building them must be explicit. However, their structure is well-equipped to handle adjustments based on its integrated nature. They are a coping mechanism to humans' inability to understand and break down complexity, and can drive research in a productive direction. For example, sustainable consumption was identified as a major driver of sustainable development in the Brundtland report. To effectively use stakeholder participation for engagement, the researchers used systems mapping to synthesize individual consumption patterns to expose the systemic aspects of consumption. The model identified areas in which consumption could be made more efficient by attempting to change behaviors (Sedlacko et al. 2014).

Approaches to enacting behavioral changes are highly contested, which is in line with systems thinking and stakeholder engagement because behaviors, motivation, and resources are not the same across all stakeholders. For example, the study found that more affluent individuals tended to respond more to policy that incentivized sustainable consumption (Sedlacko et al. 2014). It is expected that wealthier individuals have more elastic demand, and they are likely to have more options so they can consume differently without reduction. However, without approaching this from a systems perspective, researchers would not have reached conclusions about how these consumption patterns influence nations, and their connection to economic growth. Ecological economics sometimes seeks the possibility of win-win situations in which economic growth is not stifled by the introduction of sustainability (Bell et al. 2012). In this circumstance, this was found to be true among wealthier nations where the transaction costs of changing their consumption patterns are lower based on their access to alternatives.

Without understanding consumption as part of an overall societal system, the consumption patterns and behaviors of individuals or certain stakeholder groups could be viewed as fragmented, or attributed to a plethora of sources. While there are likely many other motivations influencing consumption patterns or incentivizing changes in them, a systems map can help to control those for a clearer picture (Bell et al. 2012). Below is a general example of a causal loop diagram and systems map, and an example considering transportation. Again, it is imperative to be selective in the criteria and to keep in mind that it captures one specific moment in time for a specific use case.

Other Frameworks

As previously mentioned, context is imperative to useful stakeholder engagement. One example of a framework that was used to evaluate the

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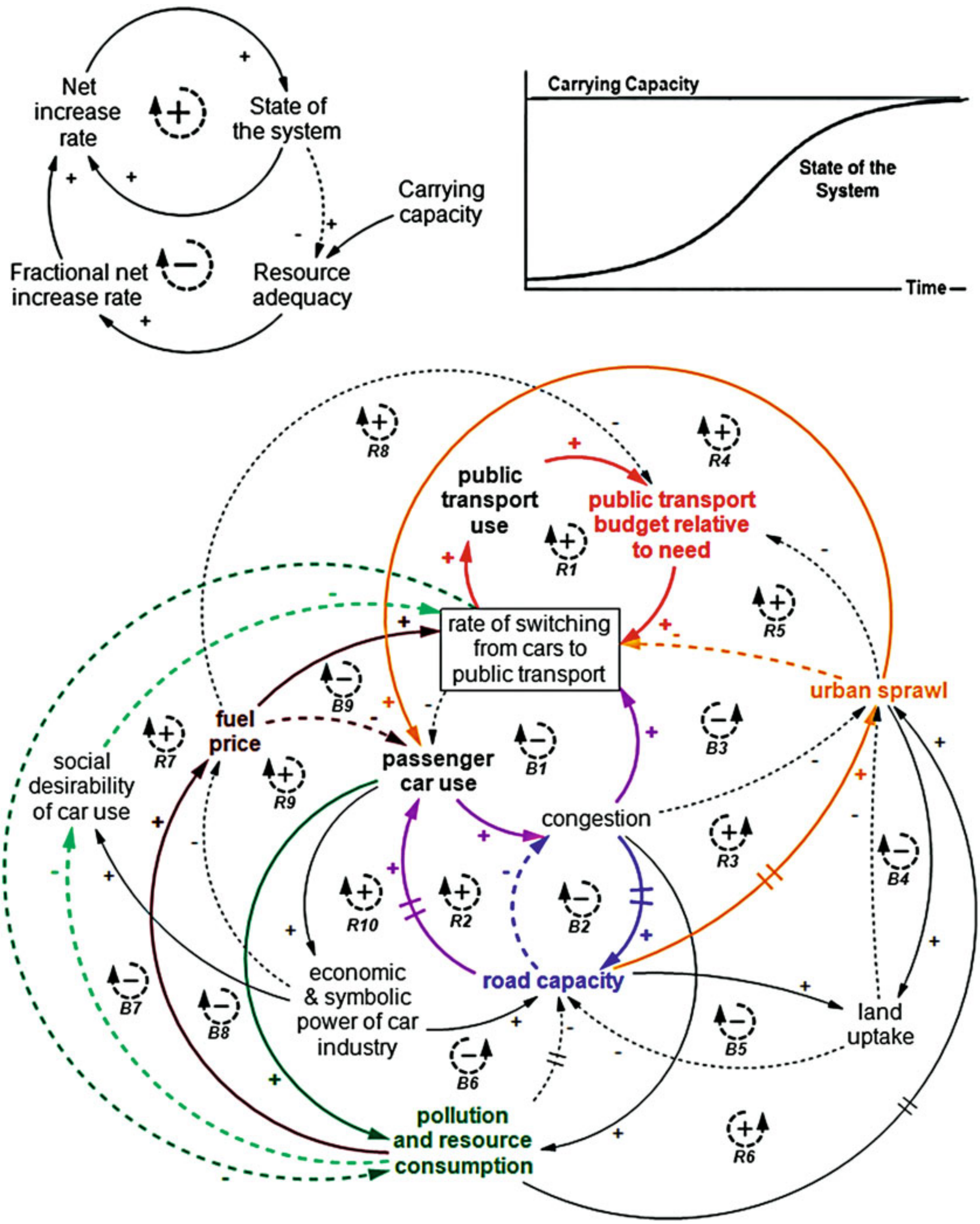

Stakeholder Mapping and Sustainable Development, Fig. 1 Systems mapping, causal loop diagram at a point in time

efficacy of environmental and sustainability policy is the European Union Framework Seven project, POINT. POINT sought to understand the policy influence of indicators. The use case for indicators is to benchmark certain policies against the movement of previously determined factors. It began in 2008 to specifically understand indicators' use and influence on sustainable development policies. Indicators can be specific to certain sectors, or they can cover many and act as a composite, like the ecological footprint. In addition to policy, the various indicators aided in the created environmental impact reports. POINT was built on research, first evaluating the validity, robustness, and relevance of indicators, then its user factors, or its relation to stakeholders (Frederiksen and Gudmundsson 2013). User factors accounted for stakeholders' behaviors and whether the identified indicators had an impact on them. The results of POINT are under continuous scrutiny as it is difficult to understand if the indicators were the correct ones to analyze policy. There have been some suggested adjustments to POINT to better incorporate stakeholders (Bell et al. 2012).

One approach to more effective stakeholder participation is Triple Task. Its three-pronged approach seeks to fill gaps in participatory literature. It starts with research questions such as "What has been done?", "By whom?", and "How is its effectiveness assessed?", providing insights. The second and third tasks coincide with the first tasks but focus on the functions of groups and how they influence indicators. Task 2 is external and conducted by researchers observing group dynamics, using a matrix approach known as BECM and developed by Open University. Task 3 uses the Symlog (System for the Multiple Level Observation of Groups) methodology. Finally, Triple Task links the outputs of Task 1 with 2 and 3, which can be a more subjective, qualitative exercise, but seeks to the set of criteria that can be used to assess groups in the context of indicators (Bell et al. 2012).

BECM and Symlog, used in Triple Task, are useful frameworks for understanding participation and stakeholder engagement in themselves. BECM is a systems approach that stands for being, engaging, contextualizing, and managing. It can be used to break down complex environments and make meaningful observations of communities. "Being" refers to an experience, or existing as a stakeholder in the given system. "Engaging" looks at the specific situation at hand and the stakeholder's place in it. Then, the situation and stakeholder are put into context so it can be effectively managed (Bell and Morse 2011). This approach isolates a situation, similar to systems mapping, and acknowledges the importance of context in determining an effective approach to a problem or to draw reasonable conclusions for research.

Symlog was developed by the Psychology and Social Relationships Department of Harvard University to understand and evaluate leadership, group dynamics, and team performance. It uses 26 descriptive items to assess effectiveness, using surveying as the main tool. There are two levels: individual and organizational values and interpersonal behaviors. The assessment is compared against over 1 million profiles from across the world (Blumberg 2006). Symlog is effective in the context of Triple Task because it is evaluated against BECM and other situation-specific research. Combined, these tools are useful in not only determining the influence of indicators, but for setting up a framework for performance improvement.

Stakeholder Preference in Sustainable Development

While stakeholder engagement and participation study the way different stakeholders interact with systems that affect sustainable development projects and attempt to capture their experiences, there is still a human element lacking. Even with research pointing toward a certain solution, there are not only cultural but livelihood factors, and simply educating people is not always enough (Cvitanovic et al. 2016). As previously mentioned, understanding incentive structures of different players in a certain system is essential achieving stakeholder buy-in and implementing effective sustainable development policies and programs. So, the concept of stakeholder preference is critical to consider. Not all stakeholders are equal in the extent to which they are affected by a problem, their influence over the community, and the resources that are available to them.

One study looked at the impact of clean development mechanism (CDM) projects in rice husk farming. A quantitative analysis by researchers and scientists revealed that the usage of renewable energy sources would most effectively promote clean development in rice husk farming. Despite the science behind this, engagement with stakeholders, in this case the farmers, revealed that this was not a priority of theirs. The CDM project did not positively affect their revenues, which are their livelihoods, so they would choose not to engage (Parnphumeesup and Kerr 2011). Unfortunately, engagement with sustainable development projects is a privilege that many cannot afford. The market system has promoted the ideal that people must act in their personal best interest before considering the goodwill of society overall. Here, sustainable development would have lowered production, revenue, and quality of life in the present, but the lack of sustainable development will hinder generations to come exponentially more than the sacrifices required today.

Another study sought to understand stakeholders in marine ecosystems and how their values would be reflected in sustainable development initiatives. The purpose of the study was to incorporate the community into management plans for the ecosystem. The stakeholders chosen for the study held a wide range of interests in the management of the coast. However, looking at the values that they attached to those interests, there were relatively few categories represented, and ultimately, the study showed that for efficacy, scientists and policymakers must balance conservation efforts with societal implications (Ruiz-Frau et al. 2011). This study, like the rice husk farmers, reveals the shortcomings of neoclassical economics in incentivizing behavioral changes in various stakeholders (Venkatesan 2019). Including various groups in research and potential solutions to ecological issues reveals the limitations of human systems in the context of the environment for high level researchers, but does not instill any sense of urgency in the community.

The Role of Economics

The introduction of stakeholders to research processes, solution development, and implementation naturally allows the collision of many disciplines. It helps those with power understand the relationships between ecosystems and economies, and how various groups interact with each other and these systems across society as well as how policies affect these connections. Mapping tools aid in illustrating the widespread institutionalization of ideas that hinder initiatives and goals of sustainable development (Sedlacko et al. 2014). Some of these ideas include the assumptions of neoclassical economics that have become intertwined with individual's bounded rationality, and how policies affect groups in varying and unequal ways. Regardless of the specifics of a situation, whether the goal is for conservation, renewable energy usage, or other, what stakeholder engagement will ultimately reveal is the limitation of human systems (Venkatesan 2019).

Neoclassical economics promotes utility and profit maximization of individuals and firms without considering the long-term effects of their actions, including the depletion of natural resources. Players in the economy internalize these principles and their participation in economic systems becomes passive, accepting economic evolution without the consideration of important externalities. Attempts at regulating externalities such as the Clean Air Act are still only optimizing in the short term without consideration of the next round of resource usage. Neoclassical behaviors have become so engrained in society that other economic systems are unable to gain traction and have become subdisciplines rather than being integrated into neoclassical thought (Venkatesan 2019). Stakeholder engagement is ecological economics' attempt at achieving some influence over thought by understanding the incentive structures and values at play.

One interesting initiative investigates the concept of a circular economy, a system that seeks to keep resources in the economy for as long as possible. It arose from the thought that a linear production model is not plausible if society is to become sustainable. A circular economy fulfills the criteria of employing thought that is contrary to neoclassical theory, but it does not necessarily include social goals. However, if it is to be used in the context of sustainable development, it is not exempt from social responsibility, nor should it ignore the potential social benefits and negative externalities it could produce (Suárez-Eiroa et al. 2019). While this notion is complex in its inception, bringing it from an idea into action is even more so. It requires intentional design and education for different levels of implementation across stakeholders, and it will face a similar challenge to most other sustainable development initiatives in incentivizing buy-in (Parnphumeesup and Kerr 2011).

Conclusion

Stakeholder engagement can be a useful tool in researching and understanding issues of ecological importance, given that it introduces various disciplines and perspectives that are not traditionally considered. Those interested in pursuing stakeholder engagement in the context of sustainable development must consider the goals and desired outcomes of initiatives, while allowing for flexibility to account for the findings based on participation. Additionally, the motives and priorities of stakeholders must be considered when designing solutions, given that individuals and firms operate primarily based on neoclassical economic principles. Ultimately, increased participation should aim to understand how to effectively influence behaviors to influence the scope of economic thought in society. Behaviors reflect values, and if values are built around sustainable thought, then successful stakeholder engagement has been achieved.

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Story

► Storytelling for Sustainable Development

Story Spine

► Storytelling for Sustainable Development

Storytelling

► Arts-Based Approaches for Sustainability

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Synonyms

Cultural knowledge sharing; Folklore; Legend; Myth; Narrative; Narrative inquiry; Pedagogic tool; Story; Story spine

Definition

Storytelling is the performance of fictional or nonfictional narratives which have an educational, inquiry, or sense-making intentionality. The performance of storytelling is ubiquitous and omnipresent, told and retold through anecdotes and life histories in conversations, as well as enshrined on stage in epic myths and legends. Within the context of sustainability and sustainable development, the intentionality of storytelling relates specifically to the Earth, its coinhabitants, and their relationality, as well as the temporal tensions or dangers of each of these dimensions (i.e., between the "here and now" and "the future") (also see chapters on ► "Dimensions of Sustainability in Higher Education").

Introduction

The use of stories in higher education crosses a number of sustainable development dimensions, including the relationships between humans and the environment, but also for healing and well-being purposes. Although "story" is often used synonymously with the terms "narrative" or "narrative inquiry," others view the notion of "story" as having a special structure and utility (as will be discussed below) (e.g., Gabriel 2000; Denning 2011). Moon (2010: i) explains that stories are omnipresent in daily life, and can include "narrative, case study, life history, myth, anecdote, legend, scenario, illustration or example, storytelling and/or critical incident" and can be "'told' in many ways – spoken, written, filmed, mimed, acted, presented as cartoons and/or as new media formats." In relation to sustainable development, Okri (1996) describes the role of the story as being vital to maintaining collective health: "A people are as healthy and confident as the stories they tell themselves. Sick storytellers can make nations sick. Without stories we would go mad." Similarly, Gersie (1992) argues that storytelling inherently considers our current concerns about the Earth and the future, as it formats our "understanding [of] the many ways in which we value and devalue our beautiful green and blue planet... [the] practical insight into approaches to our most persistent environmental difficulties" (Gersie 1992: 1). As such, storytelling in the context of sustainable development is recognized as having a deeply *educational* function, "passing on accumulated knowledge and traditions of culture" (Stevenson 2002: 187) in ways which allow for a greater "stickiness" because "stories allow a person to feel, and see, the information, as well as factually understand it . . . you 'hear' the information factually, visually and emotionally" (Neuhauser 1993: 4).

However, stories also embody an *inquiry* function, "construct[ing] new understandings and knowledge of educational practice" which when narrated "provide a source of ideas and insights... creating more sustainable forms of living" (Stevenson 2002: 187). Indeed, story can be understood as a form of knowledge which promotes "the integration of different knowledge systems... human connectedness with nature and with each other; and distributed power through participatory democracy" (Stevenson 2002: 187). In these ways, story and storytelling therefore have poignant *sense-making* functionalities at the individual, organizational, and societal levels (Moon 2010). Evans and Evans (1989) conceptualize these as three key cognitive functions: (i) concretizing abstract and complex ideas and knowledge, (ii) assimilation of knowledge and ideas, and (iii) structurizing the world. As such, the impact of stories goes beyond entertainment and can be used as a fundamental pedagogic tool for learning about sustainability and sustainable development (Wall and Rossetti 2013).

Dimensions of Stories

In the context of higher education, stories can be utilized to generate awareness of sustainable development issues, make sense of own positions in relation to their own histories, and do so in ways which pay close attention to positive psychological states (Wall and Rossetti 2013). In the context of environmental education, De Young and Munroe argue that "stories serve as a singularly effective replacement for direct experience" (1996: 171), which can be even more effective than experiential approaches to learning. There are two key dimensions of story in the context of sustainability and sustainable development: the first relates to the common structural aspects of story, and the second relates to the broader qualities embedded within the stories which shape their impact.

The first of these dimensions, the common structural aspects of story design, can be found in any traditional tale, and contemporaneously in plays and improvisation as well as in films. The "story spine" is a useful framework for story design which is deployed by Pixar (Pixar Animation Studios) the computer animation film studio in the United States (Haven 2014). These structural aspects include (Wall and Rossetti 2013: 96):

Context – Plot structures typically involve a *beginning*, *middle*, and *end*. The beginning point is typically starting with an everyday, familiar *context*, which is subsequently interrupted or challenged (the next element). This is usually represented with "*once upon a time. . ..*"

Change or Conflict – The everyday is then interrupted, and can be represented with "*but then one day. . ..*" This may be then supplemented by a *narrative*, which deepens the emotional impact of the change or conflict with a greater level of explanation, interpretation, or exploration.

Climax or Turning Point – This then leads to the moment of *choice* or decision, or arrival of a catalyst for change, which may be embodied in characters or situational events.

A Consequence – This is a result of the turning point "*and because of that*," which may also be a conclusion or resolution. This may then be followed by a summary or moral of the story, such as a call to action. Therapeutic or pedagogic stories invariably employ *resolutions* rather than merely a logical or historical conclusion, which ensures differences are resolved, learning is acquired, and any emotional tension from the listener or reader is released.

Character(s) – Throughout each element of stories and storytelling, characters act out the story. Such characters are often archetypes (such as the Hero, the Villain, the Maiden, the Crone, or the Stranger), which embody universal values; and experiential challenges such as the demonstration of courage or loyalty which are universal.

These aspects can be tracked in a storytelling performance by Kathy Jetnil-Kijiner, a Marshallese teacher, poet, and founder of the environmental NGO, Jo-jikum, who performed a poem at the UN Climate Leaders Summit in 2014 (see online here https://www.kathyjetnilkijiner.com/united-nations-climate-summit-opening-ceremony-my-poem-to-my-daughter/). Kathy Jetnil-Kijiner's poem, "Dear Matafele Peinem," was written to her 7-month-old daughter, explaining how the landscapes and communities around her have been traumatized by climate change (context/problem) because of greedy corporations (characters/villains) – but that she, as her mother, will take a stand (choice/climax/turning point) to change things before she grows. The mother, as leader and hero (character/hero), chooses to mobilize others to tackle the trauma of climate change (resolution). The performance received a standing ovation at the Summit and continues to stand as a contemporary use of storytelling for sustainable development. In this way, the impact of a story is shaped by all of the story spine aspects, especially in relation to emotional investment, the engagement in the challenge or conflict, and the embedding of learning from the resolution.

However, how effectual stories are in shaping change with respect to environmental education is also linked to the particular sustainable development topic, prior knowledge of this issue, the interestingness of it, and how attention-grabbing the story is (De Young and Munroe 1996). For example, it might be possible that "Dear Matafele Peinem" may not have the emotional connection and charge for people who do not currently have or are currently indifferent to having children and who are unaware or emotionally indifferent to the specific context of the Marshall Islands. In these contexts, a story more reflective of the circumstances of a busy city life might generate a different appeal for a different audience. For example, "iBusy" is a metaphoric story of an anthropogenic mobile phone losing charge and desperately seeking energy (Wall and Rossetti 2013). Here, the story has a number of messages related to sustainable development including energy usage, social isolation, and workplace stress:

iBusy

> I am active 100% of the time. And my battery is like a yo-yo; up and down all day.
> I awaken with my battery at 100%. I start to feed on the constant stream of emails as I hear the gurgle of mouth wash being consumed in the bathroom.
> I answer the first 100 emails with lightning speed. I hardly notice I've done it; I'm so efficient. The digital 'swoosh' sound fills me with intense pleasure and satisfaction that I have answered a question or solved a problem.
> By the time we get to the office I am hot; I've already earned my keep.
> I am on my toes every second. My battery is taking a beating.
> By midday, I need my juice. I am at 20%. We are anxious that my battery is dying. I could shut off at any second.
> We seek out sockets; looking round corners, looking under tables, asking everyone we see where the nearest socket is.
> By the time we find a socket, I'm desperate; I'm chugging along like a steam engine. I'm no longer high performance. No longer shiny, but sweating like a pig.
> I take slow sips of juice. I rejuvenate, slowly. Very slowly.
> As I rest on the desk, I slow down. I see life from a different angle. I see the flowers on the desk. I smell them. I feel the breeze from the window on my side. Ever so slight. But I feel it.
> I see the smiles and cheeky winks that my colleagues throw at each other. I see playfulness. I see happiness. I am still getting the emails, but I feel different things in them. I sense anxiety of the senders; one word answers do not satisfy their thirst for information. I sense gratitude in others; when problems have been solved. I feel alive.
> The race starts again when I hit 70%; enough to meet the torment of the email life. . .
> By night, I hit 1%.
> I'm tired again. I'm so very tired.
> I use that 1% to remind myself of the flowers on the desk. The breeze. The smiles and cheeky winks. I reminisce of that beautiful state where I can enjoy small moments in my hectic life. Small moments, but powerfully uplifting and energising.
> As I appreciate my life, I drift and finally allow myself to shut off. I drift into 0%.

Considerations about the wider context of stories extend beyond the structural aspects of a story, and point to the second dimension of stories, that is, the broader qualities of the story. These broader qualities offer additional insight into understanding how stories generate emotional impact, and include the following (De Young and Munroe 1996; Wall and Rossetti 2013):

Coherence – This is the extent to which the information presented in a story sits or hangs together so that the audience of the story can see how the different parts connect. As De Young and Munroe (1996: 180) find, "understanding is significantly aided by arranging actions towards a particular goal, thus allowing the reader to put the actions together in a meaningful way". In "Dear Matafele Peinem," there was a clear progression from the anxiety of the climate change experiences through to collective mobilization for resolution.

Character(s)/actor(s) – As outlined in the story spine above, stories and storytelling embody characters/actors which bring a story alive. Characters/actors which create greater impact are those which the audience can care about, identify with, and can track throughout the story (De Young and Munroe 1996). In "Dear Matafele Peinem," for example, the depiction of the mother and daughter as people with a deep love for the planet and its coinhabitants, resonated with the audience and many dimensions of the sustainable development agenda.

Imageability – The use of imagery in stories and storytelling helps the audience to conceptualize and visualize all elements and aspects of the story, for example, the context of the story, the nature and significance of the problem as well as its resolution, and the characters. In "Dear Matafele Peinem," there was strong use of imagery in, for example, the description of the water: "that lagoon will devour you, they say it will gnaw at the shoreline, chew at the roots of your breadfruit trees."

Mystery – Mystery is the careful task of introducing and managing ambiguity just enough to enable the audience of the story to "match the unfolding events against his or her expectations....by presenting the important information slowly, allowing it to emerge" (De Young and Munroe 1996: 180/181).

Problem resolution – Story, as Gabriel (2000) argues, is not just a narrated description, but something which enables an emotional engagement. To do this requires an emotionally engaging problem, dilemma, or paradox of some kind, in addition to a resolution. Such emotional upheaval and resolution is directly linked to how interesting and effectual storytelling is (De Young and Munroe 1996). In "Dear Matafele Peinem," the resolution appeared as a strong sense of collective mobilization with a strong sense of hope that things will improve, as it ends with the mother telling her baby, "we won't let you down, you'll see."

Different Types of Stories as Transformation Prompts

Stories embody ways of seeing and engaging in the world which guide action. The field of ecolinguistics is specifically concerned with these guiding mechanisms in relation to how we construct: ourselves, others, the environment, and the personal and collective responsibilities toward these aspects. Through ecolinguistics, higher education has adopted stories to intentionally examine and then (re)shape how people relate to the world. Within the field of linguistics, Stibbe (2015) identifies eight forms of story and storytelling which include: ideology, framing, metaphor, evaluation, identity, communication, erasure, and salience.

Ideology – This is a form of story which embodies how the world was, is and should be, from a particular group or perspective. For example, many stories (and narratives more broadly) about contemporary higher education tend to focus on the economic utility of the education rather than wider contributions to society (see Wall 2016a, b, 2017).

Framing – This is a form of story which utilizes small packets of general knowledge or perspectives, which highlight and amplify certain aspects and omit others. For example, climate change might be framed as an environmental issue, a security threat, a problem, inevitable, a predicament, a dilemma, and so on. Each of these frames shapes how we think about climate change, in terms of how we might engage with it, or if at all (Stibbe 2015).

Metaphor – This is a type of framing (as above), where the original seemingly stems from another domain. Examples include "climate change is a ticking time bomb" (Stibbe 2015), which not only gives it a sense of urgency, but also a dramatic large-scale impact. Similarly, the analysis of metaphorical stories with mythical references has been used as an educational resource and process for developing principles and values of sustainability in education (Cutanda and Murga-Menoyo 2015).

Evaluation – This is a form of story which makes a judgment about whether something is good or bad. Such stories do not necessarily need a careful cost-benefit analysis, or forensic weighing up of evidence. Instead, they are more like associations in memory, for example, that honesty or love is good and lying and hate is bad (ibid).

Identity – This is a form of story about what it means to be a particular kind of person, which might include experiences, people we connect to or identify with, where we belong, and where those people are in society. Tuncer and Sahin (2016), for example, recently used stories in education to help students explore their own life histories and how this then shaped their own understandings of sustainability. The mothers' role in shaping the sustainable use of natural resources was particularly prevalent.

Conviction – This is a form of story which questions the truthfulness and likelihood of a description of someone, something, or some event. Conviction stories are, like evaluation stories, not about whether something is measurably or objectively true, but rather the extent to which we *believe* it to be true. For example, Baytar and Ashdown (2014: 31) used video as a storytelling medium to help generate new sustainability awareness and attitudes (kindred to a form of belief) among textile and clothing students, which seemingly promoted environmental purchase practices as well as decisions to consume more sustainably.

Erasure – This is a form of story which posits something as unimportant, marginal, irrelevant, or inconsequential, for example, the reference to the sustainability of natural resources in many economics textbooks (Stibbe 2015). This might be counteracted through the use of salience stories, the next form of story.

Salience – This is a story which highlights something as important or worthy of consideration. For example, Wall et al. (2019, forthcoming) examines the use of ecostories as a pedagogical device in higher education to provoke new ways of relating between humans, the planet, and other inhabitants of the planet. Similarly, other stories have been used in pedagogical settings, which engage ecological metaphor to help make evocative points about how humans relate to one another (e.g., Wall 2016a, b).

Stories and Well-Being

In the context of higher education, stories and story-based interventions have been used to facilitate well-being outcomes at the individual, organization, and community levels (see also the ► "Arts-Based Approaches for Sustainability" chapter for more details). These include the use of traditional tales, stories of lived experience, humorous stories, narrative genre poems, and the co-creation of haiku poetry (Charon 2006; Wall and Rossetti 2013).

At the *individual* level, story has been utilized to reformulate notions of personal illness and wellness. For example, rather than placing the "life narrative" under the control of medical experts, Frank (1997) argues that the "ill person" can reclaim their own story and therefore the authority and ability to tell his or her own "life narrative" – and as a result, the capacity to be able to construct a *new* life narrative. Self-constructed narratives that deeply examine the relationship between body and story move to challenge forms of pathographic control and reorient toward self-authorship, which is linked to both resilience and sense of well-being. Within this personal narrative space, there are three main themes: (1) *restitution* narratives, where the story plot involves returning to a previous state of health, (2) *chaos* narratives, where no one body dominates in the narrative, and all life events are contingent, and (3) *quest* narratives, where illness is perceived as a spiritual journey, and one which may be a starting point for exploration of ethics in relation to the body itself (Frank 1997).

The use of story in this way, to reclaim self-authorship agencies, reflects the emancipatory commitments of Freire (1996). Here, the learner becomes a cocreator of knowledge, rather than using a "banking model" in which the student is seen as a repository for knowledge and skills deemed valuable. In a Freireian sense, storytelling can facilitate learners to take greater control of their own learning and recreate their worlds through the storying of shared and individual experiences. The use of stories can be seen to liberate education from its reliance on hierarchical knowledge transfer, to a dialogic, nonlinear, and emergent model where learner perspectives are shared (see Wall et al. 2019, forthcoming). For example, a teaching myth from Inuit folklore "The Raven and the Whale" utilizes the antihero persona of half-man/half-God Raven who commits the hubris of wanting to possess the spirit of the whale for himself, thus destroying the whale. The story has various meanings, but it is often linked to the interrelationship and dependency of nature and environment, the destructive nature of Man, our caretaker responsibility for a sustainable world, and that healing can occur after deep release of shame, guilt, and grief. Here is Raven and the Whale, a retelling by Laura Simms (see http://healingstory.org/raven-and-the-whale/):

> In the very beginning of time, the Inuit people say, Raven made the world. Raven was both a god and a bird with a man inside. After Raven created everything, he decided to remain on the earth. He loved the people and the animals and he was curious about them all. Even though he had made the world, he did not know everything there was to know.
>
> Raven liked to paddle his kayak out into the sea. One day he saw a large whale.
>
> He said, "I wonder what it looks like inside the belly of a whale."
>
> Raven waited until the whale yawned. When its mouth was wide open, he rowed right in. He tied his kayak to one of the whale's teeth and started walking deeper inside the whale's body. The mouth of the whale closed behind him and it grew dark. Raven heard a sound like a drum or distant thunder. He walked until he came to the belly of the whale. The white bones of the whale's ribs rose up around him like ivory pillars.
>
> In the centre of the whale's belly, Raven saw a beautiful girl dancing. She had strings attached to her feet and hands stretching to the heart of the whale.
>
> Raven thought, "She is so beautiful. I would like to take her out of this whale and marry her."
>
> So he said to her, "I am Raven. I made the world. Will you come with me into the world and be my wife?"
>
> The maiden replied, "Raven, I cannot leave the whale. I am the heart and the soul of the whale. But if you want to stay here and keep me company, that would make me happy."
>
> Raven threw back his beak, revealing his human face. He tossed back his wings and sat with his hands on his knees. He watched the girl as she danced.
>
> When she danced quickly the whale soared through the water. When she danced slowly the whale floated calmly. Soon, the girl danced so slowly that she stopped moving and her eyes closed. Raven felt a cool wind from the world blow through the spout of the whale. He thought again of taking the girl with him into the world. He felt human desire. And, he forgot what she said.
>
> Raven pulled his beak back down over his face and covered his arms with his wings. He grabbed the girl. He heard the strings snap as he flew with her out of the whale up into the sky.
>
> As he flew, Raven heard the whale thrashing below in the ocean. He watched the whale's body as it was tossed by the waves onto the shore. The whale was dead and the girl in his arms grew smaller and smaller and disappeared.
>
> Raven realized that everything that is alive has a heart and a soul and everything in the world is born and dies. He was overcome with great sorrow. He was so sad that he landed on the sand beside the body of the whale.
>
> For weeks he cried and cried. Then Raven began to dance. He danced for weeks. Then Raven began to sing. He sang for weeks and weeks until his heart was soothed. Then he flew back up into the sky.
>
> He promised the humans and the animals that he would always return to this world as long as we cared for one another and understood that everything in this world lives and dies, and everyone, human and animal, has a heart and a soul. Raven's tears were the first tears. His dance and his song of grief and healing were the first song and the first dance.

At the *organizational* level, story has been used in higher education-facilitated change work, which promotes or prioritizes well-being outcomes within the organization (and/or wider community in which the organization resides). For example, as part of an action research story-intervention project, Rossetti and Wall (2017) found that stories were used to engage diverse groups in dialogue (such as patients and service users), and to find a more emotionally engaged way of developing service improvement in health care settings. This included story-based team building workshops and "Story Cafes," "which use stories and conversational circles as springboards to new empathetic awareness and learning" (Rossetti and Wall 2017: 173). Well-being outcomes related to personal and collective confidence, team development, enhanced partnership working, enhanced sense of relatedness and relationships, enhanced knowledge sharing, creativity, and facilitated culture change (ibid).

Within this context, stories can be used as an extended metaphor to allow space for inquiry around shared lived experiences. As an example, the story of Indra's Net is an extended metaphor which explores the philosophical and spiritual concept of "dependent origination" in Buddhism (its earliest recorded origins being the Atharva Veda, 1000 BCE). Here, Indra's Net points to contemplation and dialogue around connectedness and interconnectedness, the tensions between "the individual" and "the tribe," social consensus, belonging and separation, protection of self, the collective, and a wider environment. Here is one translated version of the story:

> If untold buddha-lands are reduced to atoms,
> In one atom are untold lands,
> And as in one,
> So in each.
> The atoms to which these buddha-lands are reduced in an instant are unspeakable,
> And so are the atoms of continuous reduction moment to moment
> Going on for untold eons;
> These atoms contain lands unspeakably many,
> And the atoms in these lands are even harder to tell of. (Cleary 1993: 891–2)

At a *societal* level, story work can be used by higher education scholars in community settings for a wide range of health and well-being outcomes. Often the mode of these interventions is co-constructed and collaborative, and facilitated through standard outreach and community development work, research projects, or action research projects. For example, Hawkins (1993) utilized story to reduce harm from alcohol and violence, encourage practices of remembrance and honoring, support local child protection initiatives, and honor the rich healing traditions within these communities. Similarly, Lester and Wingard (2001) utilized story work processes to enable indigenous communities to tackle a range of societal issues such as youth suicide, child abuse, violence, reduced life expectancy, and alcohol and drug abuse. More broadly, story practices have been used by higher education scholars develop collective and community-based capacities to cope with and adapt to challenges such as urban and climactic change (Goldstein et al. 2015), and action-based problem-solving and learning (Gearty 2015). And finally, more recently, Maiangwa and Byrne (2015) utilized storytelling in peacebuilding and reconciliation, for example, in the context of Northern Ireland and the Border Counties of the Republic of Ireland. In this way, storytelling facilitated through the work of Higher Education institutions has been used in the restoration of trust, agency, and hope, in diverse communities.

Conclusion and Future Directions

The intentional use of storytelling for sustainable development aspirations is not necessarily a new phenomenon; it has always seemingly been an intricate part of cultural knowledge and its transference. However, its intentional usage can now be traced in practices which attempt to transform how we relate to each other, the planet, and its coinhabitants, and often in the context of inculcating well-being to combat the consequences of modern life. Storytelling for sustainable development in higher education continues to become more interdisciplinary. For example, Gunn (2016: 316) explains the need to combine reason, aesthetics, and the act of creating/making in order "to more formally craft our pedagogies to call forth (evoke) and push-out (provoke) sustainability-oriented creativity." Such approaches cross disciplinary boundaries, and echo the rise of investment in STEAM (science, technology, engineering, arts, and mathematics) rather than STEM (Payton et al. 2017). Storytelling in this context will continue to be a strong mechanism to evoke and provoke transformations in sustainable development within higher education.

Cross-References

► Art-Based Teaching on Sustainable Development
► Arts-Based Approaches for Sustainability

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Strategic Thinking and Sustainable Development

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Definition

Sustainable development can be considered as a guide for building a society that integrates economic, social and environmental issues in all its spheres. This concept must be pursued by everyone in a variety of ways, including corporate and business areas. In this context, sustainability is also included as part of strategic thinking in organizations involving in this processes the demands of diverse stakeholders (Steurer et al. 2005).

Introduction

From the Industrial Revolution to the present day, there have been continuous processes of technological advances that constantly change the organizations' performance and the view of consumers on the use of available production resources. Indeed, environmental concerns that directly impact organizations and the ways in which goods, products, and services are commercialized are the most prominent in the corporate world (Ribeiro et al. 2017).

Within this scenario, the role of strategic management, governance, and sustainability stands out. All external environment of the organizations, formed by the stakeholders (an individual, group of individuals, or entities with legitimate interests in the attitudes and performance of an organization) and shareholders (set of people that affect or can be significantly affected by the organization, including the shareholders themselves), demand from the companies actions to preserve the environment.

Aiming to demand and validate measures and actions and planning which reinforce the achievement of the goals that aim to ensure and preserve the people, the planet, prosperity, peace, and partnership, the 17 Sustainable Development goals and the 169 goals announced were formulated (United Nations 2015). It is noted that not only industries, which historically have always been targeted as villains of the environment, are being charged in this new context, but the entire production chain is being involved in processes that seek sustainability.

Therefore, the present work intends to analyze the issue of strategic management, governance, and sustainability as a management tool for the decision-making process related to positive environmental practices. This analysis involves both organizations and all their stakeholders and shareholders, evidencing actions and the benefits generated.

Organizations and Sustainability

The environmental issues exist since ancient times, and by the end of the last century, it became a worldwide relevance subject. There are several authors who address the theme of sustainability, presenting concerns about the care of the environment and the consequences of its devastation. Lima (2015, p. 27) states:

> The environment is no longer seen and understood only as a social habitat, source of unlimited natural resources and space for the deposition of waste from economic activity, to be treated as a social problem that requires attention, reflection and intervention by society. The problematization of the relationship between society and the environment, and the resulting new consciousness gave the environment a new meaning and status, constituting an "environmental issue" where it did not exist before.

From the same point of view, Tinoco and Kraemer (2011, p. 88) point out:

> Two major trends characterize the beginning of the third millennium. First, the global human ecosystem is threatened by severe productivity imbalances in the distribution of goods and services. A significant proportion of humanity continues to live in conditions of true poverty, and the projection of trends indicates a growing divergence between those who benefit from economic and technological development and those who do not. This unsustainable progression of the wealth and poverty extremes threatens the stability of the entire human system and the global environment.

In the meantime, the concept of environmental management has emerged including the organizational structure, planning activities, responsibility, practices, procedures, processes, and resources to develop, implement, achieve, critically analyze, and maintain environmental policy. In the business environment, besides other aspects, it seeks to minimize and eliminate negative effects caused in the environment by its activities. It presents then the way in which the organization internally and externally mobilizes in order to achieve the desired environmental quality, consisting of a set of measures that aim to have control over the environmental impact of an activity (Barbieri 2011).

As discussed by Tinoco and Kraemer (2011), environmental management (Table 1) can be

Strategic Thinking and Sustainable Development, Table 1 Environmental management factors in organizations

Control and reduction of environmental impacts, due to operations or products
Compliance with environmental laws and regulations
Development and use of appropriate technologies to minimize or eliminate industrial waste
Monitoring and evaluating environmental processes and parameters
Elimination or reduction of risks to the environment and man
Use of clean technologies to minimize energy and material costs
Improvement of the relationship between the community and the government
Anticipation of environmental issues that may cause problems for the environment and, in particular, to human health

Source*:* the authors based on Tinoco and Kraemer (2011, p. 89)

conceptualized as the systems and organizational program integration that allow:

Thus, for a company to actually work with environmental management, it must, inevitably, undergo a change in its organizational and business culture by reviewing its paradigms. In this sense, environmental management has been set as one of the most important activities related to any enterprise and involves several sectors of an organization (Kraemer et al. 2013).

Environmental management instruments aim to improve environmental quality and decision-making process. They are applied to all phases of the projects. In this perspective, another aspects to consider are the environmental impacts determined by the organizations. The term “environmental impact” gained a more precise definition in the 1970s and 1980s when several countries realized the need to establish guidelines and criteria for assessing the adverse effects of human interventions on nature (Tinoco and Kraemer 2011).

The legal definition of environmental impact in Brazil is expressed in Resolution No. 1 of the National Environmental Council (CONAMA) of January 23, 1986, as follows:

> Environmental impact is considered any alteration of the physical, chemical and biological properties of the environment caused by any form of matter or energy resulting from human activities, which directly or indirectly affect: health, safety and well-being of the population; social and economic activities; the biota; the aesthetic and sanitary conditions of the environment and the quality of natural resources. (CONAMA 1986)

Environmental impact is the change in the environment or in some of its components by a given action or activity. These changes need to be quantified because they present relative variations, whether they are positive or negative, big or small. What characterizes the environmental impact is not any change in the environment properties but changes that cause the unbalance of the environment constitutive relations, such as changes that exceed the absorptive capacity of the environment considered (Tinoco and Kraemer 2011)

Most impacts occur due to:

> [...] to rapid economic development, without control and maintenance of natural resources. The consequences involve pollution, uncontrolled use of resources such as water and energy, etc. In other situations, the areas are impacted by underdevelopment, which leads to undue urbanization in protected areas and lack of basic sanitation. Overall, the most significant environmental impacts are found in the industrialized regions, which offer more job opportunities and social infrastructure, leading to higher population concentrations. (Kraemer et al. 2013, p. 10)

In this context, in order to guide a more careful approach, with a new civilizing standard for corporate social responsibility, the United Nations, during the World Summit on Sustainable Development held in Johannesburg, South Africa, in 2010, presented the sustainable development which is based on three pillars: “economic development” refers to the preservation of the environment and natural resources, as well as the reduction of waste of materials. To minimize negative environmental impacts, the company must implement ways of avoiding or compensating them. For example, create projects that have a low environmental impact, invest in beneficial alternatives according to the region, and measure the amount of carbon emitted by their production processes, adapting to current standards. “Social development” refers to human capital regarding to the activities of the enterprise, including the community, the target public, suppliers, and society in general. That is, it includes wages which comply to labor law, the well-being and health of employees and their families, as well as personal and collective development. Companies should analyze how their activities interfere with communities, including social characteristics such as education, leisure, and security. And, finally, the "environmental protection" including matters related to the production, distribution, and consumption of goods and/or services, that is, considering the environmental and social pillars. It is assumed that, in order to be sustainable, the company cannot profit at the same time that it devastates the environment or provides bad conditions of work to its employees. Another important issue is the fair competition with competitors in the market (Vieira 2017).

In 2015, the United Nations reinforced this issue by establishing the document entitled "Sustainable Development Goals," which proposes 169 goals to be achieved globally by 2030. The purpose of the agenda is to reaffirm the results of all major UN conferences and summits which established a solid foundation for sustainable development and helped shape the new agenda (Vieira 2017).

The aim, among other issues, is to ensure that the efforts made to raise awareness of the sustainable structuring of a system in organizations, provide greater economic opportunity and competitive advantage, since the ecosystem has become one of the most mentioned themes today and has gained prominence in the business world, since there is a clear need for help to keep it in balance. A company concerned to contribute to a change from unsustainable consumption and production patterns to more sustainable patterns of natural resources uses, promoting quality of life, aims to benefit all stakeholders. Consequently, in a more conscious view, focused on environmental responsibility, as presented by Claro et al. (2008), sustainability in the business environment can be interpreted as satisfying the needs of individuals in the current scenario without affecting future generations, because environmental practices have become increasingly present in organizational entities.

For Dias (2006), the competitiveness of a company involves a set of factors, which are variable, complex, and interrelated, and can be possibly dependent on factors such as human capital, technology, and innovation capability. From this juncture, environmental management has acquired a consolidated position in the competitive segment, due to the benefits that such a management model provides. The demands of the new economic standard stimulated companies to seek evolution based on the identification and recognition of their target audience. These aspects began to be analyzed from the generation of competitive value and the need to develop and to look for its due market share in the commercial scope.

The need to meet this specific market share is the result of a society which gradually increases its demand for a policy of control, preservation, and environmental recovery by organizations. According to Souza and Pfitscher (2013), consumers of products and services tend to value quality coupled with environmental responsibility. Consequently, organizations are under pressure to implement environmental management to control the impact of their productive activities on the environment.

Therefore, it is imperative to constantly seek new ways to meet market demands that contribute not only to business but also to building a sustainable society. Investing in corporate sustainability is, besides an ethical and altruistic behavior, a way of contributing to the business permanence in the market.

Companies should be evaluated and managed based on their performance and financial results, having profit as the main indicator. They must also be evaluated and managed for their environmental performance, which indicators vary according to the branch of activity. The company's social performance involves indicators related to the company's way of acting as an agent for the improvement of the life of some group of people in the society in which it is inserted (Sant'Anna 2013).

"To make such a context profitable and strategic, companies must manage opportunities in two ways: innovate by taking advantage of the company's own business and/or innovate by occupying new markets, ensuring business success" (Barreto and Moreira 2015, p. 45). For the authors, sustainable management becomes an opportunity for new enterprises, for example, the improvement of human development levels, represented in the greater purchasing power which can be reflected in access to consumption and, consequently, the increase in products and services to previously unexplored markets.

Strategic Management and Sustainability

Sustainability in the current corporate context must be correlated with the strategy of companies aiming to meet the new behavior of consumers, who are more aware that products said to be ecologically correct bring benefits. These benefits must be understood through sustainable management, which causes socio-environmental impacts and requires balance of economic and financial results concerning the environment and social development promotion, as well as seek to create measures to eliminate or minimize the effects of negative impacts on the environment (Barreto and Moreira 2015).

According to the Brazilian Micro and Small Business Support Service (2016), strategic management is essential for effective action. Once recognized the scenario where the company is inserted, knowing the factors that generate opportunity for its success, as well as what generates threat to survival in the external environment, and also recognizing its strengths, competencies, and the internal weaknesses, the administrators can define what is the company's reason to exist and what goals will be achieved with the invested resources. Allowing to walk in a constantly changing environment, through administrative decisions and actions that guide the steps toward the desired results, with meaning, with determination, and with learning.

For Barbieri (2011), it is expected that the strategic management and sustainability practice will provide social, environmental, and economic benefits to the organization while contributing to sustainable development. The degree of benefit depends on the level of integration of the central themes in the organization's management, in particular, on the following factors in Table 2.

In this context, there are an increasing number of actions and measures that encourage companies to include practices and interventions that focus on environmental management and sustainability in their organizational structure. Considering this reality, the Exame Sustainability Guide, in its 18th edition, published in 2017 the list with the ranking of the most sustainable companies. We analyzed information about the conduct of the 173 companies that answered the questionnaire prepared by the Getúlio Vargas Foundation of São Paulo, which analyzes the three dimensions of sustainability – social, environmental, and economic (Vieira 2017).

Strategic Thinking and Sustainable Development, Table 2 Environmental management reflects in organizations

Encourage decision-making process with reasoned decisions based on a better understanding of society's expectations and the opportunities associated with social responsibility, including better control of legal risks and the risks of not being socially responsible
Improvement of risk management practices
Improvement of the organization's reputation and promotion of greater public confidence
Support for operations licenses
Generation of innovations
Improving the organization's competitiveness, including access to finance and preferential partner status, as well as low interest credit
Improvement of the organization's relationship with its stakeholders, thereby exposing the organization to new perspectives and contact with different stakeholders
Increased employee loyalty, involvement, participation, and morale
Improvement of the health and safety of workers of both sexes
Positive impact on the organization's ability to recruit, motivate, and retain its employees
Savings resulting from increased productivity and efficiency in the use of resources, reduction of energy and water consumption, reduction of waste, and recovery of valuable by-products
Greater reliability and fairness of transactions through responsible political involvement, fair competition, and lack of corruption
Prevention or reduction of possible conflicts with consumers regarding products and services

Source: the authors based on Barbieri and Cajzeira (2016 p. 231)

In order to choose, first, they separated the companies which scored above the average plus a standard deviation in the dimensions, regardless of the sectors in which they operate. Next, there was a journalistic investigation on critical issues of each company and the evaluation of a deliberative council, made up of specialists. The election featured ten themes: human rights, ethics and transparency, water management, biodiversity management, supplier management, waste management, sustainability governance, climate change (including energy management), community relations, and customer relations (Vieira 2017).

It is important to emphasize that for the first time, the questionnaire included questions on the 17 Sustainable Development Goals (ODS) established by the United Nations in 2015. This process generated the list of 75 best, divided into 19 sectors. Each sector has a highlight – and the other companies appear in alphabetical order (Vieira 2017). In order to demonstrate the relationship between strategic management and sustainability in organizations, the following are three prominent examples in the 2017 Exame Sustainability Guide.

The company Raízen, located in Piracicaba, São Paulo, has been present in the Exame Sustainability Guide since 2000, with 1 billion reais turnover in 2016 and approximately 5404 employees. It is taking the first step in the application of a technology capable of increasing its ethanol production by 50% without the addition of 1 ha of planted area. That is, Brazil's largest sugarcane ethanol company would be able to raise its annual output from 2 billion to 3 billion liters with the same amount of raw material used today. The key indicators that made it stand out within the regular group are ethics and transparency, biodiversity management, supplier management, waste management, sustainability governance, and relationship with the community. The factors classified as below average are human rights, water management, climate change, and customer relations (Vieira 2017).

Another company present in the Guide since 2000 is Weg, an entity from Santa Catarina, which manufactures electric motors, currently exploring the field of solar and wind energy equipment sale. The company had revenues of 9.8 billion reais in 2016 and approximately 30,000 employees. Today, there are about 90 Weg wind turbines installed in the country, the most recent, in Brasilia, on the roof of the headquarters of the Superior Electoral Court. The above-average indicators human rights, biodiversity management, governance, and sustainability stand out. The under-average indicators include ethics and transparency, water management, supplier management, waste management, climate change, relationship with the community, and relationship with clients (Vieira 2017).

Finally, the company Natura, which operates in the production of cosmetics, also present in the Guide since 2000, with revenues of 8 billion reais in 2016 and approximately 6397 employees. Many of its products take natural resources as raw material, so the company seeks to act for the maintenance and improvement of environmental conditions, minimizing aggressive actions to the environment. The company was the pioneer in launching cosmetic products with refills and without its packaging. It is also worried about using less impacting raw materials, using the green polyethylene originated from sugarcane, for example. Natura also signed a commitment to reduce emissions of greenhouse gases and seeks to boost the generation of sustainable businesses as an economic alternative for local communities. In the 2017 Sustainability Guide, Natura stood out as the sustainable company of the year.

The previous considerations confirm what has been said by Pinsky et al. (2013, p. 446) to whom "the increasing importance of sustainability in recent years has led some companies to consider the inclusion of business goals, which are compatible with sustainable development, as an integral part of business strategy." Thus, without giving up their financial responsibilities, companies can play an important role in promoting an ecologically sustainable and socially fair society. This positioning involves a new way of doing business, in which innovation and sustainability move together and become sources of competitive advantage.

Final Considerations

In the current global scenario, the need of conservation and recovery of the environment is evident, as a result of the damages caused by the fast development. Given this, strategic management and sustainability play a key role for companies which are concerned with environmental issues, social responsibility, and economic development.

It was identified in the development of this work that in order to reverse a scenario of unsustainability, due to the growing scarcity of natural resources caused by industries and society in general, it is fundamental to apply an active, conscious, and participative management among all stakeholders and shareholders.

Although in a succinct way, the concept, applicability, and success of companies that invested their efforts in the concern with the corporate responsibility in the search for sustainability were presented. Considering the results, despite the positive data, it is important to emphasize that there is still a long way in the commitment of organizations to contribute to the three fundamental factors for sustainable development, that is, to promote activities that are socially fair, ecologically balanced, and economically viable.

A company which decides to have a sustainable positioning strives to meet in varied and different ways the community, seeking to benefit it. By doing it, with a focus on socio-environmental management, the immediate return is to be a differentiated company, often becoming a benchmark in the market. Finally, it is believed that the concept and applicability of corporate sustainability are understood and exercised as a commitment to sustainable development, based on benefits such as improved institutional image, product portfolio renewal, increased productivity, increased employee commitment, better relations with public authorities and with the community, and easier to meet environmental standards, as seen in the cited examples.

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S

Strategy

▶ Waste Management Strategies for Sustainable Development

Student Empowerment

► *oikos*, International Student Organization for Sustainability in Economics and Management Education

Student Empowerment and Sustainability

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Synonyms

Student-led action; Student-led social change

Definition

Student empowerment in the context of sustainability in higher education can be understood as the act of engaging and supporting students to gain the knowledge, skills, resiliency, and desire to enact change for sustainability.

Introduction

Increasingly, higher education institutions (HEIs) are incorporating sustainability into their policies to encourage sustainable behaviors in their campus members (Beveridge et al. 2015). Research suggests that achieving sustainability in higher education (SHE) requires all campus members (administrators, staff, faculty, and students) to learn, adapt, and innovate (Huckle and Wals 2015). HEIs are particularly well situated to encourage this as they have the ability to equip graduates, and our future leaders, with the awareness, skills, and technologies required to foster sustainable behaviors and communities (Lozano et al. 2015). Shriberg and Harris (2012) assert that the active engagement and leadership of students is essential to achieving the institutional transformations necessary for SHE. Despite this, HEIs face unique challenges engaging students to adopt sustainability (Elliott and Wright 2013).

As the largest stakeholder group on campus, engaging students in SHE is imperative (Drupp et al. 2012). Students can and should be empowered by their universities to "shape the world in which they will live" (Hales 2008, p. 24), including shaping sustainability at their institutions. Today, there is growing student action across campuses addressing climate change and sustainability in HEIs (Nejati and Nejati 2013), with various other stakeholders seeking to support and encourage the engagement and participation of students during the transition (Drupp et al. 2012).

The goal of this entry is to better understand student empowerment within the context of sustainability in higher education. This knowledge is beneficial for administrators, staff, faculty, and other students seeking to understand and empower student action for sustainability on their campuses. The following section outlines the details of student empowerment, including how students are currently working to integrate sustainability in HEIs, the challenges they face, and the opportunities other stakeholders have to help them overcome these challenges. The entry concludes with suggestions for how HEIs can best support students to undertake or continue with existing sustainability efforts.

Defining Student Empowerment and Sustainability

In what follows, the definitions of empowerment and sustainability are outlined before bringing them together and exploring their meanings within the context of higher education.

Empowerment is described as a dynamic concept that:

> denote[s] feelings of control and involvement in areas of importance to individuals. Empowered individuals might be characterized as having the ability and willingness to participate in decisions that affect their own and others' life situations, and perhaps more importantly, to act on those decisions (Shellman 2014, pp. 21–22)

Shellman goes on to describe that empowerment is an iterative process, occurring along a continuum of feeling more or less empowered, and that it can be "enhanced or diminished through internal (i.e., beliefs about one's self, knowledge, and skills) and external (e.g., social group, parents, teachers) influences (2014, p. 22). Thus, the outcome of empowering a student would result in an increase of their personal power of a situation (either to change or control some element of the situation) through their own efforts, as motivated by internal or external influences.

Sustainability, broadly, ensures that the needs of present and future generations are met in environmentally, socially, and economically responsible ways (Lozano and Young 2013). More specifically, sustainability entails protecting, preserving, and enhancing the environment alongside other social, cultural, and/or economic considerations (Bieler and McKenzie 2017). Within the context of higher education, sustainability is considered across the whole institution, including within governance, research, community outreach, curriculum, and operational domains (Lozano et al. 2015; see also Domains of Sustainability). Thus, sustainability in higher education ensures that, at a minimum, the environment is considered alongside social, cultural, and economic considerations across those five institutional domains.

Student empowerment in the context of sustainability in higher education can then be considered the act of supporting students to gain the knowledge, skills, abilities, and, perhaps most importantly, the desire to enact change for sustainability on campuses. Student empowerment for sustainability is then considered deeper than student involvement and/or engagement with sustainability. Rather, the latter two terms denote an interaction with sustainability, whether initiated by the institution, staff, or faculty and resulting in passive engagement or simple rule following by students. Whereas, empowerment speaks specifically to students who are motivated to lead and initiate sustainability efforts on and off campus. Campus stakeholders that are in positions to empower students include: student groups (including unions, associations, networks, and organizations), faculty, staff, and administrators (Broadhurst and Martin 2014; Jacoby 2017; Tassone et al. 2017). While this can be achieved through the actions of the institution, staff, or faculty, the key is that it is led by the students, engaging them on a deeper more meaningful level than simply being involved as a participant or bystander. Empowering students to lead action for SHE has a ripple effect that transcends campus efforts, as it fosters behaviors that contribute to sustainable societies overall (Murray 2018).

Sustainability is a complex and multi-faceted concept. As a goal, it is similarly complex and multi-faceted with various approaches and understandings, thus creating a rather elusive "end goal." As it is a global challenge with complex local implications, fostering the aptitudes, attitudes, and behaviors in individuals is necessary to create more sustainable societies (Tassone et al. 2017) and a more liveable future than the one currently in view (Sterling et al. 2013). Tackling this incredible challenge is said to be an open-ended process that requires "continual experimentation, innovation, and empowerment" (Tassone et al. 2017, p. 342). The intention then is for students to be empowered to lead change on their campuses, experimenting and innovating, thus building the campus that they want, and engaging in social change for a better future.

Students engaging in social change on campuses is not new; their actions and activisms during the 1950s to 1970s spurred significant social transformations (Staggenborg and Ramos 2016). With the current global realities (climate change, deforestation, global poverty, pollution, etc.), empowered students have been making waves worldwide, as they demand for change on their campuses and in their societies. Students are uniquely positioned to lead change as they are deeply embedded within the local context and characters of the players involved in (un)sustainability on their campuses and in their communities. As a result, their actions offer specialized local responses to issues facing the institution (Jacoby 2017), rather than a prescriptive approach that assumes all institutions shall respond to sustainability the same way. Students who are empowered to take action for sustainability produce responses that are neither reductionist nor Newtonian, common criticisms of approaches to SHE (Lozano et al. 2015). Their actions offer contextually rich and appropriate responses to local issues, thus contributing to addressing the global sustainability crisis, locally.

Based on these understandings of student empowerment for sustainability, this entry will now move to discuss how students are empowered to lead change within the context of SHE. The drivers and barriers to student-led action for SHE will be discussed and then examples and strategies that can be of benefit to the various stakeholder groups (students, faculty, staff and administrators) to empower students to lead change will be outlined.

Drivers and Barriers to Student Action for SHE

A recent literature review revealed that students are leading significant change on campuses in the pursuit of sustainability. The review identified three common barriers to student-led action for SHE (student involvement, institutional dynamics, and funding) and three common drivers that supported their actions (collaborations with other stakeholders and interdisciplinary approaches) (Murray 2018). In regards to student involvement as a barrier, successful student-led change requires students who are motivated to lead and initiate sustainability efforts on and off campus. This requires students giving their time and energies to extra-curricular causes, often as volunteers. However, due to students' heavy school workloads, jobs, and multiple philanthropist opportunities on campuses and in communities, student-led action for SHE is often plagued with low student involvement due to limited time to volunteer. Additionally, students are typically on campus for a maximum of 4 years thus when they are demanding for change for SHE, some institutions believe they can placate students while not meeting their demands for change as the administrators simply wait for the current students to graduate and the campaign to lose steam (Murray 2018). The second barrier identified was institutional dynamics. Leading change on campus requires navigating heavily bureaucratic and political environments; skills students don't often possess. Finally, similar to many SHE efforts, financial restrictions inhibit student-led change for sustainability.

Another study revealed the campus climate itself plays a significant role, alongside supportive peer groups, and other social networks for activism (Broadhurst and Martin 2014). While engaging students in sustainability efforts is one thing, empowering them to be change makers is quite another (Broadhurst and Martin 2014). Broadhurst and Martin's (2014) research revealed that a positive campus climate where student activism is not only tolerated but actively supported is one of the best ways to ensure student empowerment. Despite this, many campuses continue to grapple with how to "deal" with dissent among students, whether the mantles they take up are for environmental or social inequities. The authors found that even when there is a negative campus climate for student activism, students will gravitate towards each other, building their own organizations and groups with like-minded students. That said, in positive campus climates, the actions of the students were less aggressive and operated in a more democratic way with the institutional system rather than against it. Campuses with negative climates often experienced more aggressive forms of student activism. Thus, if administrators/institutions are grappling with how to make change for sustainability, how to engage students in said change, and/or dealing with aggressive student dissent, supporting student empowerment is one way to address all three.

Drivers for successful student-led change and empowerment were found to lie within the various support networks that are available to students (Broadhurst and Martin 2014; Murray 2018). Whether building collaborations amongst students (networks, peer groups, etc.), with other campus stakeholders, or working in partnership with other causes and building interdisciplinary groups and/or campaigns to tackle more than one issue at a time, students found greatest success when part of a larger group or cause (Murray 2018). Collaborations with other stakeholders across campus enables students to overcome some of their greatest barriers (student involvement and continuity as well as navigating institutional dynamics) as other stakeholders (faculty, staff, and administrators) remain on campus for longer periods of time than students, thus ensuring their efforts will continue even after they graduate. Building interdisciplinary campaigns helps build the volunteer base and often times can result in greater support and/or funding as the campaign targets more than one issue.

As institutions and their various stakeholders seek to empower students to lead change on campuses, understanding the key drivers and barriers they face is important to understanding how best to support and empower them. In consideration of these drivers and barriers, examples will now be outlined for ways that each stakeholder group can work to better support student-led action for SHE.

Strategies for Stakeholders to Support Student Empowerment

In response to and in recognition of the drivers and barriers discussed above, the following section outlines various ways that each of the three major internal HEI stakeholder groups (students, faculty, and administrators/staff) can work to empower students.

Students Empowering Students

Students have been deemed a critical influence for SHE due to their bottom-up pressure and their ability to activate change within the institution using methods that other stakeholders (staff, faculty, and administrators) are not capable of employing (Drupp et al. 2012; Helferty and Clarke 2009). They are able to use their positions to pressure their institutions, to develop collaborations with other stakeholders across and outside of the campus, and to address interdisciplinary sustainability challenges (Murray 2018). As such, students supporting their peers can be an extremely effective strategy to empower student-led action for SHE.

Murray (2018) identified that students who are leading action for SHE work together in student networks (campus groups, off-campus social networks, and global student organizations) use the following types of initiatives to elicit change: behavior change activities, policy implementations, educational activities, campus gardens, greening buildings, conservation initiatives, and audits. Many of these activities are carried out on the students' own time, as groups of volunteers work together towards a common goal. Volunteerism and service learning have been identified as strategies used by student groups to empower individual students to learn the skills necessary to address some of our most pressing social and environmental challenges (Broadhurst and Martin 2014). Student groups and extra-curricular peer networks are important elements when students are working to empower other students to make change on campus.

In regards to the common drivers and barriers that students face, student organizations can ensure that campaigns have adequate support and structure to address the issue of continuity. This may include offering activism training to students attempting to lead change for SHE, which may cover topics such as how to organize a group, how to take minutes, how to work with the institution, lists of local resources (funding, supportive campus members, local organizations, etc.), as well as public speaking and/or debate training. Student unions/associations could ensure there is space available for students to meet, grants to support student SHE efforts, and general political support as the students face institutional bureaucracy. Student unions can foster a positive campus climate for activism and democratic dissent whereby students feel comfortable and well equipped to be problem solvers on campus.

Whether it is a student union, organization, or group seeking to empower students to make change on campus for sustainability, there appears to be strength in numbers – whether through collaborations with other students, organizations, or stakeholders. As students seek to empower their peers, offering opportunities to learn how to lead change on campus, to learn about the bureaucracy of the institution, and to learn how to elicit change within it, students can, and very well should, empower their peers for SHE.

Faculty Empowering Students

Faculty members play a key role in empowering students to take action for sustainability as they are directly responsible for what students are learning and the projects they undertake for their courses. A significant opportunity for faculty is to incorporate elements into their curriculums to empower students to be not only problem identifiers but also problem solvers. Problem solvers are empowered to make a change to address an inequality they see; "A problem solver… notices that something is wrong, studies the situation, develops potential solutions, and then takes action to address the problem" (Jacoby 2017, p. 4). Jacoby (2017) suggests that coursework, experiential education, and critical reflections are key to empowering students to make change. Faculty can teach students "a wide range of social change strategies, including philanthropy, service, artistic expression, community organizing, grass-roots political activity, politics in the more formal sense, boycotting/buycotting, the many forms of social media, civic professionalism, social entrepreneurship, and, yes, protest" (Jacoby 2017, p. 4). Teaching and learning in the classroom offer many opportunities to empower students to lead change for SHE.

Faculty can also be significant support structures for student-led action for SHE as they can help students overcome one of their major barriers: continuity. As previously mentioned, the ability for student campaigns to bridge between student generations was one of the main barriers identified for student-led action. Faculty are in a unique position to help bridge year to year, so that students have confidence in their organizations and efforts, knowing the institution cannot simply wait for them to graduate, ignoring the issues at hand. When a course embeds sustainability into the project and coursework, there will continually be students working on sustainability projects and/or being challenged to identify and solve sustainability issues on campus, thus ensuring that the next generation of students will be empowered to take action for SHE.

This beneficial relationship extends beyond the classroom as well (Murray 2018). As an example, across many campuses worldwide students and faculty have joined forces to pressure their institutions to commit to divesting from fossil fuels (Bratman et al. 2016). With the support of faculty, the student team members can graduate knowing that the following year some structure will remain to their divestment campaign, as the faculty will have the organizational memory to ensure continuity. Moreover, faculty members play an important role helping students navigate the complex bureaucratic and political institutional environments.

Whether arming students with the knowledge of social and environmental inequities or teaching them activist strategies, faculty can and should play a significant role in empowering students for SHE. That said, there are often few supports in place to empower faculty to take on this role (Moore 2005). The institution then must also have systems in place to support other stakeholders to empower students otherwise such efforts will continue to remain on the periphery, working in isolated pockets across the institution rather than allowing for the full transformation that sustainability requires.

Administrators and Staff Empowering Students

One of the greatest barriers students face when taking action for sustainability is institutional dynamics. Students do not always have the expertise to understand and navigate the bureaucratic system or deal with the politics of the institution and the people in power. Students often see administrators as representations of the institution itself due to the positions of power they hold (Broadhurst and Martin 2014). Administrators hold a significant opportunity to support and empower students working for sustainability as their positions of power can either help or hinder the students' actions. Administrators have the power to create positive campus climates for the students, allowing them to work within the system rather than against it (Broadhurst and Martin 2014).

Administrators have the opportunity to indirectly and directly influence student action for SHE. Indirectly, they can foster positive campus climates where students are empowered to take action for SHE and they can provide funding and space for extra-curricular activities and student organizations (Broadhurst and Martin 2014). They can encourage faculty members to support students' actions and can support faculty to develop and/or integrate environmental and social justice topics across the curriculum. Directly, they can develop internships for students to work on sustainability projects, fund student positions within the campus Office of Sustainability, and actively play a supporting role guiding students through the bureaucracy of eliciting change on an institutional level.

An institution fully committed to sustainability and empowering their students would act as a living laboratory whereby students could practice the skills they are taught and implement the knowledge they have learned from their courses and their extra-curricular activities, thus learning within an environment that acts like a microcosm of society.

Conclusion

As HEIs work to embed and integrate sustainability across the whole institution, they would be wise to focus their efforts on students' commitments to SHE. Empowering students starts with teaching and learning about sustainability, but it is deeper than simply learning to identify issues. Rather, it requires that students have the skills, confidence, and ability to not only identify solutions but also the power to implement those solutions. Students would then graduate with not only the knowledge of sustainability but also the practical skills from implementing solutions to SHE challenges on campuses.

All stakeholders on campus have significant roles to play to empower students in the journey towards SHE. Table 1 outlines the various strategies that each stakeholder group can take to help support and empower students on their journeys to leading change for SHE. Institutions would be wise to welcome student activism for SHE, to encourage democratic discourse, and to "actively support students as they cultivate their identity as agents of social change" (Broadhurst and Martin 2014, p. 83). As outlined in Table 1, administrators and staff can create positive campus climates to support student empowerment, spaces for students to meet, funds for them to achieve their goals, and supportive environments to help them navigate institutional dynamics. Faculty play a strong role through teaching as well as supporting students in their extra-curricular activities and helping to navigate the bureaucratic system of the institution. Students themselves and student organizations on campus also play a vital role in empowering students for SHE. Creating space, funds, and supportive networks of students actively working towards SHE will help empower their peers to take action, to be part of the change, and to commit to improving their campuses and their communities. As student activism on campuses continues to rise, institutions need to understand how to navigate the demands of students through supportive campus environments that not only welcome but also encourage and guide students through process of institutional change for SHE.

Student Empowerment and Sustainability, Table 1 Strategies for campus stakeholders to support student empowerment

Stakeholder	Strategies to support student empowerment
Students	Organize campaigns Recruit students not conventionally engaged in SHE Create student networks for SHE Create space for student groups to meet Develop funds for students to finance SHE campaigns Take stock of current opportunities and resources to share with student groups
Faculty	Embed sustainability in coursework Teach activist strategies Support students to solve problems on campus, using the campus as a living laboratory Partner with student groups and campaigns Guide students through institutional dynamics
Administrators and staff	Create positive campus climates Develop funds to support student groups Create space for students to meet Guide students through institutional dynamics Support faculty to embed sustainability across curriculum Incentivize sustainability projects

Returning to the definition of empowerment, we see that perhaps the most important aspect is the fact that students would feel compelled to take action for sustainability, they would feel they have the power to enact change on their campuses and thus learn the skills required to enact change in their communities. Empowering students for sustainability in higher education would result in graduates who not only have the knowledge of what sustainability entails but also the experience, confidence, and resiliency required to build sustainable communities and create a better future than the one currently on the horizon.

Cross-References

▶ Student Organization
▶ Sustainability Domains in Higher Education

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Student Networks

▶ Global Alliance of Tertiary Education and Sustainable Development

Student Organization

▶ *oikos*, International Student Organization for Sustainability in Economics and Management Education

Student-Led Action

▶ Student Empowerment and Sustainability

Student-Led Social Change

▶ Student Empowerment and Sustainability

Students for Change

▶ *oikos*, International Student Organization for Sustainability in Economics and Management Education

Students' Perception on Sustainability

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Definition

A sustainable higher institution is an institution "that apart from seeking academic excellence, tries to embed human values into the fabric of people's lives" (Nejati and Nejati 2013, p. 105). Nejati and Nejati (2013, p. 105) further defined a sustainable higher institution as an institution "that promotes and implements sustainability practices in teaching, research, community outreach, waste and energy management, and land use and planning through a continuous sustainability commitment and monitoring." Such sustainability approach would increase the rate of infusion of required attitudes and adoption of sustainability principles by the different stakeholders in the society (Nejati and Nejati 2013).

Students' perception on sustainability means the awareness, understanding, view, attitude, and conceptualization of sustainability by students. It is pertinent to note that raising awareness across higher education institutions and encouraging interactions between various stakeholders are critical to achieving sustainability.

Introduction

One of the historical points of the development of sustainability in higher education was at the Earth Summit in Rio de Janeiro in 1992, where a worldwide action strategy for delivering sustainable development was conjectured and accepted. The strategy recognized and stated that "education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues" (UNCED 1992, p. 320). Exactly a decade later, the importance of this strategy was re-highlighted by emphasizing the vital role education can play as one of the required elements for fostering sustainable development at the World Summit on Sustainable Development in Johannesburg (WSSD 2002). The third summit in 2012, Rio+20, also acknowledged the importance of education by resolving to work toward the integration of sustainable development into education (United Nations 2012). The summits had been termed as the landmarks in the development of Education for Sustainable Development (ESD) (Leal Filho et al. 2015).

Since these summits, sustainability concerns of higher education campuses have attracted a growing level of attention from both the public and policymakers. Hanning et al. (2012) worked on the engineering education curricula in terms of quality improvement and long-term strategic development of education for sustainable development. In their study, course contents and statements from students, alumni, and company representatives were used as indicators of competencies acquired by the students, and feedback from alumni and representatives of companies and different organizations were used as indicators of the competencies in sustainable development needed by the industry. The result of the study indicated that the quantity, the coverage, and the level of incorporation of sustainable development in the curriculum seemed to be key factors for the perception of competencies by the students and for the importance attached to the achievement of their goals. Azapagic et al. (2005) addressed the issue of engineering education for sustainable development by attempting to enhance the inclusion of sustainable development in the engineering curriculum. This necessitated putting forth some research questions, and the research results appeared to be encouraging. According to Azapagic et al. (2005, p. 1), students believe that sustainable development is imperative for engineers, even though they often have hitches in "making a direct link between the conceptual framework of sustainable development and engineering practice." The study "illustrates an approach to teaching sustainability that could aid in stimulating students' interest in this theme during their studies and to ensure their obligation towards practicing sustainable engineering later as professionals."

Moreover, Watson et al. (2013) conducted a study to assess the integration of sustainable development into the civil and environmental engineering curriculum at the Georgia Institute of Technology by using the Sustainability Tool for Assessing Universities' Curricula Holistically (STAUNCH)^{R}™ and students' perception surveys. The findings of the two complementary approaches showed a strong bias of the courses toward environmental issues and the need to improve the depth of coverage of sustainability content. In the same vein, Yuan and Zuo (2013) critically assessed the Chinese students' perspectives on higher education for sustainable development based on the Graphical Assessment of Sustainability in Universities (GASU) tool, particularly with the environmental, social, and educational sections as the assessment indices. They, however, observed that students are generally aware of sustainability issues with their top priorities being environmentally inclined, similar to the findings of Zeegers and Clark (2014).

Having realized the gradual penetration of environmental sustainability in business school curricula, Thomas (2005) studied a theoretical framework of perceived legitimacy for measuring the attitudes of business students toward the legitimacy of environmental sustainability of higher education. Perceived legitimacy is the perception of the students on the appropriateness of integrating sustainability concepts into the higher education (Thomas 2005). It should be noted that the perceived legitimacy was evaluated based on three criteria: pragmatic, moral, or cognitive. Even the inclusion or integration of the concepts of sustainable development in the curricula does not "guarantee that students will be persuaded to incorporate sustainability into their business decision-making models, either in school or on the job" (Thomas 2005, p. 188). Therefore, the development of such a theoretical framework is deemed useful in providing guidance for designing, developing, and applying tools for measuring students' attitudes (Thomas 2005; Watson et al. 2017). The use of the framework in developing students' attitude measurement tools will ensure the reliability of the tools in measuring the components of perceived legitimacy that will help educators in knowing if the students are rightly imbibing the principles of environmental sustainability (Thomas 2005; Watson et al. 2017).

From the foregoing and as previously argued by Azapagic et al. (2005), even though average students seem to have knowledge about the environmental aspect of sustainable development, there are notable knowledge gaps with respect to educational depth and to the social and economic dimensions of sustainability. The prime enhancement in knowledge is essential in environmental legislation, policy, and standards because students do not seem to have adequate background on these topics. Therefore, this entry seeks to emphasize the perception of students having recognized them to be important stakeholders who can influence the society, either presently or in the future, with their decisions rather than just being subjects of education. Thus, we have examined the awareness, the perception, and the factors influencing the role of students in promoting sustainability, some highlights on few case studies of such perceptions were given, and lastly, frameworks were proposed based on previous studies toward the enhancement of students' perception on sustainability.

Awareness, Perception, and the Role of Students in Promoting Sustainability

Many of the university stakeholders are unaware of sustainability principles (Nejati and Nejati 2013). Hence, several stakeholders in the higher education sectors must be made aware of their specific responsibilities toward contributing to the development of sustainable campuses. It has been acknowledged that improving the awareness of students about sustainability plays an important role in fostering sustainability in universities (Yuan and Zuo 2013). And as one of the major stakeholders in universities, the students play a key part in the bottom-up panache of sustainability because they can contribute to sustainable campus operations and relevant research among others. Passions and contributions of students have been identified to be critical assets in sustainable university projects as previous studies have found that students showed an inclination toward supporting and participating in such initiatives (Yuan and Zuo 2013).

Moreover, by educating students through a wide range of basic courses in the subject of sustainable development, the students appear to gain a comprehension of the concept and its respective connotations. By further integrating sustainable development topics all over the curricula, the students also seem to gain some gratitude for and understanding of sustainable development as well as the interrelations between such understanding and their professional work assignments (Hanning et al. 2012). Hanning et al. (2012) opined that the university plays a role as an agent of change in the society and this important role needs to be explored as much as possible by the universities in promoting sustainability. Moganadas et al. (2013) highlighted two types of perception which are perceived importance and perceived implementation. Perceived importance is the weight or priority given to sustainability from the perspective of a stakeholder, while perceived implementation is the facets that involve establishing goals and objectives, raising awareness, providing education, and developing implementation strategies (Moganadas et al. 2013). Moganadas et al. (2013) suggested that the inherent perception of campus members, including students, should be understood to promote campus sustainability.

Watson et al. (2013) argued that "curricula reforms are needed to better educate engineers on the implications that their work has on the environment and societies in this generation and future ones." They recommended that the incorporation of sustainable development principles in the existing courses can lead to students having holistic and systemic views of sustainability and adopting sustainability principles in their professional practices. Nejati and Nejati (2013) suggested that appropriate comprehension of the students' evaluation of sustainability practices of the university is important because it informs the decision-makers about the university's sustainability performance. It also provides better acumens as to how the students assess their institution in terms of sustainability and allow more involvement of the students in campus sustainability initiatives. Actually, the investigation of students' attitudes and beliefs is regarded as critical as the awareness of sustainable development may be facilitated when students are proactive. Several other disciplines have started integrating sustainability indices into their curricula to boost the overall sustainable development goals. The best outcome is "achieved when the entire university curriculum is infused with relevant education" in relation to higher education for sustainable development (Hanning et al. 2012, p. 306).

Factors Influencing Students' Perception

The expected roles of HEIs in sustainability cannot be overemphasized due to their important influence on social, economic, and environmental policy development activities (OECD 2008). The progress of HEIs in the direction of sustainable development is a function of a comprehensive system which involves the school management (Puukka 2008), the academic staff, nonacademic staff, students, and the host population. The students' population is usually higher than that of other stakeholders. This makes the perception and involvement of the students critical for the success of sustainability policies of HEIs. The students of higher institutions are a collection of people of diverse social orientations, educational backgrounds, age groups, exposures, interests, and more importantly, environmental interactions. Coupled with their chosen courses of study, all these factors in one way or the other affect their perception of sustainability issues. This is understandable because perception is a dynamic psychosocial subject that takes cognizance of these elements as key factors.

It is important to identify the factors that influence the students' perception of sustainability initiatives and how to improve them in order to enhance campus sustainability. The attitudes of the students of HEIs, based on different factors, vary toward campus sustainability programs embarked upon by their institutions. Five factors influencing students' attitudes and perception of sustainable development will be highlighted.

(i) Demographic factors, such as age and gender, have been noted to exert influence on students' perception. Olsson and Gericke (2016) found differences in the way students of different ages respond to the teaching of sustainability issues especially the adolescents and termed the phenomenon "the adolescent dip in students' sustainability consciousness." They attributed the phenomenon to "brain development and associated psychological changes." In a study at the Middle East Technical University, Tuncer (2008) concluded that there was a significant difference between male and female students' perception on sustainable development. The female students had higher scores than the male students on their perception about sustainable development (Tuncer 2008).

(ii) Socioeconomic status is a very important factor that generally influences human behavior. The socioeconomic status of a student determines the material resources (clothes, money, food, and so on) available for the student. Consequently, the amount of material resources a student has access to plays a significant role in how they exhibit certain distinctions. It determines their preference for certain neighborhoods, educational institutions, social club memberships, recreational and aesthetic types, manners and customs, clothes, food, and patterns of nonverbal behavior (Snibbe and Markus 2005; Kraus and Keltner 2009). Since all these preferences are undergoing certain changes in term of sustainability, students' perceptions about such changes are bound to be influenced by their social status.

(iii) Education and awareness level have been proven to a very large extent to have a great influence on the perception of students on sustainability. For example, attending a course on sustainable development or watching a media campaign on pursuing a sustainability goal could help a student embark on a project that has a sustainability dimension. Al Yousuf (2016) has linked education and awareness to a better adaptation to climate change by communities.

(iv) Personality and interest have a strong relationship with how an individual perceives and relates to the environment he/she lives in. Sustainability perception is therefore hinged on complex factors such as personality and interest. "Individual behavior creates the foundation for action in social, economic, and environmental sustainability which potentially guides human ability to work with one another to make sustainable decisions" (Pappas and Pappas 2015). Steg et al. (2014) also found that individuals with strong environmental values or interest do have relatively higher motivation to adopt a pro-environmental or sustainable attitude.

(v) Religious, cultural, and political orientations are another set of factors that influence the perception of students about sustainable development. Religious orientation has undoubtedly influenced the perception of outward realities and physical environment. Although its importance in academic debates remained neglected until the start of the new millennium (Deneulin and Rakodi 2011), it proves to be a determinant factor in sustainable development. Students of HEIs are mostly adults that hold divergent religious faiths which influence their perception about sustainability issues.

Hope and Jones (2014) inferred, from their study using exploratory mixed methods, the influence of religious faith on environmental issues and carbon capture and storage technologies. They concluded that Muslim and Christian participants had low perceptions of the immediate need to act on environmental issues compared to other participants. They suggested that the beliefs of the two groups in divine intervention and afterlife might account for the low perceptions (Hope and Jones 2014). Koehrsen (2017), based on social differentiation theory, identifies the manifestations of religion in sustainability transitions (STs) in two forms: (a) religious actors acting as "service providers" for STs, contributing with specific functions to these processes (e.g., public lobbying, value dissemination), or (b) "nonreligious" actors involved in STs employing religion in their communication, thereby creating "green religions." Abubakar et al. (2016) found that cultural differences might have played a role in the observed uninterested attitude of the students of the University of Dammam in contrast with the students of two US universities. They cited the top-down approach to administration and limited public participation as factors that might have fostered the uninterested attitude (Abubakar et al. 2016).

Just like religious orientation, political ideology reflects shared principles, beliefs, and values of individuals within a society. It plays a major role in their perceptions as it is "a lens through which people view and react to the world around them" (Jost et al. 2009). At the national level, the political stance on environmental issues, eco-politics, could trigger what Blühdorn and Welsh (2007) describe as politics of unsustainability. In the United States, the liberals and conservatives due to their political inclinations diverge about their beliefs regarding climate change and its impact (Botzen et al. 2016).

Highlights of Case Studies of Students' Perception

The drive toward achieving sustainable development in diverse areas of human existence has led researchers in various fields to carry out studies on perception of sustainability. The evolution of global campus rankings is also a pointer to this fact. These global rankings have acquired significant prominence with visible effects on university governance and educational policy (Marginson and van der Wende 2007; Alshuwaikhat et al. 2017; Abubakar 2019; Aina et al. 2019). The motivation of HEIs in registering for sustainability ranking is in line with the objectives of UI GreenMetric (2016) ranking. They are to "(i) contribute to academic discourses on sustainability in education and the greening of campuses; (ii) promote university-led social change with regard to sustainability goals; (iii) be a tool for self-assessment on campus sustainability for higher education institutions (HEIs) around the globe; and (iv) inform governments, international and local environmental agencies, and society about sustainability programs on campus." However, the success of the initiative cannot be achieved if developed only as a policy statement without effective involvement of the key stakeholders (Howes et al. 2017) which include the entire management and staff, the student population, and the institutions' host communities.

HEIs are regarded as the citadel of great learning and ideas. As such, the students are expected to have a positive perception about sustainable development and issues surrounding it. However, since not all students are exposed to environmental education early enough, their perception about sustainability are likely to differ. For instance, Dibra and Oelfke (2013) in studying the perceptions of master's students in sustainable tourism management program at the University of Shkodra toward sustainable tourism development in Albania found out that greater percentage had a positive perception about the outcome of sustainable tourism development for the country. The positive perception is attributed to the awareness gotten through the education received during their courses in the university.

In a similar study in the University of Plymouth, USA, on students' perception on sustainability (Kagawa 2007), it was found out that the majority of student respondents agreed that sustainability is "a good thing" even though their positive response did not particularly correlate with their degree of familiarity with either of the concepts of sustainable development or sustainability. Students also strongly associated the concepts of sustainable development and sustainability more with the environmental dimension than with the economic and social dimensions. They were also inclined toward a sustainable lifestyle through taking responsibilities such as consumers with better purchasing habits, recycling, and saving energy and/or water. However, the students harbor mixed feelings regarding the future of society in the face of sustainability-oriented challenges. In a study in the Arab countries, Cruz et al. (2018) observed that country of residence, community, and environmental knowledge exerted significant influence on the attitudes of nursing students toward environmental sustainability with the Saudi students having the most positive attitude.

Frameworks for Enhancing Students' Perception

In order to provide guidelines for designing curricula that develop graduates with the needed sustainability attributes and attitudes, a number of authors had presented frameworks for enhancing students' perception. The frameworks were based on sociological, psychological, and educational theories. Thomas (2005) developed a framework based on the perceived legitimacy theory for evaluating the effectiveness of teaching methods for integrating sustainability into the curricula. The study showed that the framework can help in understanding the attitudinal impact of a curriculum. In a further study of perceived legitimacy, Watson et al. (2017) concluded that students' perceptions of legitimacy "matter in shaping their environmentally responsible behavior (ERB)." Sibbel (2009) highlighted a set of guidelines based on social cognitive theory, the "Boyer model of scholarship," for developing graduate attributes for fulfilling the responsibilities of the global citizen and sustainability science. The guidelines entail "project learning" and multidisciplinary approaches. For promoting a systemic campus, Moganadas et al. (2013) proposed a conceptual model based on perceived importance and implementation, extrinsic and intrinsic motives, and key dimensions of sustainability. They argued that the implementation of education for sustainability should be holistic and the perceptions and motives of stakeholders are very important factors to be considered. As regard project- or problem-based learning, Brundiers and Wiek (2011) argued for the engagement of students in real-world sustainability problems. They posited that through these real-world projects, the students will be learning while assisting in solving sustainability problems in the society. In the same vein, Leal Filho et al. (2017) presented a framework through the "Universities as Living Labs" projects across three countries to demonstrate how universities can collaborate to contribute to real-world sustainability knowledge. The projects involve students, academic staff, researchers, and other stakeholders, including external ones. The foregoing shows that frameworks for enhancing students' perception should be holistic and multidisciplinary and incorporate real-world projects and external collaboration.

Conclusion

There is no doubt that higher education could play a vital role in achieving sustainable development since development indices and rankings depend on it. Students' population are always the highest in any institution; hence, their opinions on the current discourse are crucial. The concept of sustainable development and the demands that this puts on individuals and professionals are constantly evolving. Furthermore, it is essential that educational institutions are flexible regarding to the competencies related to the sustainable development that they aim at providing to their students. Students' perceptions will always affect institutional policies and strategies within and outside the institution. This leads to the general conclusion that the students' perception on sustainable development could be better improved if universities take it up as a crucial task by providing education for sustainable development to their students in all programs to meet the needs of the society and industries/companies. The universities should also encourage the integration of sustainable development into more courses, where relevant, to increase the relevance of the topic and make clear the connections to different knowledge areas to students and to introduce sustainable development as an integral part of their professional work. Knowing fully well that there are many other stakeholders of sustainability in a university, opportunities exist to explore these stakeholders' perceptions of campus sustainability with a comparison to the student's perspectives.

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Students' Perspectives on Sustainability

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Synonymous

Attitudes; Perceptions; Points of view

Definitions

According to the Oxford Dictionary, the definition of perspective is "*a particular attitude towards or way of regarding something; a point of view.*" Furthermore, studies on perspectives on sustainability focus on what students know about sustainability. As a result, we define perspectives on sustainability as the perceptions, points of view, attitudes, and/or knowledge someone has about sustainability. Perspectives can act as drivers for change by triggering reflections on the status quo and on how to further develop Education for Sustainable Development (ESD).

Introduction

Education plays a central role in sustainable development. Even though a lot of research has been carried out regarding Education for Sustainable Development (ESD) in higher education, many universities are still behind in terms of what is needed. Literature regarding strategies for integrating sustainability in higher education is abundant. It is frequently put forward that ESD calls for a systemic change and paradigm shift, both at institutional and student level. Divergent perspectives on sustainability can act as barriers to integrate sustainability in higher education by perpetuating the traditional ways of thinking and being. Perspectives can act as drivers for change by triggering reflections on the status quo and on how to further develop ESD.

This chapter discusses three main perspectives on sustainability: the relativistic perspective, the environmental perspective, and the technocratic perspective. These three perspectives emerge from the literature and relate to different aspects of ESD integration. The *relativistic* perspective relates to how sustainability is conceptualized and understood. The *environmental* perspective refers to the dominant pillar of sustainability seen as its synonym. The *technocratic* perspective connects with the dominant teaching paradigm and, consequently, how knowledge is perceived and used to solve problems. Other perspectives might exist, but we have decided to focus on these three perspectives because students and educators share these, which present a barrier to integration of ESD in higher education.

The following three sections discuss each one of the perspectives mentioned above. The chapter closes with two other sections: recommendations and suggestions for ESD and conclusions.

Relativistic Perspective on Sustainability

Commonly, sustainability is defined as "*meet[ing] the needs of the present generation without compromising the ability of future generations to meet their needs*" (World Commission on Environment and Development 1987, p. 43), but other definitions exist. The Centre for Sustainable Futures (CSF) at the University of Plymouth takes a holistic concept of sustainability that embraces the "*complementary notions of environmental security, intra-generational and inter-generational equity, economic betterment, and social and environmental justice*" (Kagawa 2007, p. 319). Even though there has been a "universal" definition of sustainable development since 1987, many academics agree that there is no single framework, conceptualization, and understanding of sustainability (Kagawa 2007, p. 319). This presents a challenge for the conceptualization of sustainability among students and academic staff.

In a report for the Higher Education Academy on Sustainability in Higher Education: Current Practice and Future Developments, Dawe et al. (2005) state: "*substantial work in progress, a range of good practice, but overall a patchy picture with sustainable development being marginal or non-existent in some influential disciplines but increasingly higher profile in others*" (Dawe et al. 2005, p. 4). This indicates a fragmented and unbalanced integration of sustainability in higher education.

In addition, many teachers and lecturers feel alone and unsure about the meaning of the words "sustainable development" (Parkin et al. 2004). Parkin et al. (2004, p. 10) mention some typical responses by teachers:

- It is vague and meaningless; my job is difficult enough without any more confusion.
- It is the environment, isn't it? – and we are addressing that.
- It is a political thing, an ideology and therefore not a legitimate thing to put into my course.
- It is hugely complex, a vast body of knowledge that goes across many subjects and disciplines, therefore too much to put on my course, or expect my staff (or me) to know about.

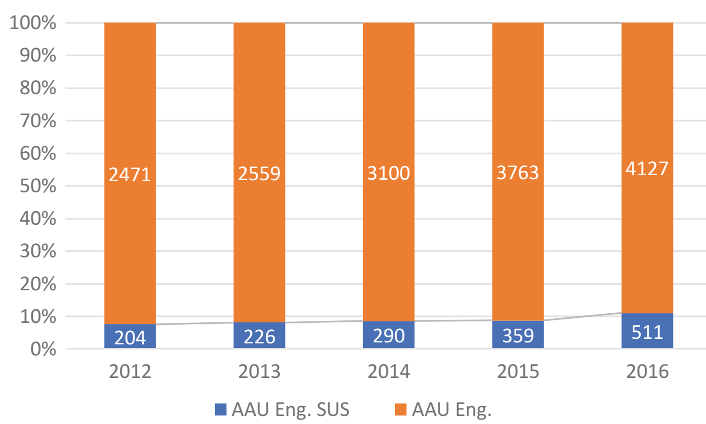
In another study, Guerra et al. (2016) analyze students' and academic staff's perspectives on sustainability, indicating that the existing flexibility in defining sustainability leads to a multitude of definitions, where "everything can be sustainable development." Furthermore, the authors claim that "*if a multitude of definitions [. . .] are to coexist, staff and students are faced with the challenge not only to understand different definitions of sustainability but also to adopt or even develop their own definition(s) of sustainability.*" In sum, a fragmented integration, the sense of insecurity, the lack of understanding, and the multitude of definitions have contributed to a relativistic perspective on sustainability. This makes it difficult for academic staff and students to take the need for education for sustainability seriously.

Environmental Perspective on Sustainability

The second perspective on sustainability, we will focus on is the environmental perspective. Very often environment is used as a synonym for sustainability. It is actually one of the typical teachers' responses when it comes to defining sustainability (Parkin et al. 2004, p. 10). Also, when measuring "what students know about sustainability," there is an emphasis on environmental sustainability (see, for example, Clark and Zeegers 2015; Hopwood et al. 2005; Jollands and Parthasarathy 2013; Miller and Brumbelow 2017; Tuncer and Sahin 2016; Zeegers and Francis Clark 2014). As a result, economic prosperity and social equity, the two other pillars of sustainability, are neglected. Clark and Zeegers (2015), for example, refer to a study by Oxford University (see Summers et al. 2004) of postgraduate teacher education students and found that 87% of the students cited the centrality of the environment, 69% cited economic examples, and 49% mentioned social sustainability.

At Aalborg University (AAU), all engineering curricula are problem based and project organized (PBL), where groups of students solve real problems through projects from day 1. Furthermore, one of the defining principles of the Aalborg PBL model is participant-directed learning, which means that students have a certain degree of freedom to define topics and learning outcomes beyond the ones formally stated in the curriculum (Aalborg University 2015; Graaff and Kolmos 2003). Problem-based project modules constitute 50% of the semester, providing the opportunity for students and supervisors to work with sustainability without realizing it (Hansen et al. 2014, pp. 39, 75). Following this assumption, engineering students' project reports written in the period 2012–2016 have been analyzed (2018) using the Global Reporting Initiative (GRI) as indicators. A total of 17,610 engineering projects from the Aalborg Project Library (Aalborg University Bibliotect 2018) have been listed and screened, and showed that 1590 projects relate to sustainability. These results show an increase in students' interest in sustainability over the years (Fig. 1) and a predominant focus on environmental sustainability (Table 1). Within the environmental quality category, all GRI indicators are addressed in all reports.

Students' Perspectives on Sustainability, Fig. 1 Distribution of AAU faculty of engineering student reports (AAU Eng.) and AAU faculty of engineering student reports on sustainability (AAU Eng. SUS) between 2012 and 2016 (n = 17,610)



Students' Perspectives on Sustainability, Table 1 Overview of frequencies of GRI indicators per category of analysis

Category	School of architecture, design, and planning	School of information and communication technology	School of engineering science
Economic prosperity	180	352	277
Environmental quality	1433	856	1067
Social equity	333	108	652
Total of GRI indicators	1946	1316	1996

Each category clusters subcategories and indicators providing 34 keywords used in the projects' content analysis. The frequency for each category is calculated summing the frequencies of the subcategories and indicators. The category sustainability is the exception where sustainability constitutes a keyword by itself together with the word "sustainable"

Technocratic Perspective on Sustainability

While the above two sections relate to the concept/definition of sustainability (i.e., the relativist perspective on sustainability) and the narrow focus of sustainability (i.e., the environmental perspective on sustainability), this section addresses the technocratic perspective on sustainability. The technocratic perspective on sustainability is mainly related to the dominating teaching paradigm, i.e., the ways we perceive knowledge and address problems (Gough and Scott 2006; Guerra 2014; Orr 2011; Williams 2008). The dominant teaching paradigm is characterized as mechanistic and reductionist, promoting a simplistic view of knowledge and silo thinking (Guerra 2014; Orr 2011; Williams 2008).

Williams (2008, p. 41) says that "*the traditional forms of schooling have exacerbated the problems of isolationist and silo thinking.*" Gough and Scott (2006) examine the perspectives involving politics, education, and sustainability. According to these authors, the technocratic perspective "*depends upon a reductionist, mechanistic view of the natural world, and exhibits confidence in the ability of human beings to develop scientific and technological solutions to environmental problems as they emerge*" (Gough and Scott 2006, p. 277). This means that sustainable problems are always simplified – by removing, for example, their contextual elements – and "solved" with the proper technical and disciplinary expertise (Guerra 2017). Consequently, the current teaching paradigm is to train students and equip them with the technical and disciplinary knowledge and competencies to solve them, thereby perpetuating the silo thinking. Therefore, educating for sustainability within this silo thinking would also mean that different areas solve the problems within their discipline and are linked to a specific pillar of sustainability. For example, social scientists should solve social sustainability problems, economists should solve economic sustainable problems, and biophysical experts should solve environmental sustainability problems (Gough and Scott 2006). This silo thinking is also visible, for example, in engineering and science where sustainability mainly focuses on environmental problems and technical solutions. More multidisciplinary collaboration is needed, not only within a knowledge domain but also across different areas of expertise (Guerra 2017).

Gibbs et al. (1998), for example, identify a spectrum of perspectives organizations have when approaching sustainable development, ranging from a technocentric "very weak sustainability" position through to an ecocentric position of "very strong sustainability" (Gibbs et al. 1998, p. 1352). In a technocentric "very weak sustainability" perspective, the "*emphasis will effectively be on raising environmental efficiency, that is, reducing the environmental impact of each unit of economic activity and addressing individual parts of the economy, such as firms or sectors, without a holistic approach to the environment*" (Gibbs et al. 1998, p. 1352). Educating for sustainability needs not only to be problem oriented, but it also needs to consider the types of problems and contexts used for students to solve them. Therefore, the teaching paradigm needs to change to a more holistic one, where the curriculum is problem oriented and promotes multidisciplinary collaboration across programs, departments, and faculties (Guerra 2017).

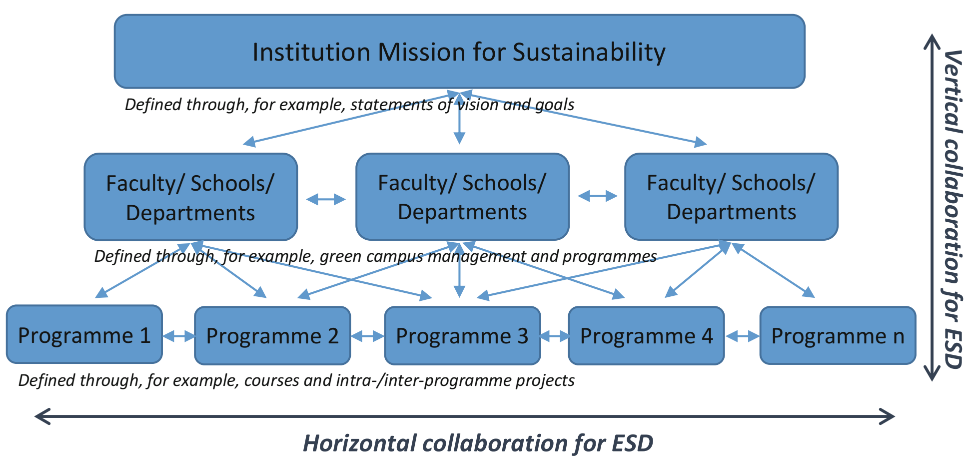
In the specific case of engineering education, the technocratic perspective prevails. For example, all engineering education programs at Aalborg University (AAU), Denmark, are organized around problem-based projects (PBL). Even though PBL is a suitable pedagogy for integrating sustainability, studies carried out at AAU show that different types of problems present different relations to ESD. For example, the problem scenarios used in technical education programs, such as civil engineering, do not necessarily include environmental, social, and economic contextual elements, thereby limiting the understanding of the problem as a whole as well as the decision-making processes and impacts of the solutions developed (Guerra 2014, pp. 218–221). Recently, 36 reports on both B.Sc. and M.Sc. students were randomly selected from a pool of 1590 projects addressing sustainability. Most of the reports focus on a set of technical and disciplinary goals, enclosing a restricted number of sustainability indicators within the same sustainability sphere.

Recommendations and Suggestions for ESD

As argued above, sustainability is a complex concept, where divergent definitions and conceptualizations are a challenge for its integration in higher education. Therefore, an institutional definition of sustainability and a frame of action in relation to the different education programs/practices are of utmost importance in order to construct a comprehensive framework for sustainability (Guerra 2014). Figure 2 illustrates the different levels of integration and collaboration of ESD with the aim of developing a comprehensive framework to define sustainability. Students must be involved at all levels when it comes to defining sustainability and the development of a comprehensive framework for its conceptualization and implementation in higher education.

Such a comprehensive perspective on sustainability would also imply communication and collaboration vertically and horizontally across institutional levels, involving educators, administrators, and students, as well as other stakeholders like companies, NGOs, etc. Furthermore, an institutional comprehensive framework for sustainability would align its integration at different levels, i.e., management, research, and educational. For example, an institution's mission statement for sustainability would be wide and broad, whereas in the specific departments, programs, and courses it would be defined within its disciplinary contexts and be more action oriented (Guerra 2014; Sterling 1996).

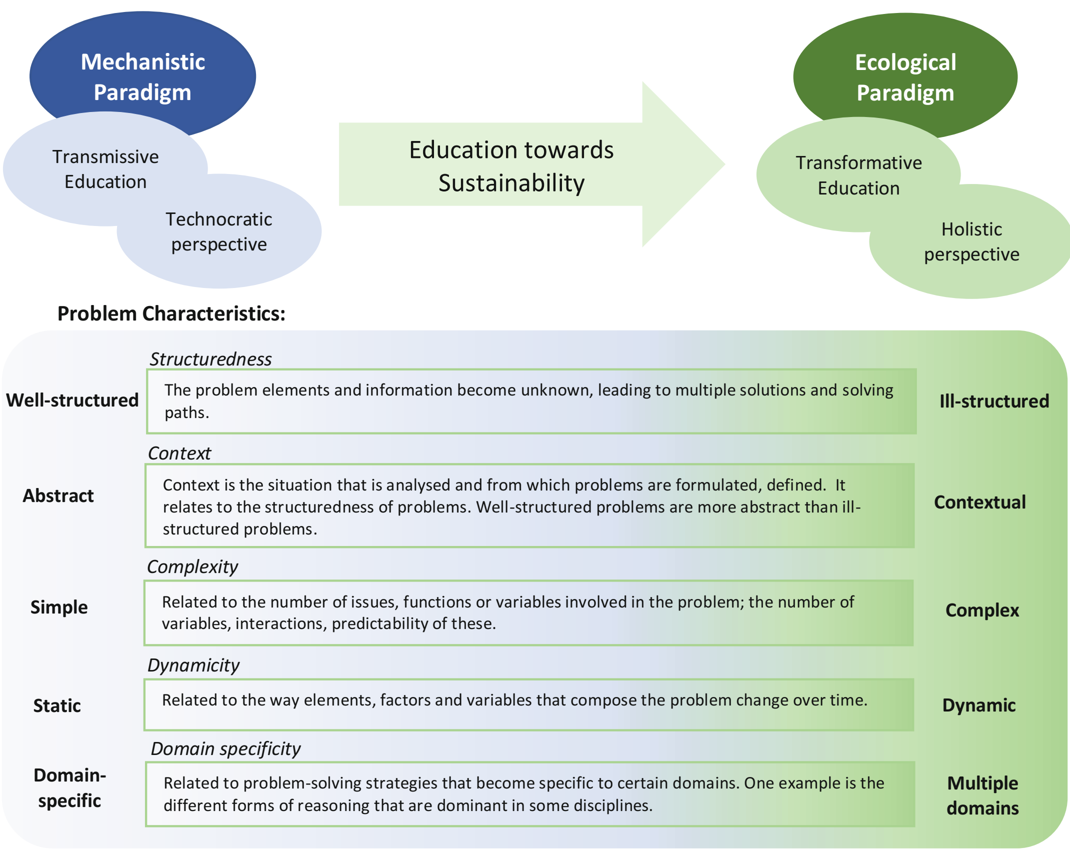
Nevertheless, it is essential for students to understand the relationships between environmental, social, and economic dimensions of sustainable development in order to cope with the characteristics of postmodern society such as climate change,



Students' Perspectives on Sustainability, Fig. 2 Different levels of integration and collaboration for a comprehensive definition of sustainability. (Based on Guerra 2014) social inequality, resource depletion, and the interlinked nature of these challenges (Winter and Cotton 2012, p. 784). A focus on environmental sustainability only narrows the understanding of sustainability. Educating for sustainability means educating holistically, promoting systems thinking and critical reflection, involving the three pillars of sustainability. Greening higher education by adding courses on sustainability to the curriculum is not enough; it is necessary to integrate sustainability topics from all three pillars wherever it is appropriate and aligned/contextualized with course content.

Therefore, a PBL curriculum for ESD should create opportunities to equip students with competencies to tackle complex problems and deal with the uncertainties of technology in order to develop better and sustainable solutions for local communities. The types of problems and problem scenarios play a central role in developing not only students' technical expertise, but also competencies for sustainability.

Jonassen (2011) identifies five main characteristics of problem scenarios: structuredness, context, complexity, dynamicity, and domain specificity. These characteristics are interconnected and present a continuum, from well-structured to ill-structured, abstract to contextual problems, simple to complex, static to dynamic, domain-specific to general/multiple domains. Both ends of the spectrum relate to different perspectives on teaching. For example, well-structured, abstract, static, and domain-specific problems align with technocratic perspectives whereas ill-structured, contextual, and multidisciplinary problems align with a more holistic perspective. The latter types of problems are also referred to in literature as sustainability wicked problems. See, for example, Mulder et al. (2015), Waddock (2013) and Seager et al. (2012). Figure 3



Students' Perspectives on Sustainability, Fig. 3 Landscape of problem characteristics and their relation to teaching paradigm for ESD. (Based on Jonassen 2011; Sterling 2001) illustrates the landscape of problems based on their characteristics and their relations with the paradigm and type of education for sustainability.

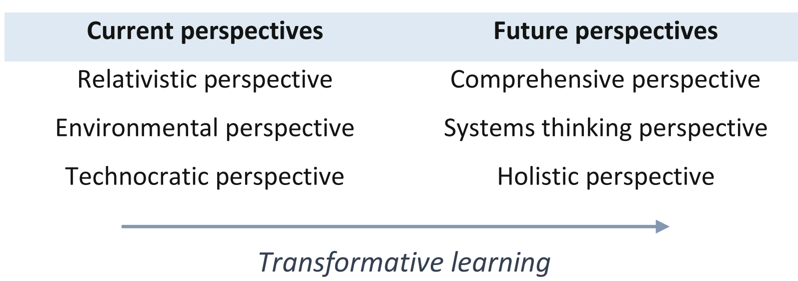
On the other hand, the PBL curriculum should not throw students into the "deep end of the pool" when they enter higher education. Learning through problems for ESD should rather be progressive by developing the right competencies in order to be able to navigate in the complexity that sustainable wicked problems require.

Conclusion

Inserted into the *Encyclopaedia on Sustainability* series, this chapter addresses the topic "Students" (future) perspectives on sustainability' through three perspectives: the relativistic, the environmental, and the technocratic perspectives on sustainability. These perspectives are mainly drawn from different studies investigating sustainability in higher education. Note that literature refers mainly to the current perspectives on sustainability and not to future ones. In fact, studies focused specifically on students' future perspectives on sustainability are scarce, if nonexistent.

The three perspectives discussed in this chapter allow us to identify where the integration of sustainability in higher education finds its weaknesses in educating and preparing our students for the future. Investigating and understanding students' perspectives on sustainability should be one of the first steps any ESD integration strategy should have. Students' perspectives on sustainability provide an early diagnosis and understanding of where education for sustainability is "failing." To some extent, the above three perspectives show this. For example, in the relativistic perspective, students struggle with a multitude of sustainability concepts not only at institutional level but also at course level. Sustainability should be seen as an integrative and contextual concept, where the institutional mission provides the guidelines and the different educational programs contextualize and operationalize it within the disciplinary area. Therefore, ESD should promote a comprehensive perspective on sustainability. While the relativistic perspective emphasizes the challenges in conceptualizing sustainability as a whole, the environmental perspective refers to where the emphasis is. The environmental perspective reduces sustainability to environmental issues: waste management, climate change, etc. Focus on the environment only narrows and limits the understanding of sustainability and the interrelations between social and economic systems. Therefore, ESD should develop a systems thinking perspective on sustainability. Finally, but importantly, the technocratic perspective relates to the dominant teaching paradigm, how knowledge is perceived and used to solve problems, i.e., mechanistic and reductionist. ESD advocates a change of paradigm, where students should learn through active learning pedagogies and solve real problems. The sustainability content can be put in the curriculum through courses (known as the greening approach), but if students do not actively engage in their learning process, they learn *about* sustainability and not necessarily *for* sustainability. Therefore, the ESD teaching paradigm should be holistic and problem oriented.

Figure 4 summarizes the students' perspectives discussed in this chapter and refers to what future



Students' Perspectives on Sustainability, Fig. 4 Students' perspectives on sustainability: current and future perspectives students should have. To change students' current perspectives on sustainability, a transformative learning process is needed, where students' world views, beliefs and values change and become aligned with sustainability principles and values.

The transformation of higher education and perspectives on sustainability is a hard and long process that requires different resources and several stakeholders, and faces challenging barriers. However, literature presents good examples from all over the world (see, for example, Arizona State University 2019; Chalmers University 2019; Fenner et al. 2005; Leiden-Delft-ERASMUS 2019; Mulder et al. 2012; Sipos et al. 2008), showing the variety of initiatives, strategies, and activities of ESD integration.

Currently, a "new wave" of ESD is taking shape through the 17 Sustainable Development Goals (SDGs). Published by the United Nations in 2015, the SDGs constitute a framework for sustainable development actions toward 2030. The SDGs are based on previous declarations and what the eight Millennium Goals did not achieve for Sustainable Development (MGSDs) (2000–2015) (United Nations 2015). The SDGs provide higher education institutions with an opportunity to revise their role in educating for the future, and for sustainability, and to develop strategies and implement initiatives capable of fostering change. To support higher education institutions in this pursuit, more knowledge is needed on students' perspectives on sustainability, how they change over time, how they affect students' personal lives, professional identity, and practice, and what the impacts are of different learning and teaching strategies.

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Substitutability

► "Deep" or "Strong" Sustainability

Supradisciplinarity

► Multi-disciplinarity

Sustainability

► Green Living Guide and Sustainable Development

Sustainability and Education Policy

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Definition

Sustainability refers to continuity of the world for the next generation with reference to its social, environmental, and economic dimensions. Sustainability, as an interdisciplinary concept, regards sustainable development as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland 1987). Education about sustainability becomes increasingly important for the next generation, who are exposed to a wide range of challenges concerning sustainability. One of the major concerns is the ongoing impacts brought about by climate change affecting environmental sustainability in various regions of the world, which in turn could affect social and economic sustainability. In order to promote sustainable development in the next generation, adequate education policy for sustainability is advocated among education institutions around the world, with endorsement by the United Nations. Such education policy for sustainability should be integrated into formal plans and procedures by tertiary education institutions and across academic disciplines and are essential for reinforcing sustainability efforts (Leal et al. 2018).

Introduction

Social and environmental sustainability affects how human beings would continue to inhabit in the planet earth. In order to safeguard the sustainability of the world, it is necessary to engage educational institutions in a formal way through incorporation of appropriate policy on sustainability education for the next generation. There has been a global trend for sustainable development as embraced by the United Nations in its Sustainable Development Goals (SDGs). This particular trend has become relevant to political agendas among various nations, seeking a balanced approach for their economic development. In the meantime, there have been more academic research studies and education programs among tertiary institutions on issues relating to sustainable development. Relevant research and scholarly outputs would underpin quality education about sustainable development. Pertinent education policy needs to be formally incorporated into education institutions to ensure that their overall performance is measured and aligned with the mission and vision for sustainability. Specifically, sustainability can be embedded into the mission, vision, and strategy of an educational institution. It is also essential for an education institution that embraces sustainability to design institutional learning outcomes for the development of its students with relevant competence for sustainability. Education policy for sustainability can also enable sustainable campus development among education institutions by active engagement of their students and other local stakeholders through a variety of learning and sharing activities.

Global Awareness About Sustainability Issues

Sustainability has, in the recent decade, received attention in academic research areas, ranging from accounting, business, and economics to environmental sciences, politics, and sociology (Hopwood et al. 2010; Leal 2011). The significance of the concept of sustainability has been highlighted by international communities and policy makers as a key premise for nurturing a notion about wholeness and interdependence of life as well as a basis to learn about continuation on a global scale (UNESCO 1997). More recently, a number of Sustainable Development Goals (SDGs) have been established by the United Nations as part of the 2030 Agenda to initiate a global effort and to establish a long-term target for sustainability performance. In particular, SDG Goal 4 is set to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." As deliberated in the UN SDGs, obtaining quality education is considered as fundamental for improving people's lives and sustainable development as one of the responses to the growing global concerns over climate change and other issues relating to environmental and social sustainability (Leal et al. 2017a).

In fact, a broader sense of sustainability has been advanced to cover ethical issues resulting from unsustainability of the world and its consequence on public health (Martin et al. 2016). As reported by the Lancet Commission on pollution and health, 2017, "*Pollution is the largest environmental cause of disease and premature death in the world today. Diseases caused by pollution were responsible for an estimated 9 million premature deaths in 2015–16% of all deaths worldwide – three times more deaths than from AIDS, tuberculosis, and malaria combined and 15 times more than from all wars and other forms of violence*" (Landrigan et al. 2017). In particular, it is alarming to reveal that these sustainability issues are associated with key emitters of carbon dioxide and sources of pollution, include coal-fired electricity-generating plants, mining operations, deforestation, and fossil-fueled vehicles resulted from the legacy of the traditional economy (Landrigan et al. 2017). In response to these concerns, policy makers should realize that education about such a linkage between sustainability and human health is much needed for the next generation as literally the most imminent stakeholders in recognizing such emerging concerns and seeking solutions that would mitigate these trajectory developments in search of a low carbon economy. As such, education policy for the next generation should consider timely incorporation of sustainability issues into the education curriculum.

Interdisciplinarity as Requirement for Sustainability Education

Issues relating to sustainability are interdisciplinary and require reformulation of public policy from different disciplines and experts to work together in addressing these issues. Similarly, it is essential for education institutions to formulate policy to advocate that education for sustainability needs to adopt an interdisciplinary approach as problems related to un-sustainability are linked across various disciplines. In seeking solutions to improve sustainability, it is critical to uphold education about sustainability as a study that is not confined to a particular discipline. It would take concerted efforts and interdisciplinary knowledge from a broad-based business discipline, including accounting, finance, management, and operations, to applications of science and technologies. There is a need for the next generation to exploit technological innovation in combating challenges in the development of a more sustainable economy for the future (Ashford and Hall 2011).

The concerns over the linkage between environmental sustainability and public health, for instance, require expert inputs across business, engineering, medical health, and the sciences. Sustainability education often involves learning experience across interrelated disciplines in understanding the pertinent problems as well as possible mitigating measures and solutions (Jones et al. 2010). There are however variations perspectives on education for sustainability, namely the instrumental view, the intrinsic view, the resilient learner, and learning via resilience theorists (Sterling 2010). In order to enhance study about sustainability, it is argued that a paradigm shift should take place with a change in epistemology extended from reductionism to holism (Tilbury 2014). Cross disciplinary efforts among the policy makers are widely observed in the real world in dealing with environmental and social sustainability issues. For instance, the finance ministry needs to implement economic incentives to encourage public behavior in support of environmental sustainability, such as reduce, reuse, and recycle. Education about sustainability needs to embrace these real-world interdisciplinary issues. As these issues related to sustainability are relevant to education programs of various disciplines, pertinent institutional learning outcomes should be incorporated especially by tertiary education providers as policies focused on such matters.

Development of Policy for Sustainability Education in Tertiary Institutions

Despite external concerns over sustainability, an institution needs to consider legitimacy when making changes and adopting a transformed mission and vision that differs greatly from its past. There are institutional constraints that remain to be overcome in developing, introducing, and implementing new policies as noted in institutional theory (Gray et al. 2014, p.86). A research study suggests that there are barriers for implementing sustainability education among institutions in various countries, but which could be mitigated if support is provided by institutional leadership (Leal et al. 2018).

Institutionalization of practice for social accounting and sustainability is an exemplary area of study that examines a process of homogenization through a combination of coercion, normative, and mimetic mechanisms (Gray et al. 2014, p.86). Such a practice could gain momentum for legitimacy among institutions as there is an emerging global effort to advance sustainability as advocated under the UN SDGs. Further, internationally recognized policy for sustainable developments could have a positive impact for formulation of sustainable development policy at a regional and national level that in turn drive local sustainability incentives (Ng et al. 2017).

Education for sustainability can largely be formalized into three types of education institutions:

primary schools, secondary schools, and higher education institutions including universities. In fact, there have been active developments among primary and secondary school teachers to incorporate education for sustainability (Huckle and Sterling 2014). Higher education institutions are similarly considered as a key component to reinforce sustainability education for the new generation (Clugston and Calder 1999; Cebrian et al. 2013). It is critical for leadership in higher education institutions to reconsider their existing mission and vision so as to integrate sustainability issues into their policy and rules for curriculum and pedagogy when seeking such a positive change (Tilbury 2011).

Various studies have suggested that the traditional curriculum in higher education institutions needs to be redesigned or integrated with sustainable development into current pedagogy and curriculum innovation. Many institutions have redesigned the current curriculum or programs in order to change the focus to nurturing and fostering sustainability leadership skills, sustainable management, and sustainability competence (Leal et al. 2018; Ng et al. 2017). However, a traditional approach without a complementary vision from the top management for sustainability education could linger with rather narrow topics and market-based programs of environmental conservation, engineering, and scientific innovation (Savelyeva 2016). Such barriers in policy and implementation development for sustainability education still remain in various countries as constrained by the extent of leadership commitment (Leal et al. 2017b).

From Global to Local Initiatives in Developing Education Policy for Sustainability

Despite mixed experience in implementing education for sustainability, there have been various cases of effective implementation through international and local collaborations. For instance, Guido et al. (2018) reports on a model for transnational collaboration in higher education for sustainable development through collaboration between two higher education institutions, from the USA and Europe, respectively. Such knowledge exchange about sustainability performance has been found effective in promoting pertinent collaboration on education between two institutions. In fact, globalization has further legitimized relevant policies for sustainable developments as led by the tertiary institutions among advanced economies. There have been a number of initiatives taken by various international associations that promote and support education and research on sustainability. These associations have a global network of academics and practitioners supporting knowledge exchange and transfer that shapes the development of education policy for sustainability. Some of these notable international associations for sustainability education and research, affiliated with tertiary institutions on a global basis, are summarized in Table 1.

The Association to Advance Collegiate Schools of Business (AACSB), the largest accreditation body for business schools around the world, has also stated in its eligibility guides that business schools must demonstrate a commitment to dealing with education about emerging corporate social responsibility issues, including sustainable development and environmental sustainability (AACSB 2018).

Increasingly under this global trend for cooperation on sustainability education and research, there are higher education institutions that started to engage their students in sustainability education. Leung and Ng (2016) examine the case of a multiple-campus experience of a higher education institution that engages its students and other local stakeholders in campus sustainability developments. Such an approach of engaging key internal and external stakeholders would enable formulation of well accepted and legitimate policy for effective adoption and implementation through a sustainable campus committee. This case study also reflects a top-down approach by the management of an institution in formalizing and implementing such a formal campus sustainability policy, enhanced with informal, action-based learning activities (Leung and Ng 2016). The study by MacVaugh and Norton (2012) further points toward the effectiveness of using

Sustainability and Education Policy, Table 1 International associations shaping policy for sustainability education and research

International associations for sustainability education and research	Objectives	Key activities
Higher education sustainability initiative (HESI) Source: https://sustainabledevelopment.un.org/sdinaction/hesi	The higher education sustainability initiative (HESI) is a partnership between the United Nations Department of economic and social affairs, UNESCO, United Nations environment, UN global compact's principles for responsible management education (PRME) initiative, United Nations University (UNU), UN-HABITAT, UNCTAD and UNITAR, and was created in 2012 in the run-up to the United Nations conference on sustainable development (Rio + 20). Through its strong association with the United Nations, HESI provides higher education institutions with a unique interface between higher education, science, and policy making	With commitments from over 300 universities from around the world, HESI accounts for more than one-third of all the voluntary commitments that were launched at Rio + 20. Through its network of higher education institutions, it promotes teaching sustainable development across all disciplines of study, as well as encourages research and dissemination of sustainable development knowledge, green campuses, and supports local sustainability efforts. It also shares relevant information with its international networks
The sustainability and education policy network (SEPN) Source: https://sepn.ca/	The sustainability education and policy network (SEPN), an international network of researchers and organizations advancing sustainability in education policy and practice, emerges in response to these knowledge gaps. SEPN integrates partnerships between researchers, organizations, and policy partners. SEPN undertakes policy research in international, national, and regional education systems to provide comparative evidenced-based understandings of policy, and enable deeper responses to sustainability. SEPN aims to facilitate two-way flow of knowledge between researchers and nonacademic partners and to develop rigorous comparative, evidence-based understandings of sustainability in education policy. It utilizes research-based evidence to diverse stakeholders and decision-makers. It intends to contribute to research literature in a range of disciplinary fields with an applied impact on policy and practice throughout education systems	SEPN started its national level research collaboration by collecting and analyzing comparable data across Canada's formal education system in 2012. This initiative allowed an examination and comparison of the range of sustainability policies and practices being developed, implemented, and experienced in Canadian primary, secondary, and post-secondary contexts. Since then, SEPN has expanded its focus to pertinent research and education internationally. SEPN's partnership model's focus on research-informed policy making provides researchers and policy makers with a framework for furthering collaboration on policy research and sustainability development in education to maximize the potential for impact
Inter-university sustainable development research programme (IUSDRP) Source: https://www.haw-hamburg.de/en/ftz-nk/about-us.html	It aims to develop interdisciplinary, cross-faculty teams among its member universities, focusing on sustainable development. It provides a working environment that is fertile for international cooperation, supporting institutional and inter-institutional project development. It also engages the sustainability research community at member universities, in the joint training of PhD students and the organization of specific, strategic events. It facilitates the production of high quality, joint publications	It enables institutional strengthening by means of networking, helping to build systems and networks that can respond to emerging funding opportunities, and hence strengthening the member organizations. It facilitates know-how transfer by means of practical projects, transferring the best available know-how and expertise on sustainable development available in the partner universities to others, helping them to advance the cause of sustainability at the institutional level

(*continued*)

Sustainability and Education Policy, Table 1 (continued)

International associations for sustainability education and research	Objectives	Key activities
Centre for social and environmental accounting research (CSEAR) Source: https://www.st-andrews.ac.uk/csear/	CSEAR aims to be a world-recognized, global community of scholars who engage with students, activists, practitioners, policy makers, and other interested groups in order to generate and disseminate knowledge on social and environmental accounting and accountability as a way to envisage and enable a more sustainable society. It also promotes accounting scholarship to enable a more sustainable society. Within the area of social and environmental accounting and accountability, broadly defined, its mission is to encourage and facilitate high quality, relevant research, teaching, and external engagement with practice and policy through developing knowledge, expertise, resources, and a supportive network for mentoring and career development	CSEAR activities include supporting sustainability-accounting education; organizing conferences around the world; sponsoring and commissioning research; mentoring emerging scholars in the field; engaging with practice, the profession, NGOs, activists, government and academe; making research accessible to society at large through communications such as press releases and nonacademic articles

active and problem-based learning on a personal and local level to enhance the implementation of education for sustainability in business-related higher education programs.

Higher education institutions can in fact incorporate learning outcomes aiming to improve the sustainability competence of their students (Shephard 2008; Hill and Wang 2018). Such formalization of learning outcomes and objectives can be embedded at institutional, program, and subject levels. As revealed in a case study, such integrated, outcomes-based learning would enable more effective integration of sustainability education and pertinent ethical knowledge in undergraduate study programs (Ng et al. 2017). An important role of a higher education institution is to engage its students together with other local stakeholders in learning about issues related to sustainability and potential mitigating measures through concerted community sharing activities, such as conference meetings, seminars, and workshops (Ng et al. 2018).

Concluding Remarks

In the recent decades, there has been an increasing global trend to support development of policy for sustainability education among higher education institutions. Some pioneering institutions have indeed implemented such policy, which in turn strengthens synergy between institutional and program-level learning outcomes. Such learning outcomes as advocated by senior management of an institution would uphold the objective for good citizenship and sustainability competence of its graduates through such an integrated approach within an institution. Through formalized education policy, engagement of key internal and external stakeholder as well as implementation of campus-based learning activities, such policy would gain the necessary legitimacy and consensus for subsequent implementation. As a result, students can be given the opportunity to develop their sustainability competence while interacting with various stakeholders in seeking solutions for sustainability.

In order to enhance the sustainability performance in a higher education institution, it is suggested that relevant performance measures pertinent to campus sustainability be developed for reporting and monitoring purposes, which would eventually result in effective delivery of results (Leal et al. 2018; Ng et al. 2017). It requires continuous efforts that in turn take into account the review of sustainability performance while looking into areas of improvement based on the measured performance indicators in comparison with the past. It is a control mechanism for the management of an institution that is committed to its policy in support of sustainability initiatives in a unique way.

To conclude, there is a growing trend to develop and implement policy for sustainability education among higher education institutions around the world. Such a trend is promoted by international associations in support of joint academic research and knowledge exchange initiatives that in turn shape the development of education policy for sustainability around the world. Formal approaches, such as incorporation of pertinent learning outcomes, are often supplemented with informal learning activities and involvement of students, as observed in various studies. It is paramount for educational institutions to engage students about sustainability through self-motivation as well as fostering understanding of the rationale for sustainability education that is associated with their own well-being. The linkage between sustainability and public health needs to be augmented for students engaged in campus sustainability programs as a key initiative under the policy for sustainability. It is critical for education institutions to embrace that education for sustainability demands an interdisciplinary approach. This not only requires research and scholarly work for generation of relevant knowledge about sustainability, but also formal curriculum and informed learning and teaching activities through active engagement with key stakeholders.

Cross-References

► Campus Sustainability
► Sustainability and Education Policy
► Sustainability Education
► Sustainable Development Goals

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Sustainability and Life Cycle Cost Analysis

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Definition

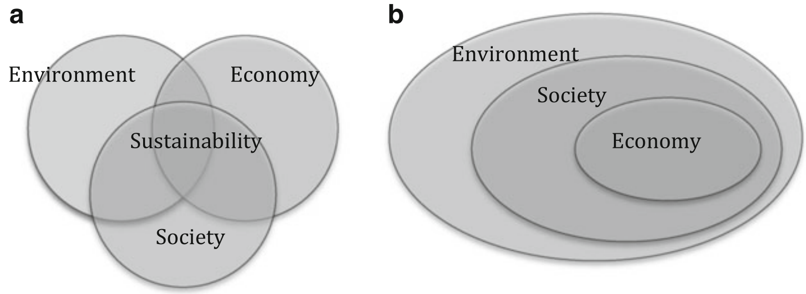
Sustainability is the goal to create and maintain conditions suitable for human life and well-being. Life cycle cost (LCC) analysis is a method for calculating the total cost of ownership of an asset (e.g., a building) over its entire useful life span. It is also referred to as "cradle to grave" cost analysis and is related to life cycle assessment (LCA). Costs included in LCC are the financial costs to design, build, operate, and dispose of the asset as well as the environmental and social costs associated with it, for which LCA can provide estimates. Designing assets with low LCC and LCA impacts thus serves the overarching goal of sustainability.

Introduction

Sustainability is broadly defined as the goal to "create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations" (EPA 2018). Closely related to sustainability is the paradigm of sustainable development, which the 1987 Brundtland Commission famously described as "[human] development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs" (Brundtland Commission 1987). Thus, sustainability and its application to human development are inherently intergenerational, focused on meeting needs (as opposed to wants), and involve maintaining functioning societal, economic, and natural systems.

One way to visualize sustainability is in the form of three overlapping circles (cf. Fig. 1). The circles represent the three domains or pillars of sustainability, i.e., the economy, the society, and the environment. Sustainability requires balancing these domains and hence lives within the overlapping area of the circles. In another conceptualization, the environment, the society, and the economy are depicted as nested ovals. In this perspective, nature and its life-sustaining services function as the "envelope" of society, which in turn enables economic systems to operate. Here, the three domains are organized hierarchically compared with their more egalitarian positions in the previous model (cf. Fig. 1).

The two visualizations thus imply different roles and privileges for the three domains: the



Sustainability and Life Cycle Cost Analysis, Fig. 1 Conceptualizations of sustainability according to weak (panel (**a**)) and strong sustainability (panel (**b**))

three overlapping circles represent a weak sustainability concept, i.e., a balance in which no pillar is more important than the others, and hence positive gains in one area can substitute for losses in another. The nested circles conceptualization, in contrast, is known as strong sustainability, because the nested structure implies that the dimensions are of a different relative importance. In a strong sustainability framework, some environmental services cannot be substituted with man-made alternatives, and their maintenance are preconditions for achieving objectives in the other domains (Neumayer 2003). Other formulations of sustainability have been proposed, but they can generally be placed between the concepts of weak and strong sustainability.

Since the Brundtland Commission released its report "Our Common Future," many scholars and practitioners in virtually all fields, sectors, and disciplines have sought to "operationalize" its definition of sustainable development (Lélé and Norgaard 1996). Many different models, indicators, and assessment tools have been proposed and led to changes in the way we live our lives, governments pursue development, and businesses operate.

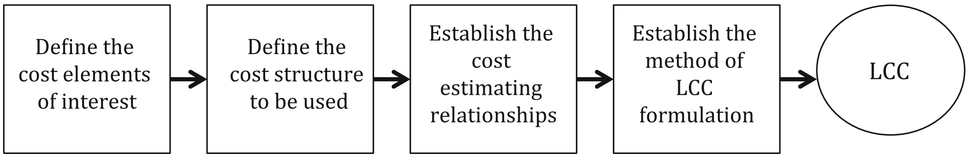
Life cycle costing (LCC) can be seen as one such approach, although its existence predates the Brundtland definition. It is a method for the economic valuation of the full life cycle costs of a product, process, or service (for brevity simply referred to as product in the remainder), i.e., costs that go beyond the initial costs of making or purchasing the product. The practice originated in military equipment planning and cost projection studies conducted in the United States in the 1960s before it spread more widely to businesses and governmental procurement departments.

By applying LCC, users of a product acknowledge that the purchase cost is only one portion of the total financial cost associated with product ownership. Other cost factors include operation, maintenance, and, ultimately, disposal. Through the application of a life cycle perspective, LCC may shed some light on environment-related costs throughout the product's life span (e.g., direct costs related to compliance with emission regulations and disposal). However, it is primarily a type of net present value (NPV) cost accounting that facilitates optimization of value for cost. In other words, LCC belongs to a set of *economic sustainability* tools designed to identify the total costs of a product, process, or activity discounted over its lifetime, which may or may not correspond to the solution offering the most environmentally sustainable choice (Pré 2012). In many cases, however, LCC helps identify opportunities for more efficient use of natural resources and reduce costs by way of decreasing pollutant emissions, water and energy use, and waste.

This article places LCC within the context of sustainability by explaining its general framework and its capabilities and limitations to foster decision-making for sustainability. It is also reviewed within the context of sustainability in higher education.

What Is Life Cycle Costing?

The concept of life cycle costing (LCC) originated in the 1960s when the US Logistics Management Institute used it to determine costs related to a military project (Okano 2001). LCC is an evaluation method and decision-making



Sustainability and Life Cycle Cost Analysis, Fig. 2 Life cycle costing procedure according to Harvey (1976)

tool that considers the total sum of costs (and benefits) related to a product's life span and facilitates choosing from a set of alternative product options (cf. Fig. 2).

Its emphasis is on deciding how best to allocate a finite budget to maximize its overall net return (Okano 2001). Cost categories considered in LCC include outlays for research and development, capital investments, production and construction, operation, maintenance and support, and retirement and disposal. Since the product and its life cycle are at the heart of LCC, it may include not only the costs incurred by manufacturers but also those related to suppliers, customers or users, maintainers, and those involved in the product's final disposal. The method covers the real and traceable money flows between the life cycle phases of the product but also monetary expenses for covering environmental, health, and compliance risks (externalities) that can reasonably be internalized over a decision-relevant time horizon (e.g., as part of forthcoming regulations).

The development of LCC is a rational outcome of normative neoclassical economic theory, according to which firms (and other actors) seek to maximize profits while having full knowledge of costs and benefits (Cyert and March 1963). Prerequisites for this approach are knowledge of preferences and information on available alternatives, as well as the corresponding effects of choosing among these alternatives, applicable discount rates, and future market and regulatory conditions. As will be pointed out in this article, LCC falls short of being able to fully account for environmental and social impacts, because full information on the product's impacts is not always available (Gluch and Baumann 2004).

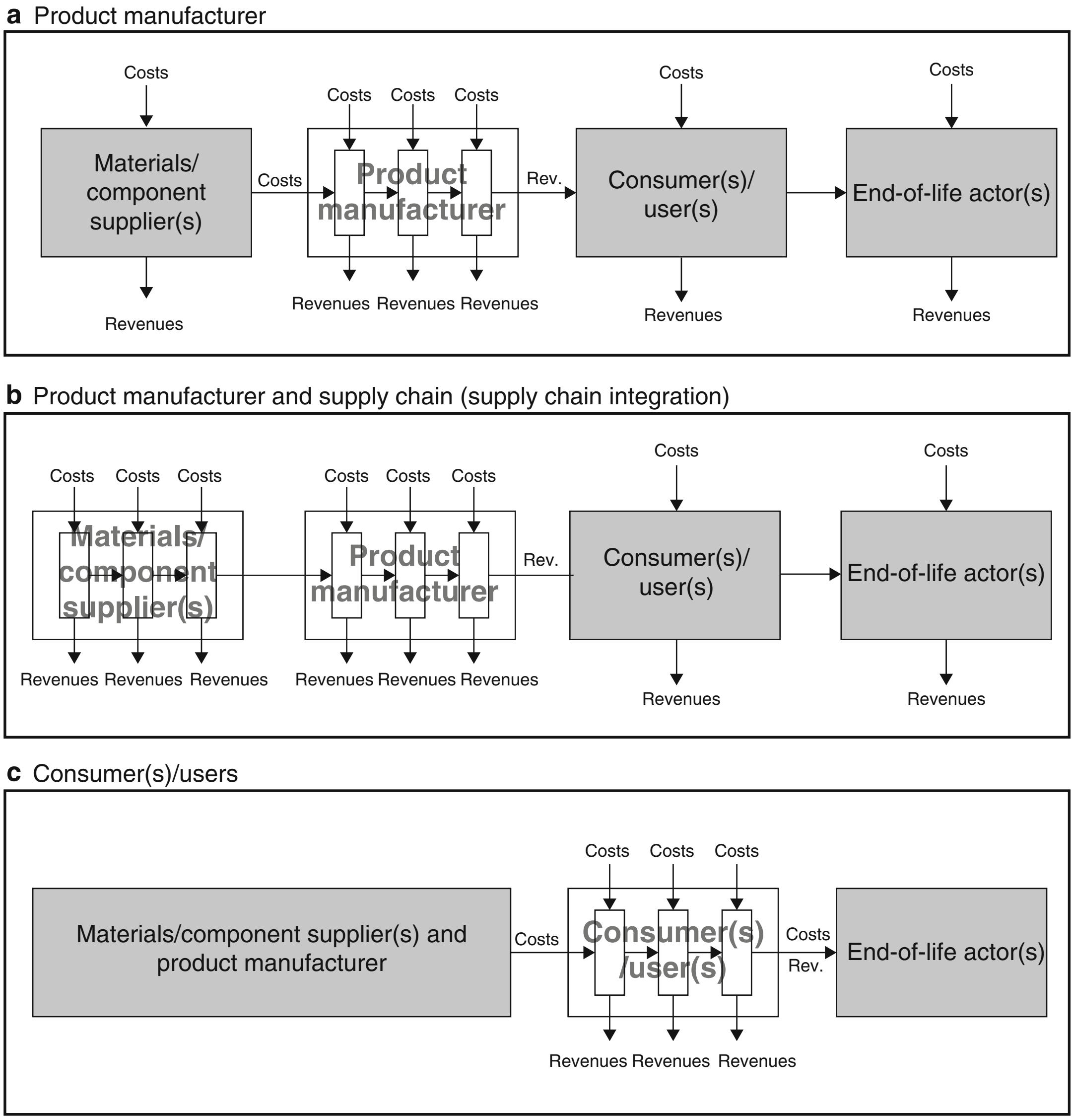
The main users of conventional LCC are businesses and governments, who need to make product development and procurement choices between alternatives on the basis of economic considerations. The costs considered may not always address the full life cycle and frequently focus on the perspective of a given actor such as the manufacturer or the user. Other costs, although relevant for the product's overall life cycle costs, are typically neglected, thus making conventional LCC less comprehensive in scope than other types of life cycle analysis such as life cycle assessment (LCA) (Hunkeler et al. 2008; see also ► "Cradle-to-Grave and Sustainable Development" topic). Figure 3 illustrates some of these different assessment perspectives.

The general procedure for conducting a LCC is described in Kaufman (1970) and includes the following steps:

- Establish the operating profile of the product.
- Establish the utilization factors of the product.
- Identify all the cost elements.
- Determine the critical cost parameters.
- Calculate all costs at current prices.
- Escalate current costs at assumed inflation rates.
- Discount all costs to the base period.
- Sum discounted costs to establish the net present value.

A typical LCC thus considers a large number of items, including the initial capital cost, the lifespan of the product, the discount rate, and the operating and maintenance costs (Woodward 1997). LCC also makes use of information from other products and feedback loops in which the product's operation itself provides ongoing data. Uncertainty and sensitivity analysis is an important part of determining the robustness of the LCC analysis.

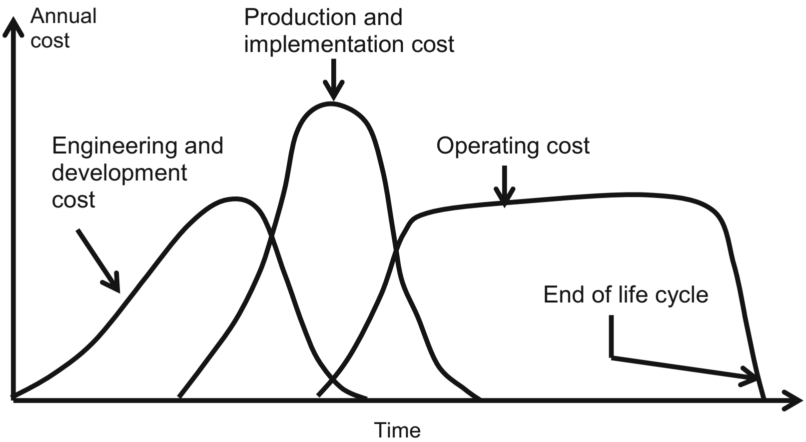
While these items may appear straightforward to determine, there are in practice many decisions



Sustainability and Life Cycle Cost Analysis, Fig. 3 Examples of different perspectives and hence assessment boundaries in LCC. (Source: Rebitzer and Hunkeler 2003)

to be made that are subjective or uncertain. These include determining the relevant life span of the product. In contrast to LCA, in which the life cycle refers to the time span between sourcing the raw materials and the product's final disposal, "life cycle" in LCC refers to the timeline of the product's existence and is a variable that needs to be specified. It may refer to the economic life, the technical lifetime, the physical or the utility lifetime. The economic lifetime is the estimated profitable period of the product, while the technical lifetime refers to the time period until technological innovation renders the product obsolete. The physical lifetime is the estimated period during which the product can be used, and the utility lifetime is the time until the product ceases to satisfy established performance standards (Gluch and Baumann 2004).

In addition to appropriately selecting the cost items to be included and defining an appropriate



Sustainability and Life Cycle Cost Analysis, Fig. 4 Distribution of cost categories along the product's life cycle. (Source: Woodward 1997)

life cycle, the discount rate is of particular importance, since costs arise at different points in the product's time horizon as shown in Fig. 4. To adequately reflect these costs, LCC considers the time value of money and applies discount rates. The lowest discount rate applied is the market interest rate adjusted for inflation. Another option is the cost of equity or financing. If environmental and/or social costs are within the scope of the LCC, then a social discount rate may be more suitable than one based on the opportunity cost of capital. Other approaches include the "hurdle rate," which refers to differential rates that reflect costs that do not negatively impact the environment ("green rate"), that have uncertain impacts ("yellow rate"), and that have known negative impacts ("red rate"). Red rates are generally set to 0%, i.e., their occurrence in the future is just as bad as if they occurred today, while the green rate reflects more closely the time value of money and the yellow rate is somewhere in between the red and the green rate. The choice of discount rate can have a substantial influence on the results of LCC when the product choices to be evaluated have long life spans and incur costs at different points in time.

Despite the information needs and complexities involved in conventional LCC, it is now a relatively widely used method with particularly strong presence in the construction sector for both public and private facilities, where it is enshrined in ISO15686 (ISO 2017). This is not surprising considering that much of a building's lifetime costs arise during operation, including costs related to occupancy, operation, and maintenance (Stanford 2005). The US Federal Government mandates the process for LCC analyses in the Code of Federal Regulations (CFR), Title 10, Part 436, Subpart A: Program Rules of the Federal Energy Management Program:

> The most effective approach to LCC is to appropriately integrate it into the design process. The building design evolves from general concepts to detailed analysis. LCC needs to follow the same approach paralleling the focus to the current level of detail study. . . . When defining alternatives for life cycle costing, an acceptable level of overall building services must be assured throughout the analysis period. Design alternatives must be compared against a baseline reference alternate that is the lowest first cost of the alternatives being considered. The baseline alternate must offer a viable system, employing state of-the-art design features, and be in compliance with all project requirements. Where existing conditions form part of the baseline alternate, the analysis must not only include intended project work, but also the additional costs necessary to achieve code compliance and reliable operation over the analysis period. The analysis period should be chosen to fully represent all costs.

To further standardize the application of LCC in building design, the Federal Government encourages the use of the National Institute of Standards and Technology (NIST) Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135). NIST also issues real growth Energy Price Indices and Discount Factors for Life Cycle Cost Analysis.

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A computer program, the Building Life Cycle Cost (BLCC), is available to perform LCC analyses (GSA 2018).

How Does Life Cycle Costing Relate to Sustainability?

One of the main connections between LCC and sustainability is through its holistic life cycle perspective. LCC is valuable because it offers a systematic way to conduct a full cost accounting analysis, albeit its focus is on direct economic costs arising to the entity conducting the LCC and not on environmental impacts and their costs. Its main shortcomings arise from (Adapted from Gluch and Baumann 2004):

- The inability to handle decision-making under uncertainty, which can be considerable in estimating environment-related costs in the presence and especially in the future.
- Assuming that alternatives are always available (this is akin to taking a weak sustainability perspective). With such a view, irreversible changes, such as extinction of species or catastrophic climate change, are not considered as a problem since they can be "replaced" with alternatives.
- Ignoring items that have no owner and/or market value, which is the case for some environmental products and services such as clean air, biodiversity, and soil erosion protection.
- Oversimplifying multidimensional environmental problems since it assumes that everything can be expressed as a one-dimensional unit, such as monetary figures.

Researchers have worked to examine the environmental links that can be made with LCC and to extend LCC categories to include more environmental objectives, similar to LCA. Gluch and Baumann (2004) provide an overview of LCC and LCC-related techniques that allow inclusion of environmental costs (Table 1).

Since LCC predates LCA and serves an economic purpose, it has developed its own distinct conceptual foundations and methodological approaches, which differ from LCA. Not much integration has initially happened, but both approaches share many fundamentals, including goal and scope definition, inventory creation, and inventory analysis (although LCC has no formal impact assessment step), followed by interpretation of the results. Since LCC and LCA differ in their objectives, the system boundaries, cutoff values, and other analytical decisions may vary as well. Thus, for promoting greater integration, it is critical that both are based on a consistent definition of the product system and that study-related decisions such as setting of cutoff criteria are based on with the intended goals of the study (Swarr et al. 2011). Secondly, since LCC and LCA should complement each other in the context of life cycle product sustainability assessment, it is important to avoid double counting the same environmental impacts in both financial and physical terms.

To bridge the gap, the concept of environmental LCC has emerged, primarily within the life cycle assessment community. Environmental LCC was developed by a scientific working group within the Society of Environmental Toxicology and Chemistry (SETAC) that was established in 2002 and published a code of practice in 2011 (Swarr et al. 2011). It is closely related to LCA and uses the same system boundaries and functional unit. By translating the physical impact and damage estimates into monetary terms, environmental LCC includes externalities, i.e., costs borne by society, and typically covers the full life cycle (Hunkeler et al. 2008). As a result, environmental LCC is technically more complex to carry out but feasible when the LCA results are available. Environmental LCC is often used as a tool for external communication and certification through eco-labeling programs, while conventional LCC is used more widely as an internal decision-making tool (Lichtenvort et al. 2008).

Environmental LCC and LCA are both multistep procedures tracking the resource and energy requirements, emissions, and waste throughout a product's life span. While LCA converts them to physical damage estimates (Pré 2013), LCC is typically used to identify a cost-optimal product design that minimizes life cycle costs while complying with applicable laws and regulations and meeting the product's specific design goals. LCC

Sustainability and Life Cycle Cost Analysis, Table 1 Overview of LCC type methods for assessing environmental costs

Concept	Definitions/description	Cost categories
Full cost accounting (FCA)	Identifies and quantifies the full range of costs throughout the life cycle of the product, product line, process, service, or activity [28]	Identifies and quantifies (1) direct, (2) indirect, and (3) intangible costs
Full cost environmental accounting (FCEA)	Embodies the same concept as FCA but highlights the environmental elements [24]	Varying
Total cost assessment (TCA) (I)	Long-term, comprehensive financial analysis of the full range of internal costs and savings of an investment [28, 29]	(1) Internal costs and savings
Total cost accounting (TCA) (II)	Term used as a synonym for either the definition given to FCA or as a synonym for TCA [28]	(1) Conventional costs, (2) hidden costs, (3) liability costs, (4) less tangible costs
Life cycle accounting (LCA)	The assignment or analysis of product-specific costs within a life cycle framework [30]	(1) Usual costs, (2) hidden costs, (3) liability costs, (4) less tangible costs
Life cycle cost assessment (LCCA)	Systematic process for evaluating the life cycle cost of a product or service by identifying environmental consequences and assigning measures of monetary value to those consequences [5, 31]. LCCA is a term that highlights the costing aspect of life cycle assessment (LCA)[a] [28]	Add cost information to LCA
Life cycle costing (LCC) (I)	Summing up total costs of a product, process, or activity discounted over its lifetime [24, 27, 28, 30]	Varying
Life cycle costing (LCC) (II)	A technique which enables comparative cost assessments to be made over a specified period of time; taking into account all relevant economic factors both in terms of initial costs and future operational costs [IS015686][b]	Varying
Full cost pricing (FCP) Whole life costing (WLC)	Term used as a synonym for FCA or LCC [28] synonym to TCA (I) or LCC [7]. More specifically defined by Clift and Bourke [16] as "the systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset"	See FCA and LCC (1) Initial costs and (2) operational costs

[a]Life cycle assessment (LCA)—an environmental management tool for evaluating the environmental impacts of products and services from cradle to grave in their life cycles [32]
[b]This definition is not developed in an environmental context; it is defined in a building and construction assets standard [ISO 15686]

requires an extensive inventory of economic data. In this quest, LCC encounters many of the same data quality and completeness issues as LCA inventories. In some cases, LCC data may even be more volatile than physical data due to their reliance on dynamic markets and potentially use of different currencies (Ciroth 2009). Capturing economic costs along the life cycle chain means that data from many different actors need to be collected, some of which will be proprietary or be calculated according to custom in-house methodologies that need to be reconciled with the inventory overall. The time sensitivity of economic cost data can make information obsolete faster than physical process information. LCC has an advantage over LCA in that it requires no allocation of impacts to specific processes nor does it require the use of characterization factors and weighting to arrive at estimates for impact and damage indicators. Instead, costs can be aggregated and used directly as a measure of the product's life cycle financial impact. The procedures for interpreting, communicating, and reviewing LCC results are analogous to those for an LCA (Swarr et al. 2011). Just as with LCA, not all actors along a product's life cycle chain are equally well positioned to make decisions based on LCC information. Cost information is typically fragmented, and their collection and analysis requires substantial knowledge about the product and industries involved. Thus, a consumer is less likely to use LCC to inform purchase decisions than a manufacturer is in making product development decisions or a raw material supplier is in deciding on whether to build a new mine or refinery.

Key to achieving environmentally desirable LCC results is that LCC is applied holistically (see also Full Cost Accounting in Table 1) and that it is used early in the product design, development, or selection process. Even more preferable is it to combine LCC with LCA and a third life cycle assessment tool, *Social LCA*, which assesses a product's social life cycle impacts (UNEP 2018) to conduct a full life cycle product sustainability assessment (LCSA) (cf. Fig. 5) and make sustainability-driven decisions.

The basic equation for a life cycle-based sustainability assessment is shown in Eq. (1).

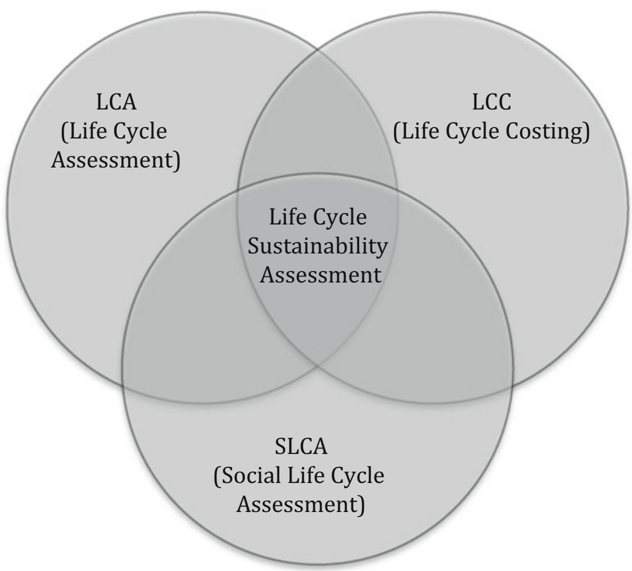
$$\text{LCSA} = \text{LCA} + \text{LCC} + \text{SLCA} \quad (1)$$

Of the three components, only LCA has been standardized to date (ISO 2006a, b), while UNEP (2009) has published guidelines for social LCAs and developed methodologies for different impact subcategories. SETAC hopes to build consensus for an international standard for LCSA, similar to the ISO 14040 and 14044 standards for LCA (Swarr et al. 2011).

Life Cycle Costing and Sustainability in the Context of Higher Education

Institutions of higher education are concerned with LCC in at least two ways. First, as owners and managers of physical assets such as classrooms, laboratories, dormitories, and dining halls, they aspire to manage these assets well from an economic- and mission-driven perspective. Many institutions of higher education have also adopted sustainability goals for their campus operations, from energy- and water-saving targets to going zero waste and carbon neutral. Using LCC as a decision-support tool can help institutions assess opportunities for upgrading infrastructure, deciding on when to retire equipment or buildings, and making the most of new investments taking not only total cost in account but also its sustainability aspirations.

The second context in which institutions of higher education can connect with LCC and sustainability is through teaching and research. LCC can be incorporated into courses in economics,



Sustainability and Life Cycle Cost Analysis, Fig. 5 Life cycle sustainability assessment. (Source: UNEP 2018) engineering, and sustainability through its net present value analysis, systems thinking, and sustainability policies. Indeed, training future graduates in the concepts and methods of LCC could increase the application of a more holistic lens in physical infrastructure design and costing, a lens that is currently still too often narrowly focused on capital costs.

Final Comment

LCC is a tool for the economic valuation of the full life cycle costs of goods, predominantly physical assets, by including costs that go beyond the initial costs of making or purchasing the good. The method covers the real and traceable money flows between the life cycle phases of the product but also monetary expenses for covering environmental, health, and compliance risks (externalities) that can reasonably be internalized over a decision-relevant time horizon.

Although LCC has been promoted as a tool for life cycle product sustainability assessment, on its own, it cannot capture the full spectrum of environmental and societal impacts of products. Combining LCC with LCA and SLCA, however, can offer a more complete and detailed amount of information to decision-makers. Moreover, if done correctly, the three components minimize double-counting while adequately capturing environmental and societal externalities. More work is needed to test how well using three separate assessment methodologies translates to making consistent and accurate sustainability judgments and how their inherent trade-offs or conflicts can be made transparent and resolved (Swarr et al. 2011). As promoted by SETAC, one way to achieve a coherent framework for life cycle sustainability assessment is to integrate the three methods, LCA, LCC, and SLCA, via ISO standards. This would entail a robust methodological foundation to be adhered to in sustainability assessments.

Cross-References

▶ Cradle-to-Grave and Sustainable Development

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Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool

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Introduction

Definition of Key Terms

This section explains three key terminologies as they relate to sustainability assessment in HEIs for better understanding of the various tools and processes used in the assessment;

(a) **Sustainability:** Sustainability is defined in this paper to mean the processes of managing, within the limits of available physical, natural and social campus resources, in ways that allow the living systems in which humans are embedded to thrive in perpetuity (Dunkley 2013). According to Geir (1994), it is paramount for our generation to manage the resource base such that the average quality of life we aspire to attain can potentially be shared by the generation unborn. Safeguarded within the United Nations' Millennium Development Goals (MDGs) and Millennium Improvement Goals (MIGs), sustainability precepts has transcended through Global initiatives down the European Union's (EU) Sustainable Development Strategy (EU-SDS) and other National laws (Glavic and Lukman 2007), to currently, the Sustainable Development Goals (SDGs) initiatives. It has become a major focus in international political discourse in recent times for developing and sustaining economic programmes and projects, including; academic curricular, research, development and scholarship, and general HEIs campus management (Wright 2002). These are necessary for improving the quality of university campus life (UCL) for the present and future generations (Hameed and Waheed 2011).

(b) **Sustainability Assessment (SA):** Assessing sustainability, according to Bond et al. (2013), involves a process by which the implications of an initiative towards achieving sustainability are evaluated. In this study, SA is defined to imply all processes that direct decision-making in curriculum development, research and scholarship towards sustainability. Such initiatives could apply to a proposed or existing programme, policy or plan, or on an on gong practices or activity, enactment of legislation or to undertake a new project. This paper, specifically, looks at sustainability practices in academic curricular, research, scholarship and development in selected Ghanaian Universities' transition towards achieving key aspect of the sustainable development goals (SDGs).

(c) **Sustainability Assessment tool (SAT):** SAT is a novel and reliable instrument for assessing the capacity for sustainability of various programmes, services and projects in the public and private sectors, including HEIs. An agglomeration of tools exists today (AULSF 2009; GC 2002; Roorda 2001) for integrating sustainable development into University education (Lozano 2006; Shriberg 2004). In this study the SAQ was used as a tool for such assessment. This tool was developed by the University Leaders for a Sustainable Future (AULSF) with input from diverse key stakeholders (AULSF 2009). It is qualitative in nature and assists in assessing the extent to which HEIs are sustainable in key aspects of HEIs (Alshuwaikhat et al. 2016) operations, including curriculum, research, scholarship and development.

Overview of Global Sustainability Initiatives in HEIs

Over the past two decades, HEIs have intensified efforts at addressing and supporting sustainability challenges in HEIs of learning (Krizek et al. 2011). Many universities over the world have devised and implemented numerous sustainable initiatives by adjusting and restructuring their teaching and learning curriculum, research and scholarship, campus operations and financial management using sustainability principles and integrating them into campus operations that conform to best practices (Glavic and Lukman 2007).

Quite a number of HEI's initiatives have been successfully implemented in advanced countries with positive results since sustainability requirement became imperative (Alshuwaikhat et al. 2016; Krizek et al. 2011). However, not too many universities in emerging economies, including Ghana, have recorded such best practices in their annals due to non-holistic campus sustainability assessments, using either, known or novel sustainability tools. What pertains, in most instances, are not the required restructuring and adjustments needed for sustainability integration in Ghanaian HEIs. The "whole-university" approach, which among others, reconsiders how higher education can handle and manage sustainability challenges by adjusting curriculum, research, scholarship and development, through to general campus management, with stakeholder involvement (Alshuwaikhat et al. 2016; McMillan and Dyball 2009) misses out on HEIs in emerging countries.

According to Alshuwaikhat et al. (2016), the Talloires Declaration, mooted by a team of HEI executives (HEIEs) to forster sustainability in HEIs, started in 1990. Two decades later, the initiative spread to 52 countries with over 421 HEI executives signing the declaration. Most of the signatories were from developed countries (Alshuwaikhat et al. 2016). The association of university leaders for a sustainable future (ULSF) followed later with a similar initiative. Their aim was to promote sustainability globally in the area of research, scholarship and development, teaching curriculum, operations and community outreach in HEIs through research, assessment and publications (McMillan and Dyball 2009). In 1993, another sustainability group known as 'Second Nature (SN)' directed a similar initiative, amied at bringing about total transformation of university education by supporting management and leaders of HEIs to make their institutions just, healthy, and livable for all (Nixon and Glasser 2002). In 2006, the Australasian campuses towards sustainability (ACTS) group for promoting global dialogue in relation to sustainability in higher education gained momentum when it joined forces with the Environmental association for universities and colleges (EAUC) in the United Kingdom and the Association for the advancement of sustainability in higher education (AASHE) in the United States to distribute HEIs member resources around the world. Literature on HEIs sustainability initiatives in the developing countries and for that matter, Ghana's HEIs, on the other hand, were found to be scanty, with no clear direction. These evidence of sustainability initiatives existed in isolated instances, embedded in a number of campus programmes and activities, and to a greater extent, supported exogenously.

Evidence of Sustainability Practices in Ghana's HEI

HEIs' sustainability practices in Ghana, although not supported by formal policy documents, were identified to exist in University campuses in four main forms, along the construct of Krizek et al. (2011);

(a) **Students Campus Initiatives (SCI)**

Sustainability initiatives carried out under SCI, were seen in a form where students of a particular department or belonging to an association of a particular course or programme, who in one way or the other have had encounter with sustainability

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discourse and wanting to advocate for or practicalise it, start by calling for various sustainability-related services and programmes on campuses. University management, normally at this stage, either resist such initiatives or may give minimal attention and support to them. To put such initiatives to work, determined students organises and launch out their own efforts, which in most University campuses in Ghana are characterised with activities such as, single department tree planting or campus greening exercises, immunisation awareness campaigns, recycling programs, fitness and walking campaigns, campaigns to boycott use of plastics and energy conservation campaigns. When faculty buys into such efforts, it may take the form of either creating new sustainability course work(s), embarking on fieldwork(s)/fieldtrip(s) or projects and awareness campaigns to address a particular issue; to limit use of hazardous chemicals, consumption of certain harmful products or campaign on why a certain initiative should be encouraged or discouraged. This initiative phase can linger on or die off with the exit of that particular year group of student advocates or may feed into subsequent phases as new initiatives may be brought forth by new entrant's campaigners into the discourse. When University Management fails to respond to the evolution of these efforts in a timely fashion, the initiative becomes a de facto definition of the culture of sustainability efforts on that campus (Beringer and Adomßent 2008). Management may find it difficult to mainstream such efforts into governance structures, as their origin renders them difficult to coordinate. Sometimes these SCI initiatives compete with management goals with no clear directions. As a result, it is not far fetch to conclude that SCI are often given low profile if university management does not see the need to buy into them.

(b) **Sustainability for Cost Savings Initiatives (SCSI)**

In this form, sustainability initiatives are mooted by senior members or students' with strong involvement of senior members in activities that may have cost saving aspects of a business case and environmental sustainability component. University management will gladly buy into such sustainability initiatives when they see it inspire cost savings and a high tendency to improve campus reputation. Such initiatives were found within programmes that call for use of alternative energy sources, energy efficiency, water conservation, climate change and green branding. When SCSI is associated with senior members within the group, it fosters a greater collaboration within the operations of the group strong enough to even influence heads of departments (HoDs) and deans of faculties (DoFs) to develop new curriculum (major, minor or combine certificate programmes) and have it accepted and funded by university management.

(c) **Transformational Management Leadership Initiative (TMI)**

At the transformational management initiative (TMI) level, university management, or a group of them, openly promote a sustainability agenda and rally behind it as a central element of their management style. Management initiate and embrace the concept as a central value of their administration's goal and strategic plan and strive to get the support of University Councils or Boards. There is full executive leadership on sustainability with keen understanding of its tenets and vision for the future with TMI. Sustainability initiative at this level is given the highest priority with stakeholder engagement, especially, when it has strong foreign funding component. This was observed to be present in most HEIs's top management levels in Ghana.

(d) **Integrated Sustainable Campus Community (ISCC)**

An integrated sustainable campus community is a self-actualised university campus that most HEI management often quote or aspire to have and encourage others to do so as well. ISCC is characterised by high level visionary leadership and a fully integrated sustainability novelty that enhances educational outcomes tired with sustainability-related operations, student life, staff, and community engagement activities. Educational experience is integrated into both the inside and outside the knowledge transfer process where students learn about sustainability in all majors and at the same time observe and learn from the campuses with practical models, sustainability principles and practices. Fully self-actualised and integrated sustainability campus communities worldwide were identified to include, the first zero-emission campus of Leuphana University (Germany), University of Gothenburg (Sweden), Trier University of Applied Sciences in Germany (Alshuwaikhat et al. 2016) and Ashesi University in Ghana. Here sustainability operations, student activities, and community partnerships are coordinated coherently in a systems-thinking mode in all university campus offices and faculties.

Characteristics and Challenges of Implementing Sustainability Initiatives in HEIs

According to Krizek et al. (2011), corporate institutions respond positively to issues of sustainability better than HEIs because the former have profit oriented shareholders with strong external determinants. Case studies of corporate organisations that have successfully implemented sustainability principles and practices to influence their core business models include; Dow Jones Sustainability Indexes, Dow (2010), Lubin and Esty (2010) and the Volkswagen Group (2008). HEIs have only subtle stakeholders who are equally not immune to many of the external drivers in their attempt at shifting the paradigm towards sustainability (Wright 2010). Thus, sustainability practices across all walks of campus-life tend to be relatively more challenging than in the corporate business world (Bardaglio and Putman 2009).

According to Krizek et al. (2011), HEIs are typically tasked with the trinity of education, research and service. Working towards achieving these trio objectives, which in themselves have competing goals, may water down a focused orientation and create competing priorities since different constituents of the trinity demand different services. University campuses are largely made up of five entities; students, teaching staff (faculty), non-teaching staff, alumni and the community in which they serve. Each of the bodies has varying and sometimes competing priorities in terms of sustainability. For instance, waste segregation, composting, energy efficiency and recycling efforts may very much offer some experiential learning for students and the community but may contribute little towards advancing formal curricula or have any immediate impact on teaching and non-teaching staff. Likewise, with the rise in cross-cutting sustainability-oriented courses in Ghanaian Universities over the last 10 years, the impact is yet to be significantly felt in campus waste separation at source, renewable energy installations, including; biogas digesters, water conservation and recycling technologies. It is often difficult to uncover cross synergies between campus constituents. Campuses also faces management challenges akin to small cities as they need to provide an array of support services in an increasingly complex learning environment with limited resources. This promotes the sprawling of horizontal campus community with sometimes, diffused focus and shrinking revenues, especially where university management is asked to cut costs, increase productivity (teaching and research, quality leadership succession) but not the payroll (Krizek et al. 2011; Bardaglio and Putman 2009). This typical structure of HEIs, where power is concentrated at several levels, and with a culture of protecting tradition and academic freedom, tend to hinder sweeping sustainability changes.

Known Tools for Sustainability Assessment in HEIs

Although a comprehensive list of potential tools exist for sustainability assessment and management processes in the corporate business world (CBW), Alshuwaikhat et al. (2016) outlines six (6) known ones useful for sustainability assessment operations in HEIs. These are;

1. ***The sustainability tracking, assessment and rating system (STARS)***

"STARS" was developed by the Association for Advancement of Sustainability in Higher

Education (AASHE). It is a "voluntary, self-reporting framework for recognizing and gauging relative progress toward sustainability for colleges and universities" (AASHE 2010). The objectives of STARS include; (a) providing a framework for understanding sustainability in all sectors of higher education; (b) enabling meaningful comparisons over time and across institutions using a common set of measurements developed with broad participation from the campus sustainability community; (c) creating incentives for continual improvement toward sustainability; (d) facilitating information sharing about higher education sustainability practices and performance and (e) building a stronger and more diverse campus sustainability community.

2. ***The Auditing Instrument for Sustainability in Higher Education (AISHE)***

"AISHE" was developed by the Dutch Committee on Sustainable Higher Education (CDHO) and Niko Roordia to measure the level at which sustainable development is been integrated into HEIs. In other words, AISHE measures "sustainable education" based on a quality management model (Pipjelink 2011; Roorda 2001).

3. ***The Good Company's Sustainable Pathways Toolkit (GCSPT)***

"GCSPT" was produced by Good Company, a private sector business company, Good Company, based in the USA. Their objective was to produce a fairly simple and straight forward tool to market to potential university and college customers interested in sustainability assessment. The toolkit has 20 core indicators and 10 supplementary indicators, each with a performance benchmark attached (Good Company 2002).

4. ***The Campus Sustainability Assessment Framework for Canadian Universities (CSAF)***

"CSAF" is a famous Canadian tool which gauges the level of sustainability of Canadian universities. It was developed by the Royal Road University in Canada and has gained international reputation in the realm of Sustainable Campus (Brand 2012; Roorda 2001).

5. **The Sustainability Competency and Opportunity Rating and Evaluation (S-CORE)**

"S-CORE" is a multi-purpose sustainability assessment tool that helps Organisations to determine whether they are on the right path to green growth and also identify new opportunities in the process. It was developed by AXIS Performance Advisors in collaboration with the International Sustainable Development Foundation and the Zero Waste Alliance (Brand 2012; Roorda 2001).

6. ***The Sustainability Assessment Questionnaire (SAQ)***

"SAQ" is designed to assist in assessing the extent to which HEIs attain sustainability in teaching, research, operations and outreach. It is qualitative in nature and ensures that the major activities on campuses become ecologically sound, socially just, economically viable and humane for now and the future generations.

According to Gasparatos (2010), the selection of any of these tools, which in most cases, is determined by the researcher, must be based on solid theoretical concept, good understanding of the economic, political and cultural needs and values of stakeholders. A number of methodological steps embedded within the tools make selection and use of any of the tools value judgement free. Tool selection, thus, frames the sustainability assessment with practical and ethical implications. Therefore by selecting a particular tool, the researcher subscribes to and reaffirms a specific worldview as the correct or most appropriate yardstick to measure an aspect of sustainability practice in HEIs (Krizek et al. 2011).

Methods and Tools

Employing exploratory research design, this study used the SAQ tool to assess integration of sustainability practices in two key university areas of operation; teaching and curriculum, and research and development towards sustainable development in ten (10) Ghanaian HEIs (Table 1). The first part assessed teaching and curriculum sustainability practices using five (5) semi-structured self-administered questions. The aim was to establish whether HEIs; (i). Offer specific programmes or curriculum on sustainability, (ii). Offer specific courses related to sustainability, (iii). Integrate sustainability topics in taught courses, (iv). Integrate fieldwork and internships in programmers or curriculum, (v). Address local sustainability issues and challenges in teaching programs and (vi). Allow students from different disciplines to offer, at least, a university-wide course on issues related to sustainability.

Further, there were a mixed of closed and open-ended questions asking management of HEIs to outline their academic programs and courses related to sustainability, specific sustainability degree programs, relevant mandatory courses for students and the extent of sustainability focus in various disciplins and interdisciplinary programmes (Table 2).

The second part consists of eight (8) closed questions on HEIs sustainability aspects of research, scholarship and development in Ghana. Management were asked to say 'Yes', 'No' or not 'Sure' to questions centered on the extent to which the university is involved in sustainability-oriented research and associated development opportunities for faculty and students, integration of local and global sustainability issues in the university's research agenda, the existence of specific sustainability units/centers and research outputs in fields related to sustainability (Table 3).

Results and Discussion

Integrating Sustainability into HEIs' Teaching and Curriculum

Teaching and curriculum development in HEIs is one important way of integrating sustainability principles and practices, and ecological literacy in students (Wright 2010). According to Bowser et al. (2014), Universities are better placed to do this by incorporating environmentally friendly education into their teaching and learning systems. From returned responses (Table 2) using the SAQ tool, averagely, less than half (42%) of the HEIs investigated responded positively ('Yes'), 38% said 'No' and 20% of the HEIs were 'Not sure' to all questions posed in Table 2. Tentatively, 53% of the Universities allowed students from different disciplines to take, at least one course (university-wide courses) on issues related to sustainability (Table 2). The sustainability focus on teaching and curriculum in conventional programmes is depicted by Fig. 1, where much concentration was found within the natural sciences (30%), followed by engineering (19%), physical sciences (16%), social sciences (15%), medicine and health sciences (12%) and Arts and humanities (8%) respectively.

Sustainability Related Research, Scholarship and Development in HEIs

Returned responses from the SAQ survey (Table 3) shows that 59% of HEIs are involved in research, scholarship and development in the area of sustainability, 63% HEIs encourage students and staff to research, undertake projects and write thesis or dissertations in and on sustainability related issues. Thirty three percent of the Universities offer faculty and school research funding in the area of sustainability for the various disciplines which is consistent with current best practices within Universities Worldwide (Comm and Mathaisel 2005). An appreciable number of HEIs (75%) collaborates with other institutions and industries in their quest for finding solutions to sustainability challenges and 62% already have in place research centers or units for sustainability studies. However, only 21% of the HEIs had prioritise sustainability aspects in their research outputs in journals, conference and seminar/workshop publications. This was also highly tired to research and scholarships with external collaborations, funding and support. When HEIs were asked to state 'Yes', 'No' or 'Not sure' to whether they devote substantial proportion of their research funding (>20%), specifically, to sustainability research, scholarships and development (Table 3), the survey results indicate only 8% of HEIs commits such amount of their research

Sustainability Assessment in Ghana’s Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Table 1 Selected HEIs sustainability programmes/curriculum and field of study

Course/programme	Institute/department	University	Field
MSc and MPhil in Climate Change and Sustainable Development	**Interdisciplinary**	University of Ghana, Legon (UGL)	**Multi-disciplinary**
BA Geography	Geography and Resources Development		Natural resources
Post-graduate studies	School of Business		Climate change
BSc. Computer Science	Geography and Resources Development		Sustainable development
Bsc Nursing	Environmental Studies and Sanitation		Climatology
BSc planning etc	Computer science		Natural sciences
	Population studies, medical school etc		Medicine/Allied health sciences
			Management etc
MSc. Climate Science and Meteorology	**Interdisciplinary**	Kwame Nkrumah University of Science & Technology	**Multi-disciplinary**
Doctor of Pharmacy	Department of Physics	(KNUST) -Kumasi	Management
BSc. Emergency Nursing	Pharmacy		Natural resource
B.A Economics	Health		Climate change
B.A. Social Work	Architecture		Medicine
BSc planning	Computer Science		Health science
MSc. Renewable Energy	Renewable energy etc		Climate mitigation etc
BSc. Computer Science			
B.Sc. Dental Surgery			
B.Sc. Architecture			
MSc. Health Informatics etc			
MSc. Environmental, Science, Policy and Management	**Interdisciplinary**	Institute of Local Government Studies, Accra and Tamale (ILGS)	**Multi-disciplinary**
B.A. Public Sector Management	Urban and Environmental Management		Climate change
B.A. Community Development etc	Public Sector Management		Public Sector Management
	Community Development		Community Development etc
Bsc. Environment and Development Studies	**Interdisciplinary**	Central University, Miotso-Tema (CU)	**Multi-disciplinary**
BSc planning	Environment and Development Studies		Environment and Development studies
BSc. Computer Science	Architecture		Computer science
B.Sc. Architecture	Engineering		Engineering
BSc Business management etc	Business management		Pharmacy etc
MA in Environment and Resource Management	**Interdisciplinary**	University of development studies (UDS)	**Multi-disciplinary**
B.Ed. Health Sciences	Faculty of Integrated development		Climate change
B.Sc. Renewable Natural Resources Management			Smart agriculture
BSc. Nurse Anesthesia			Medicine etc
B.Sc. Biotechnology and Molecular Biology etc			Allied health
			Planning etc

(*continued*)

Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Table 1 (continued)

Course/programme	Institute/department	University	Field
BSc in software Engineering	**Interdisciplinary**	Ashesi University (AU)	**Multi-disciplinary**
BSc. Computer Science	Computer science		Climate change adaptation & mitigation
BSc in management information system etc	Management information technology		Computer science
			Business technology etc
B.Sc. Medical Laboratory Technology	**Interdisciplinary**	University of Cape Coast (UCC)	**Multi-disciplinary**
B.Sc. Agricultural Extension	Environment, Pharmacy		Smart agriculture
B.Sc. Animal Production	Medicine/Allied health sciences		Fisheries
B.A. Population and Health	Computer Science, Smart agriculture		Climate change adaptation & mitigation etc
B.Sc. Animal Production etc	Agricultural economics, Oil and gas studies		
	Educational foundations, Distance learning		
	Agriculture extension etc		
B B.Eng. Electronic and Communication Engineering. Sc. Bio-Medical Engineering	**Interdisciplinary**	Koforidua University of All Nations (ANU)	**Multi-disciplinary**
B.Eng. Oil and Gas Engineering	Electronic and Communication		Electronic and Communication
	Bio-Medical Engineering		Bio-Medical Engineering
	Oil and Gas Engineering etc		Oil and Gas Engineering etc
B.Sc. Information and Communication Technology (ICT)	**Interdisciplinary**	Ghana Institute of Management and Public Administration (GIMPA)	**Multi-disciplinary**
	Environmental Studies and Policy		Public policy
M.Sc. Environmental Studies and Policy	Management Information Systems		Environmental policy
M.Sc. Management Information Systems	Information and Communication Technology (ICT)		Financial policy
MBA (Healthcare Management option)	Hospitality management etc		Business policy etc
B.Sc. Business Administration (Accounting), etc			
M.Sc. Engineering Project Management	**Interdisciplinary**	Ghana Technology University College	Software Engineering
M.Sc. Engineering Project Management	Software Engineering		Mobile Internet Communication
BSc. Computer Science	Mobile Internet Communication		Telecommunication Engineering etc
B.Sc. Solar Engineering etc	Telecommunication Engineering etc		

Source: Based on Ghana National Accreditation Board data, 2017

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Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Table 2 Programmes and curriculum bothering on sustainability

Teaching and programmes/curriculum	Returned responses (%) $n = 10$		
	Yes	No	Not sure
1. Do you offer specific programmes/curriculum on sustainability?	47	23	30
2. Do you offer specific courses related to sustainability?	41	46	12
3. Do you integrate sustainability topics in taught courses, fieldwork and internships?	33	39	28
4. Are local sustainability issues and challenges addressed in teaching programs?	35	45	20
5. Do students from different backgrounds require to offer, at least, one course (university-wide courses) on issues related to sustainability?	53	37	10

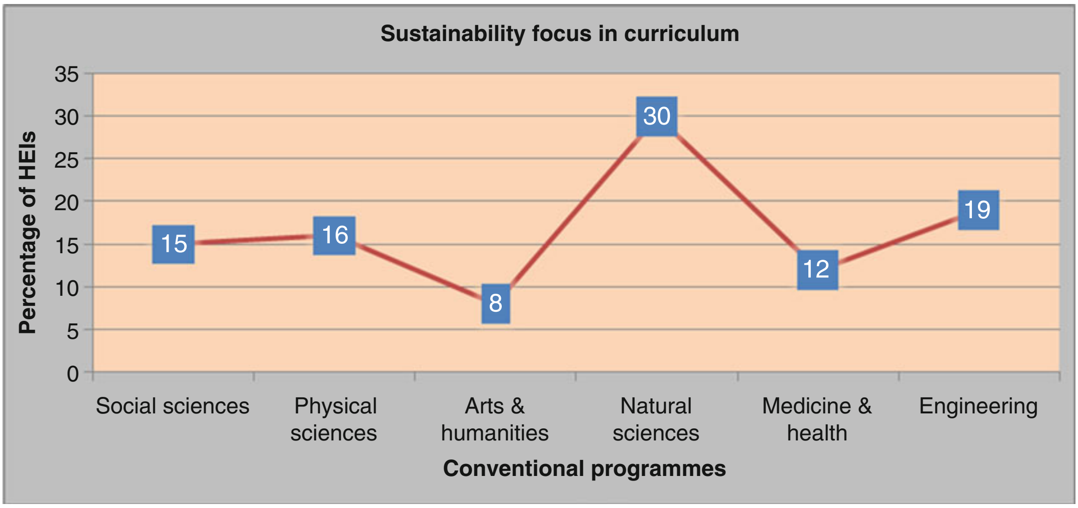
Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Table 3 Sustainability aspects of research, scholarship and development

Research, scholarship and development	Returned responses (%) $n = 10$		
	Yes	No	Not sure
1. Involved in research and development in the area of sustainability	59	19	12
2. Offer faculty/school research funding in the area of sustainability for the various disciplines	33	51	16
3. Encourage sustainability related thesis/ project designs by students or staff	63	26	11
4. Have local sustainability contents in their research agenda	46	41	13
5. Collaborates with other institutions and industries in pursuit of solutions to sustainability challenges	75	0.9	0.6
6. Have research centers/units/groups for sustainability	62	18	20
7. Priortise sustainability aspects in the research outputs e.g., journals and conference publications	21	63	16
8. Devote substantial funding for sustainability research, scholarships and development	0.8	12	80

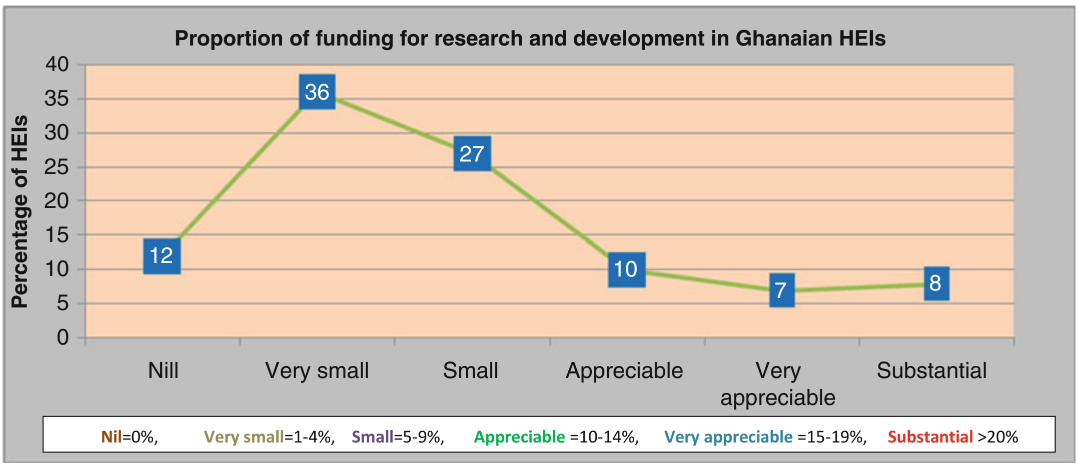
funding (>20%) to this initiative (Fig. 2). Twelve percent had no such intentions (Nil = 0%), 27% were spending small proportions (5–9% of research funds), 10% were doing so appreciably (10–14% of research funds) and 7% of HEIs were doing so very appreciable (spending 15–19% of research funds). Three public Universities (University of Ghana, University of Cape Coast and Kwame Nkrumah University of Science & Technology) and three private Universities (Ashesi, Central and All Nations) werefound to be running comprehensive life-long action learning educational programmes and several courses that directly engage the local community on issues relevant to sustainability discourses.

Conclusion and Recommendation

It is evident from the study that efforts at attaining the sustainable development goals (SDGs) are driving HEIs all over the World to formulate and implement sustainability initiatives. Although this paradigm shift permeate all spheres of a University's campus life cycle, this paper assessed sustainability adjustment and



Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Fig. 1 HEIs sustainability focus in teaching and curriculum



Sustainability Assessment in Ghana's Higher Educational Institutions Using the Assessment Questionnaire as a Tool, Fig. 2 Proportion of research funding specifically devoted to sustainability practices in HEIs

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restructuring in teaching and curriculum, and in research, scholarship and development in ten (10) Ghanaian HEIs (Table 1) using the SAQ as a tool. The scope of sustainability practices in Universities in developing countries needed to broaden, especially in Ghana, if the desired goal to transform HEIs into centers of excellence in sustainability principles towards attaining the broader SDGs, envisioned in Ghana's Vision 2030, are to be realised. There is evidence to show (Table 2, Fig. 1) that over the past decade, HEIs are offering specific programmes, curriculum and teaching of courses relating to sustainability, but on limited scale, identified in the form of SCI, SCSI and TMI. There is a need for Ghana HEIs to promote sustainable campus practices that can offer management organisational changes that will move them to the fourth initiation phase (ISCC) to ensure inclusive and equitable quality education that promotes lifelong learning opportunities for all. Inferring from Walton and Galea (2005) to foster good governance and management at this level;

(a) HEIs need to modernise their charters, decision-making systems and policies to reflect sustainability ethics, transparency and democracy.
(b) HEIs must promote a vision of the future that prepare graduates with inter-disciplinary approaches to solving problems that integrates challenges of the twenty-first century through teaching, research and knowledge transfer.
(c) HEIs must respond positively to policy agendas that provide transformational leadership for society in a complex, rapidly changing times, ensure equal opportunities, articulates human rights and understand employer demands in context of future needs.

Sustainability aptitude is cultivated by means of learning in lecture theaters and on the field through problem solving techniques. This has been observed to be beneficial as it brings cost saving to HEIs in areas; including use of energy, water, waste, transport human capital and emission of carbon dioxide (CO_2). The teaching and learning processes and community participation are equally enriched through knowledge and technology transfers. To consolidate gains in sustainability initiatives as well as broaden the scope in line with best practices globally, HEIs in Ghana, in collaboration with the responsible government ministry and other related stakeholders must endevour to;

(a) Integrate green and sustainability themes into teaching, curricula and research across diverse academic programmes, centers, and initiatives that address sustainability issues.
(b) Mandate every long essay, thesis, dissertations and projects to address sustainability challenges and sustainability impact assessment.
(c) Provide adequate funding support for research and educational initiatives with focus on the addressing sustainability and green economy issues.
(d) Embark on campus upgrading systems management in critical areas of campus operations, including; lighting systems, energy efficiency, reducing greenhouse gas outflows, decreasing waste, and improving transportation and operation efficiency.
(e) Meet faculty members, non faculty staff, students and HEI communities at regularly intervals to foster partnership, create awareness, evaluate sustainability initiatives and recommend new approaches towards sustainable development.

In this way, sustainable campus, which is a community that "acts upon its local and global responsibilities to protect and enhance the health and wellbeing of humans and ecosystems", can be guaranteed (Lozano 2010; Velazquez et al. 2006; Cole and Wright 2003) in HEIs.

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Sustainability Assessment Methodology

► Higher Education's Sustainability Assessment Procedures

Sustainability Assessment Tools

► Higher Education's Sustainability Assessment Procedures

Sustainability Balance

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Introduction

For many years, the construction industry has increasingly been concerned about environmental impact, usually expressed as greenhouse gas (GHG) emissions, resource consumption, and waste generation. This industry consumes more than 40% of the world's resources, requires 40% of global energy, emits 30% of GHG emissions, and uses 25% of the global water supply (UNEP 2016). To reduce these problems, sustainability goals have been incorporated into the construction industry globally.

Apart from the building and construction industry, the office buildings sector has a significant impact on the environment. It should take responsibility for its energy consumption, waste generation, greenhouse gas emissions, natural resources depletion during project lifecycle from initial stage to demolition stage (Ortiz et al. 2009). Regarding the United States (USA), buildings alone consume 39% of energy use, 72% of electricity resources, emit 39% of carbon dioxide, and consume 13.6% of portable water in the year of 2008 (EIA report 2008). Similarly, in Singapore, the buildings account for 35.9% of energy consumption and 37.8% of electricity consumption (Energy Market Authority 2018). Compared with these countries in the world, Australia is in a similar situation. In this country, buildings generate about 9% of national GHG emissions (Australian Government 2015) and 30–40 of solid wastes (ABS 2016). In addition, these buildings use 21–30% of the total potable water in urban centers (Corr et al. 2008). With such significant consumption and emissions profile, the development of sustainable practices for building projects is necessary for reducing their impacts on the environment.

However, the most critical issue for implementing sustainability in practice is additional cost or cost premium for incorporating sustainable or green features and technologies. As documented in many previous studies, the additional cost is still inconsistent and varied (Issa et al. 2010; Hwang and Tan 2012; Yudelson 2010; Kim et al. 2014). With particular relevance to Leadership in Energy and Environmental Design (LEED) certification, a green rating scheme devised by the United States Green Building Council (USGBC), the additional cost varies from 2% (Kats et al. 2003) to 13.8% (Kats 2010) of total construction cost. Conversely, the additional cost may be insignificant or even nonexistent in office projects (Matthiessen et al. 2007; Rehm and Ade 2013).

In Australia, the additional cost of using Green Star-rated projects follows a trend similar to the USA. The process of seeking certification from relevant organizations, such as USGBC for LEED and GBCA for Green Star, also involves a cost. For Green Star certification in Australia, this cost ranges from 3% to 5% for 5-Star Green Star projects and 5% for 6-Star Green Star projects where there are no iconic designs (Langdon 2007). Depending on the type of design, in some instances, the cost is insignificant in the Green Star certification as illustrated by research undertaken at Bond University (GBCA 2008a).

Several studies have been undertaken to address and reduce the issue related to the additional cost from different approaches. One of the most popular approaches is to demonstrate the additional cost through different case studies on office projects with actual cost data collected from different countries such as the UK, USA, and Australia (Kats et al. 2003; Steven Winter Associates 2004; Ahn and Pearce 2007). The second approach is to evaluate the additional cost according to participants' perceptions using research surveys (Houghton et al. 2009). Another approach is the suggestion of different models such as the model of selecting material suppliers (Calkins 2008; Akadiri et al. 2013), the assessment model of innovative green technologies (Collier et al. 2013; Sheikh et al. 2011), or Life-cycle cost (LCC) and Life-cycle assessment (LCA) models (Gluch and Baumann 2004; Chen et al. 2011; Kneifel 2010). However, it is evident that a framework for supporting decision-making on sustainable office projects or indeed other types of buildings through the Triple Bottom Line sustainability assessment of green features and technologies is lacking.

Approaching the decision-making process and taking into consideration Triple Bottom Line (TBL) sustainability, this chapter aims to establish a multipillar decision-making (MPDM) framework for assessing green features and technologies (GFTs) for office projects in Australia. In other words, a multipillar decision-making framework provides the underlying rationale and the process for GFTs assessments under the three pillars of sustainability: Economics, Environment, and Society. The framework supports the selection of green features and technologies at the initial stage (or the conceptual design stage) of an office project, which is essential for realizing sustainable development goals (Vyas and Jha 2017; Da Silva and

Ruwanpura 2009). Such a framework and understanding of sustainability assessment also contribute to reducing or eliminating the issue related to the additional cost by the efficient selection strategy of GFTs.

This chapter begins by reviewing sustainability, office projects, and Green Star tool used for sustainable or green office projects in Australia. Following this is an explanation of what GFTs are and a shortlist developed from 181 Green Star-rated office projects – new build. An understanding of pillars and subpillars was then undertaken by examining how Green Star uses these in their rating tool. The next section is the research method of Analytic Hierarchy Process (AHP) and the use of an in-depth questionnaire survey. Then, the findings of the weightings of three main pillars and subpillars, the GFTs assessments, and the framework establishment are discussed. The last section is the conclusion of this research Chapter with its main findings and outcomes.

Sustainability and Office Projects in Australia

Sustainability has been defined, and redefined, many times over the last few decades. The most common definition of sustainability used has been put forth by WCED (1987) is "... to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 43). Technically, sustainability can be as comprehensive as the relationship between Economic Prosperity, Environmental Quality, and Social Justice; this is known as the Triple Bottom Line (Elkington 1997). Sustainability also encourages the exploration of innovative measures to eliminate problems that can compromise or seriously hinder the TBL. Recent global events, such as the adoption of the Sustainable Development Goals (SDGs) by almost all countries, have focused attention back on proactive efforts by all levels of society to achieve sustainability outcomes.

Based on these definitions, the use of building features and technologies in sustainable or green office projects are desirable if they generate benefits to TBL sustainability. In this research chapter, green features are defined as structural aspects that improve a building's environmental friendliness in different ways, for instance, energy savings and waste reduction. Green technologies are interpreted as "any well designed technology capable of addressing high energy demands without posing negative effects to the environment" (Dadzie et al. 2017). They are also the technologies that exceed the benchmark of more conventional systems typically used in office buildings.

In Australia, office buildings constitute a substantial proportion of non-residential projects. These buildings make up more than one half of buildings in Australia (GBCA 2015b). Recent building numbers are approximately 4500 buildings across Australia, corresponding with more than 25 million m^2 floor area (Property Council of Australia 2017). Office buildings account for 25% of the total of 19% of energy consumption and 23% of overall greenhouse gas emissions (GBCA 2015b). Accounting for the highest proportion of the building sector and following the need to reduce construction impact on the environment, there is an obvious interest that office projects integrating sustainability should be prioritized in this industry (Butera 2010; Zuo et al. 2016).

Green Star Rating Tool: Office Design

Green Star rating tool is selected for this research because of its brand recognition in sustainability and green office projects in Australia. Green Star is a voluntary tool and the recognized brand for sustainable development in the nonresidential sector of the building and construction industry. It is a reliable proof of sustainable projects being carried out and accepted by consumers and the construction sector in this country. This tool was launched in 2003 as the "second-generation rating tool" of Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM), the "oldest" sustainability rating tools from the USA and the UK, respectively. The Green Star rating tool is managed by the Green Building Council of Australia (GBCA) – a nonprofit organization to assist green building development in this country (GBCA 2015a).

According to GBCA (2015a), Green Star – Office Design benchmarks an office project against the following nine categories:

Management	Indoor environment quality	Energy
Transport	Water	Materials
Land use and ecology	Emissions	Innovation

Green credits are accumulated from nine categories integrated with their weightings. The weightings differ in the states and territories of Australia, particularly in the categories of Water, Land Use, and Ecology (see Table 1). Of the nine categories, the Innovation credit is an additional credit and is not included in the core credits comprising certification. Therefore, the final score is the sum of credits from eight categories plus the credit inherent in the Innovation category. This score decides the rating of Green Star certification based on comparing the credit ranges for Green Star levels.

Green Star certification for office design is determined in three levels: 4-Star, 5-Star, and 6-Star based on the credit total awarded. The three levels are shown below:

From 45 to 59 for 4-Star rating, recognized as "Best Practice"
From 60 to 74 for 5-Star rating, recognized as "Australia Excellence"
From 75 to above for 6-Star rating, recognized as "World Leadership"

Identification of GFTs

Based on their definitions, many GFTs are suitable for sustainable office projects. To select the GFTs, a study of 181 Green Star office projects in Australia over 12 years was taken. The most frequently occurring GFTs were then selected, leading to a total of 46 GFTs.

These GFTs were shortlisted based on previous reports of office buildings in Australia, including Green Star rating and Ecological Sustainable Development (ESD) principles. The GFTs selected are the primary elements in office designs for achieving Green Star certification. They have been mainly derived from the categories of Energy, Water, and Indoor Environment Quality, which are highlighted by ESD principles. GFTs have been emphasized in both active and passive systems used in buildings such as lighting systems, passive ventilation, energy technologies, renewable energy systems, water conservation, and transport. While there is a great breadth of use of GFTs, based on their widespread acceptance in previous studies, frequently used ones occurring in reality in Australia have been selected. Based on the study of 181 Green Star – new build projects identified through publications on the GBCA website. A comparison between what was reported in the literature and that shown in

Sustainability Balance, Table 1 Credits in eight categories and their weightings

Category weightings	No points	NSW (%)	ACT (%)	NT (%)	QLD (%)	SA (%)	TAS (%)	VIC (%)	WA (%)
Management	12	9	9	9	9	9	9	9	9
Indoor environment quality	27	20	20	20	20	20	20	20	20
Energy	24	25	25	25	25	25	25	25	25
Transport	11	8	8	8	8	8	8	8	8
Water	13	12	12	10	14	15	10	15	14
Materials	23	14	14	14	14	14	14	14	14
Land use and ecology	8	6	6	8	4	4	8	4	5
Emissions	14	6	6	6	6	5	6	5	5
Innovation	No weight. Innovation credits are added								

Source: (GBCA 2008b)

reality was then undertaken to provide this short list of 46 GFTs. They are reported in Fig. 1 corresponding to the relevant categories in Green Star.

Pillars and Subpillars of TBL Sustainability

In a decision-making framework, pillars and subpillars need to be developed to aid the decision making process. This two-stage process is essential as a single pillar is unable to significantly consolidate the contributions of all the GFTs to TBL sustainability. It is therefore essential to have multi-pillar set for the assessment of all GFTs. Multi-pillars may consist of qualitative and quantitative elements under the three main pillars selected in this research. Doing so helps to evaluate both tangible and intangible contributions of GFTs.

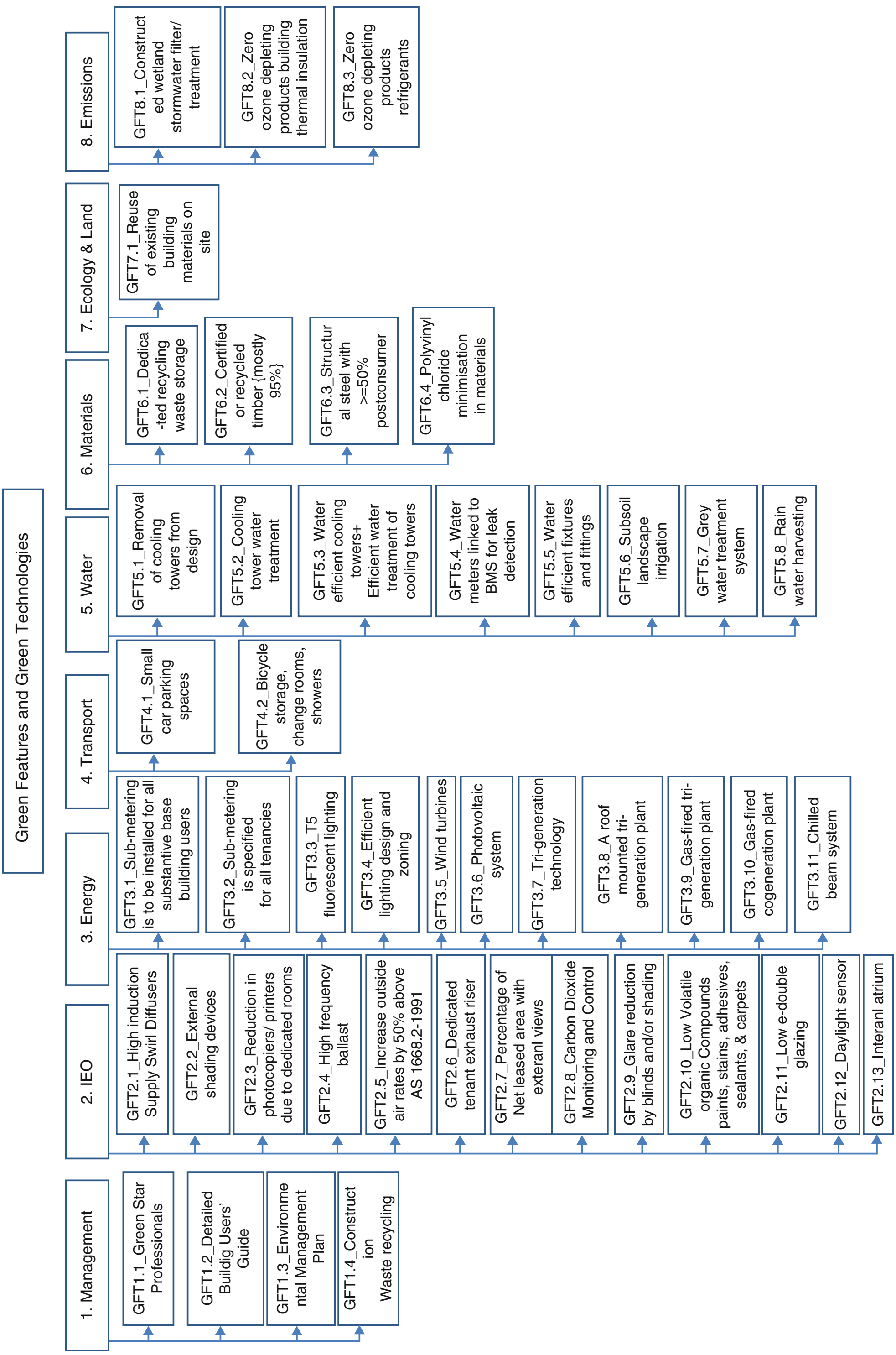
Based on TBL sustainability, the three pillars are Economics, Environment, and Society while subpillars are selected by a systematic approach focusing on five fundamental principles: coherence with project decision (consistency), independence of each criterion, same scale, measurement, and relationship with green features and technologies (Convertino et al. 2013; Si et al. 2016). This selection also relies on what has been included in previous studies. Based on these principles and previous studies, subpillars under each pillar are considered and selected properly. There are in total 7 subpillars for Economics, 7 subpillars for Environment, and 6 pillars for Society (Table 2).

Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is employed as the most suitable multicriteria decision-making method for this research. This is because AHP firstly assists decision-making by allowing the assessment of qualitative and quantitative elements of the multipillar decision making process. It also satisfies certain objectives in the evaluation hierarchy (Zhao et al. 2017) such as achieving sustainable goals. There is a single direction of evaluation structure applicable to all assessments (Zhao et al. 2017). The second step with using AHP is the pairwise comparison of pillars and subpillars to detect the intensity of preference among them (Pohekar and Ramachandran 2004). A scale of 1 to 5 is used in AHP with "1" standing for the equally important level and "5" representing extremely important level. This scale was selected and confirmed by participant's suggestions in the survey pilot. Lastly, AHP uses the principal eigen-vector for aggregating the final vector of different weight coefficients. Eigen-vector is calculated by a matrix $A = (a_{ij})$ with i and j represented pillars and subpillars from 1 to n. The formula is written as $A = a_{11}a_{12}\ldots a_{1n}a_{21}a_{21}\ldots a_{2n}a_{n1}a_{n2}\ldots a_{nn}$. On this basis, the decision is usually made by selecting the highest ranking of GFTs in their assessments.

Questionnaire Survey

AHP assists the establishment of a multicriteria decision-making framework. To accomplish this objective, an in-depth questionnaire survey was used for data collection. This survey received ethics approval from the University Ethics Committee as interacting with people needs to be open and transparent while respecting their rights and privacy as individuals. The survey was designed using Qualtrics, a survey instrument used by the university and available online, making it easier to use. After 4 months spent contacting potential participants throughout Australia, 38 responses were received, but only 13 were fully answered responses and therefore, viable for research analysis. This response rate is 13.48% based on the contact made with 282 institutions, sustainability divisions, construction organizations, and individuals. This low rate can be explained by the 1-h questionnaire length and research requirements for participants to be knowledgeable about and experienced in sustainability issues. The 13 fully answered surveys were completed by different stakeholders, including Developers, ESD consultants, Architects, Building Services Engineers, Quantity Surveyors, Facility Managers, and Researchers. They are also from very senior positions in their organizations such as director, national manager, and principal. Despite the low



Sustainability Balance, Fig. 1 Green features and technologies resulting from the sample of buildings: 46 in total

Sustainability Balance, Table 2 Rationale supporting the structure of pillars and subpillars

Pillar	Subpillar - Level 1	Subpillar - Level *2*	Reference
Cl. Economics	Cl.l Cost	Cl.l.a. Initial/capital cost	(Collier et al. 2013; Akadiri et al. 2013; Si et al. 2016)
		Cl.l.b Construction cost premium	(Kats 2010; Langdon 2007)
		Cl.l.c Operational cost	(Collier et al. 2013; Si et al. 2016)
		Cl.l.d Maintenance cost	(Collier et al. 2013; Si et al. 2016)
		Cl.l.e Maintenance complexity	(Akadiri et al. 2013)
		Cl.l.f Payback period	(Collier et al. 2013)
	C1.2. Organizational prior experience		(Akadiri et al. 2013)
C2. Environment	C2.1 Resources sustainability		(Nadoushani et al. 2017)
	C2.2 Energy usage	C2.2.a Heating	(Collier et al. 2013; Nadoushani et al. 2017)
		C2.2.b Cooling	
	C2.3 Water usage		(Collier et al. 2013)
	C2.4 Indoor environmental quality (IEQ)		(Si et al. 2016)
	C2.5 Waste management		(Akadiri et al. 2013)
	C2.6 CO2 Emissions reduction		(Si et al. 2016)
C3. Society	C3.1 Societal benefits	C3.1.a Community engagement	(Si et al. 2016)
		C3.1.b Aesthetics	(Collier et al. 2013; Akadiri et al. 2013)
		C3.1.c Local Infrastructure Development	(Sheikh et al. 2011)
	C3.2 Organizational benefits	C3.2.b Health and Safely	(Akadiri et al. 2013)
		C3.2.b Productivity performance	(Si et al. 2016)
		C3.2.c Social reputation	(Si et al. 2016)

response rate, the complexity of survey makes the data valuable for analysis and for establishing the framework from different stakeholder assessments of perspectives concerning a green office project.

Findings and Discussion

This section presents the three main research findings, which are discussed as below.

Weightings of Pillars and Subpillars

Based on AHP principles, the weighting of every pillar and subpillar is estimated by a pairwise comparison matrix. Then, weightings were assigned from the highest priority as pillars to the lowest priority as subpillars of the relative importance. Regarding relative importance of the three sustainability pillars, when analyzed as a whole, participants reported Environment as the most important pillar. The next pillar was Economics and this was followed by Society. In the Environment pillar, C2.2 Energy Usage was the most important subpillar, while for the Economics pillar, C1.1 Cost was more important than C1.2 Organizational Prior Experience. In terms of the Society pillar, C3.1 Societal Benefits was more important than C3.2 Organizational Benefits (see Fig. 2).

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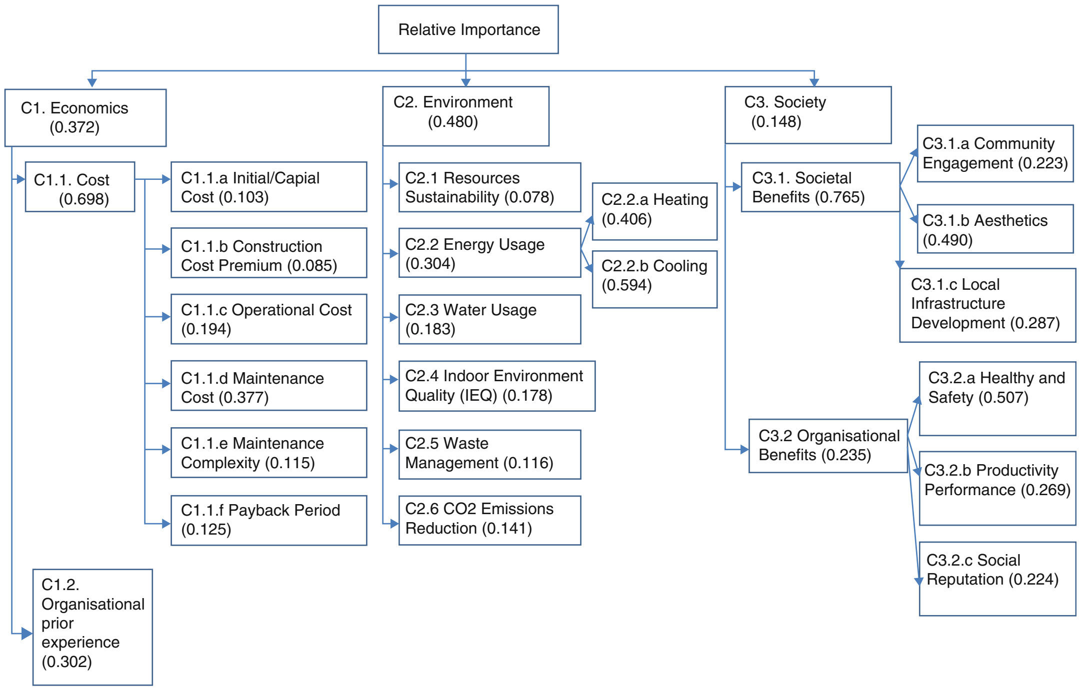


Sustainability Balance, Fig. 2 Relative importance of subpillars and pillars in pairwise comparison

As can be seen in Fig. 2, the different relative importance of pillars and subpillars illustrates the imbalance that survey participants perceived in the three pillars of TBL sustainability. Technically, sustainability principles of the TBL approach consider the three pillars of Economics, Environment, and Society as ideally having equal relative importance. In other words, these pillars should be balanced when sustainability is being assessed. However, the findings illustrate that Environment is the most important pillar, while the Society is the least important pillar. Similarly, the subpillars have different relative importance in contrast to the balanced relative importance.

With assigning the relative importance of pillars and subpillars, the weightings of pillars and subpillars are determined based on their priority. For example:

$$\begin{aligned}&\text{The weighting of C1.1.a}\\&\quad = \text{Relative Importance of C1}\\&\qquad \times \text{Relative Importance of C1.1}\\&\qquad \times \text{Relative Importance of C1.1.a.}\end{aligned}$$

By doing so, the weightings of pillars and subpillars undertaken in this research are shown in Table 3.

Assessment of GFTs

For GFTs assessments, their ranking is based on the integration of their pillars' assessments. In every pillar, the assessment is determined by multiplying GFT assessments with their correlative weightings. This calculation follows the principles of the AHP tool. The highest ranking green feature or technology is the one which generates the most benefits that make TBL sustainability possible. Conversely, the lowest ranking green feature or technology produces the least benefits to the three pillars of sustainability. Based on their rankings, green features and technologies are selected from the highest to the lowest benefits for their suitability in green office projects.

On the one hand, GFTs in the Management category provided the most significant benefits to the TBL sustainability. GFT1.1 – Green Star professionals, GFT1.3 – Environmental management plan, and GFT1.2 – Detailed building users' guide

Sustainability Balance, Table 3 Relative importance of subpillars and pillars in pairwise comparison

No	Code	Pillar or subpillar	Relative importance	Weighting
	Cl	Economics	0.372	
1	Cl.l	Cost	0.698	
1.1	Cl.l.a	Capital/Initial cost	0.103	0.027
1.2	Cl.l.b	Construction cost premium	0.085	0.022
1.3	Cl.l.c	Operational cost	0.194	0.050
1.4	Cl.l.d	Maintenance cost	0.377	0.098
1.5	Cl.l.e	Maintenance complexity	0.115	0.030
1.6	Cl.l.f	Payback period	0.125	0.032
2	C1.2	Organizational prior experience	0.302	0.112
	C2	Environment	0.480	
1	C2.1	Resources sustainability	0.078	0.037
2	C2.2	Energy usage	0.304	
2.1	C2.2.a	Heating	0.406	0.059
2.2	C2.2.b	Cooling	0.594	0.087
3	C2.3	Water usage	0.183	0.088
4	C2.4	Indoor environment quality (IEQ)	0.178	0.086
5	C2.5	Waste management	0.116	0.056
6	C2.6	CO2 emissions reduction	0.141	0.068
	C3	Society	0.148	
1	C3.1	Societal benefits	0.765	
1.1	C3.1.a	Community engagement	0.223	0.025
1.2	C3.1.b	Aesthetics	0.490	0.055
1.3	C3.1.c	Local infrastructure development	0.287	0.033
2	C3.2	Organizational benefits	0.235	
2.1	C3.2.a	Healthy and safety	0.507	0.018
2.2	C3.2.b	Productivity and performance	0.269	0.009
2.3	C3.2.c	Social reputation	0.224	0.008

measured at 3.205, 3.026, and 3.006, respectively. The next categories were Energy and IEQ. In the Energy category, GFT3.11 – Chilled beam system (3.070), GFT3.1 – Submetering is installed for all substantive base building users (2.947), and GFT3.6 – Photovoltaic system (2.879) were reported as the primary GFTs that created greater benefits. For the IEQ category, GFT2.11 – Low e-glazing or double-glazing (2.980), GFT2.1 – High induction supply swirl diffusers (2.906), GFT2.9 – Glare reduction by blinds and/or shading (2.905), and GFT2.3 – Reduction in photocopies/printers due to dedicated rooms (2.629) generated greater benefits from the TBL perspective. On the other hand, GFTs in the categories of IEQ and Energy provided the least benefits. Particularly, in the IEQ category, GFT2.6 – Dedicated tenant exhaust riser and GFT2.5 – Increase outside fresh air intake rates by 50% took the lowest positions of 2.481 and 2.588, respectively. Similarly, in the Energy category, GFT3.10 – Gas fired co-generation plant and GFT3.3 – T5 fluorescent lighting were the next GFTs that generated less benefits, at 2.591 and 2.629, respectively (see Table 4).

Regarding the GFTs group that were assessed as offering the most benefits to the TBL, the selection of these GFTs for the different Green Star categories can be explained differently. For the Management category, the selection of GFTs is made possible by the achievement of green credits and the cost spent. In research by Zuo et al. (2016), they stated that GFTs in the Management category helped to obtain green credits easily with their frequencies being more than 85%. GFTs in the Energy and IEQ categories are explained by presenting the current trend in sustainable technologies being developed for achieving green credits. Firstly, the focus of GFTs in the Energy and IEQ categories is on energy

Sustainability Balance, Table 4 Assessments of 46 GFTs based on the TBL sustainability approach

Categories	GFs and GTs	Economics	Environment	Society	Sum	Ranking
1. Management category	GFT1.1	1.045	1.694	0.466	3.205	1
	GFT1.2	1.095	1.493	0.418	3.006	4
	GFT1.3	1.115	1.475	0.436	3.026	3
	GFT1.4	1.170	1.242	0.396	2.808	22
2. Indoor Environmental Quality category	GFT2.1	1.018	1.494	0.394	2.906	9
	GFT2.2	0.978	1.485	0.441	2.904	11
	GFT2.3	0.979	1.286	0.364	2.629	42
	GFT2.4	1.108	1.209	0.369	2.686	39
	GFT2.5	0.975	1.223	0.390	2.588	45
	GFT2.6	0.967	1.163	0.351	2.481	46
	GFT2.7	1.040	1.203	0.455	2.697	38
	GFT2.8	1.101	1.374	0.400	2.875	13
	GFT2.9	1.089	1.400	0.416	2.905	10
	GFT2.10	1.125	1.143	0.362	2.630	40
	GFT2.11	1.084	1.510	0.386	2.980	5
	GFT2.12	1.075	1.256	0.385	2.715	34
	GFT2.13	1.103	1.258	0.489	2.850	18
3. Energy category	GFT3.1	1.167	1.394	0.387	2.947	6
	GFT3.2	1.167	1.336	0.350	2.853	17
	GFT3.3	1.108	1.156	0.364	2.629	41
	GFT3.4	1.165	1.276	0.400	2.841	19
	GFT3.5	1.093	1.201	0.428	2.721	32
	GFT3.6	1.186	1.233	0.460	2.879	12
	GFT3.7	1.044	1.369	0.387	2.801	23
	GFT3.8	1.041	1.357	0.385	2.783	26
	GFT3.9	1.016	1.305	0.378	2.699	36
	GFT3.10	1.010	1.206	0.375	2.591	44
	GFT3.11	1.204	1.465	0.401	3.070	2
4. Transport category	GFT4.1	1.070	1.242	0.414	2.726	30
	GFT4.2	1.085	1.244	0.491	2.820	21
5. Water category	GFT5.1	1.036	1.343	0.449	2.828	20
	GFT5.2	1.046	1.284	0.368	2.699	37
	GFT5.3	1.084	1.403	0.387	2.874	14
	GFT5.4	1.188	1.382	0.370	2.940	7
	GFT5.5	1.150	1.373	0.394	2.917	8
	GFT5.6	1.060	1.274	0.382	2.716	33
	GFT5.7	0.999	1.240	0.376	2.615	43
	GFT5.8	1.132	1.316	0.420	2.868	16
6. Material category	GFT6.1	1.079	1.311	0.404	2.794	24
	GFT6.2	1.112	1.274	0.376	2.762	27
	GFT6.3	1.082	1.249	0.381	2.712	35
	GFT6.4	1.093	1.247	0.384	2.723	31
7. Ecology and Land category	GFT7.1	1.035	1.326	0.427	2.788	25
8. Emission category	GFT8.1	1.068	1.316	0.485	2.869	15
	GFT8.2	1.152	1.223	0.373	2.748	28
	GFT8.3	1.133	1.220	0.379	2.732	29

efficiency and reduction of environmental impacts (Darko et al. 2017). This focus sets out to eliminate a building's impact on the built environment. GFT3.11 – Chilled beam system, as an example, reveals that GFT3.11 minimizes energy consumption significantly and this in turn leads to environmental protection (Love et al. 2011). Secondly, in achieving Green Star certification, the energy category accounts for the highest green credits of 24 to 25 and then the IEQ category with 20 to 27 green credits, to receive green credits (see Table 1). Therefore, the GFTs assessments primarily concentrate on the energy efficiency and IEQ, which generate the higher benefits of TBL and subsequently higher green credits. It can therefore be stated that GFTs assessments indicate the casual link between the benefits to TBL sustainability and the achievement of green credits.

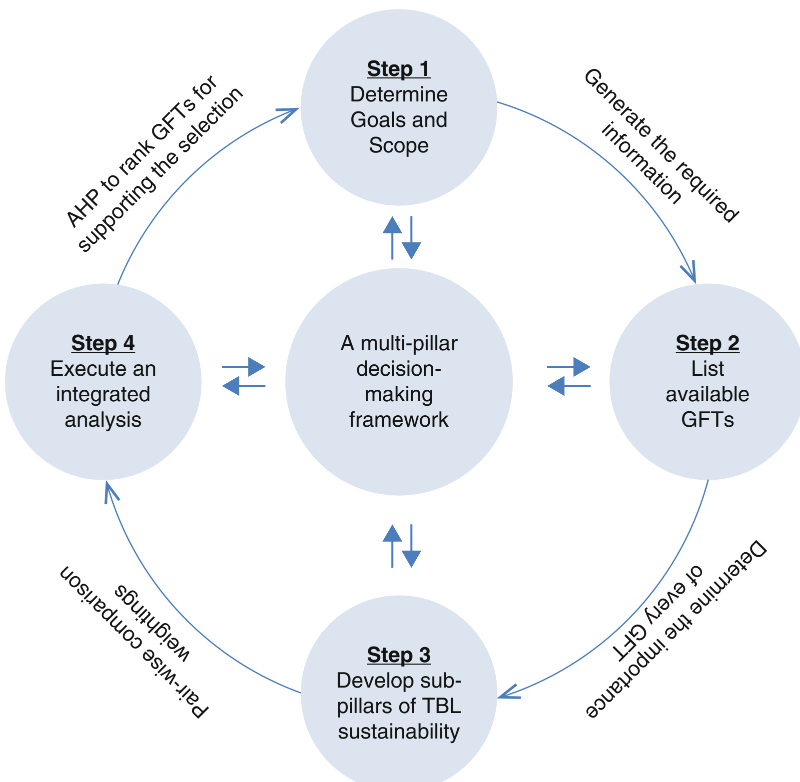
As can be seen in Table 4, GFTs in Energy and IEQ generate the least benefits to TBL sustainability. This ranking reflects the recent changes of how GFTs are used in the development of sustainability in office projects. For example, GFT3.3 – T5 fluorescent has the lowest ranking because it has been replaced by Lighting Emitting Diodes (LEDs) that reduce energy consumption (Doulos et al. 2017). LEDs save energy and are more efficient than T5 fluorescent in the lighting system. Hence, GFTs assessments from the approach of TBL sustainability reflect the development of green features and technologies in green office projects.

A Multipillar Decision-Making Framework

Logically following the process used in this research, a multipillar decision-making framework for the selection of GFTs can now be established with four principal steps. The framework is the most important outcome of this research. They are described in more details below:

Step 1: Determine goals and scope of a green office project. This step generates the required information concerning green features and technologies and may be used to create the pillars and subpillars for assessing green features and technologies, presented in Fig. 3.

Sustainability Balance, Fig. 3 The multipillar decision-making framework



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Step 2: List all green features and technologies that are available (in this research, it was 46, based on assessment of 181 Green Star projects) to be considered for a particular green office project. It determines which GFTs would be appropriate to be considered for assessments. One may commence with the ones identified in this research and eliminate or add as required.

Step 3: Determine assessments of GFTs based on subpillars for the Economics, Environment and Society pillars. This framework can use the subpillars and pillars of this research as a reference (see Fig. 2). Analytical Hierarchy Process (AHP) has been employed to determine weightings of subpillars and pillars.

Step 4: Execute an integrated analysis of green features and technologies using AHP. The rankings of these green features and technologies can now be developed. This ranking process assists in the selection of green features and technologies where Triple Bottom Line sustainability: Economics, Environment, and Society are a critical consideration either as part of a rating tool or a requirement from other considerations, such as Sustainable Development Goals.

The multipillar decision-making framework can be flexibly modified to meet the context of every green office project. It enhances the understanding of the benefits to Economics, Environment, and Society that are potentially generated by GFTs. This framework will assist decision-makers to identify suitable GFTs at the initial stage of a project and subsequently lead to better outcome of sustainability in an office project.

Conclusion

A multipillar decision-making framework for assisting in the selection of green features and technologies has been developed in this paper. This framework assesses green features and technologies considering Triple Bottom Line sustainability. This framework can be implemented at the initial stage of an office project for aiding the selection of GFTs. It provides GFTs information for supporting decision-makers when they are working with project consultants and other relevant stakeholders. Furthermore, this research indicates that of the three pillars: Economics, Environment, and Society; Environment is the most important pillar in the development of green office projects. These pillars do not have the same relative importance demonstrating the imbalance between the three pillars. There is a causal link in the assessments of GFTs under TBL sustainability and the achievement of green credits in Green Star, or indeed any other tool similar to Green Star. This link leads to special focus on GFTs in the Energy and IEQ categories, as these categories are heavily credited in the Green Star rating tool. Finally, the research shows how to use the framework for selecting GFTs to be applied to an office project. These research findings and outcomes make a substantial contribution to understanding the decision making process for sustainable development in office projects in Australia. This process is not just applicable in the Australian context but may also be applicable to other similar tools and countries adopting such tools.

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Sustainability Barriers

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Synonyms

Barriers: Obstacle, Difficulty, Impediment Sustainability: Sustainable Development, Sustainable Community, Ecological Sustainability, Sustainable Growth

Definition

Sustainability barriers may be defined as the obstacles seen in respect of the implementation of sustainability efforts.

Introduction

Barriers can be considered as situations or issues that make the execution of an activity or action difficult. We can compare the barrier to an obstacle and a difficulty to an impediment. The paths to sustainability are full of barriers (Milbrath 1995). Sustainability tends to take into account the economic, social, and environmental aspects (Elkington 1994) so that future generations can meet their needs, according to the most famous definition of sustainable development, from the Brundtland's (1987) Report.

Even with the definitions laid down given by Elkington (1994) and Brundtland (1987), according to Milbrath (1995) and Paiva Duarte (2015), there is little agreement on what constitutes the concept of sustainability, because the definition tends to vary according the context to which it is applied. Milbrath (1995) also reinforces that sustainability can be termed as "sustainable development," "sustainable societies," "sustainable communities," "ecological sustainability," "sustainable growth," and "strategic sustainability." Thus, in this text, we will use the term sustainability as synonymous of sustainable development, in line with authors such as Lozano (2008) and Choi and Ng (2011).

Sustainable development has been a relevant study topic, and it became a concern for researchers, consumers, producers, industries, nonprofit organizations, trades, universities, and society in general. Thus, we highlight the actions by the United Nations (UN), regarding sustainable development, as the definition of the 17 sustainable development goals (SDG) to be implemented by 2030, which are no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life and land; peace, justice, and strong institutions; and partnerships for the goals (UNDP 2016). These goals of the UN are focused on covering all countries, due the current concern of the continuity and maintenance of planet earth, both in social, economic, and environmental matters.

However, several barriers can interfere in the awareness, implementation, and execution of sustainability actions. Therefore, according to Horhota et al. (2014), identifying barriers can be a first step for organizations to become more sustainable. Thus, this text aims to identify the barriers to sustainability or to sustainable development. It is important to show that this research is limited only to identify the sustainability barriers. The research didn't have any pretention of addressing studies that show how to beat those barriers. Therefore, the question about how to overcome the sustainability barriers is placed like a suggestion for a future research.

The Sustainability Barriers

According to Milbrath (1995), reducing the impacts on the environment implies the need for a change of values and behaviors for sustainable development. Thus, identifying the barriers that tend to block or prevent these sustainable values and behaviors is very important. Several theoretical and empirical studies have sought to identify the barriers to sustainability in companies, industries, and universities.

Among the theoretical studies, we highlight two literature reviews carried out by Milbrath (1995) and Stewart et al. (2016). Milbrath (1995) identified two groups of barriers: (1) deficiencies in consciousness, knowledge, and information and (2) cultural traps that obscure vision and forestall action, which can influence sustainable development, as shown in Table 1.

Milbrath (1995) emphasizes that most of the barriers identified in his study are directly related to the individual, especially in relation to his way of thinking. This author also mentions that concern for individuals needs to overcome these barriers and adopts a more sustainable behavior for the survival and continuity of planet earth. In this way, overcoming the barriers that hinder the adoption of sustainable development can be one of the challenges of the present and future generations.

Another literature review was conducted by Stewart et al. (2016) who identified internal barriers such as structural, political, human, and cultural dimensions and external barriers such as regulation, market, technology, and tool and value network. These barriers were verified in four different approaches: process/production, product, supply chain, and value proposition. These authors identified these internal and external barriers from a literature review of 22 empirical studies. Table 2 summarizes the barriers identified in Stewart et al. (2016).

Among the empirical studies, we emphasize that companies, industries, and educational institutions are also concerned and committed to implementing sustainability actions, but several barriers also tend to interfere in this process. For example, the study by Wilson and Rezgui (2013) analyzed 27 consulting organizations from different sectors such as construction companies and practitioners, advisory groups, umbrella professional organizations, consultants, policy-makers, and education and training bodies. These authors identified three groups of barriers (individual perceived barriers, organizational perceived barriers, wider industry perceived barriers) which tend to make it difficult for companies to achieve sustainable development. Chowdury et al. (2015) analyzed six textile and clothing industries and identified three factors of barriers for sustainability, from the social, environmental, and economic perspective.

Paiva Duarte (2015) conducted a survey in Brazil with a group of managers and employees from different organizations and identified five groups of barriers: semantic barriers to sustainability, attitudinal barriers, political barriers, systemic barriers, and macro-systemic barriers. Kuppig et al. (2016) conducted a survey with different organizations and identified that capital also tends to be one of the main barriers for private companies to invest in sustainability actions; also according to this author, capital does not tend to be such a relevant barrier for the public sector.

The study by Horhota et al. (2014) stressed that many higher education institutions placed emphasis on promoting sustainability, but to achieve

Sustainability Barriers, Table 1 Sustainability barriers

Sustainability barriers	Definition
Deficiencies in consciousness, knowledge, and information	**Ignorance about how the world works**: There is awareness and concern about the issue of sustainability, but there is little knowledge about it
	Utilizing linear rather than systemic thinking: The need to think systematically to achieve sustainability
	Incoherencies in key premises about how the world works: The need to understand how the world works
	Faulty theories of social stability and social change: Difficulty in visualizing the need for change in the world to achieve sustainable development
	"Infoglut" in the information society: Excessive information on a wide range of issues can also create barriers to relevant issues such as sustainability
	Most people are not listening: There are a number of agents of change concerned with the issue of sustainability. However, most citizens turn to listening to messages from conventional media, and these messages about sustainability tend not to have large audiences; these tend to be mostly people who are already interested in the subject
Cultural traps that obscure vision and forestall action	**Creeping environmental problems vs. competing problems**: Due to the many different problems that society faces, other problems may be prioritized, rather than environmental ones
	Profound fascination with technology: One of the barriers to sustainable development is to focus on and expect results through the use of technology, regardless of the culture, values, behavior patterns, etc.
	Lack of imagination: Difficulty of using the imagination about how our future will be, a new society, a more sustainable society; in this case, this requires people to be curious and in trying to imagine different scenarios
	Deep psychological investment in the status quo: Difficulty of changing current patterns of consumption and lifestyles
	The siren call of progress: One is taught to want progress, without seeking to be more "advanced," and thus to do greater things, in an easy manner and using less resources such as energy and material and even in making less money, lowering population growth, and doing things more slowly.
	Relative deprivation arid frustration: Related to lifestyle, deprivation of a particular pattern of consumption can lead to frustration
	The injustice of being victimized: People who tend to be afflicted by damage from environmental degradation, tend to feel as victims of this process, and tend to find it difficult to contribute to sustainability actions.

Source: Adapted from Milbrath (1995)

sustainability on the university campus, universities tend to have to overcome many barriers, such as communication/awareness, inconvenience, financial concerns, and lack of engagement. These authors performed such research in Furman University, located in South Carolina, USA. Another study, in the context of teaching, was carried out by Evans et al. (2012) who analyzed a case study in two regional primary schools, in Far North Queensland, Australia, and identified two types of barriers to the implementation of sustainability in this school, administrative barriers and conceptual barriers. The barriers identified in the empirical studies are presented in Table 3.

We can verify that several of these barriers identified, according to Tables 1, 2, and 3, are linked to the behavior and values of organizations and people, as well as aspects related to the organization's own structure, i.e., internal barriers. As mentioned by Stewart et al. (2016), several external barriers also tend to influence companies in the implementation of actions aimed at sustainable development.

Sustainability Barriers, Table 2 Internal and external sustainability barriers

Factor of sustainability barriers	Barriers	Production	Product	Supply chain	Value proposition
Structural dimensions/ internal	Difficulty to scope/prioritize/set goals, lack of strategy		X	X	
	Lack of goal translation to functional/ department basis		X	X	
	Difficulty to define relevant sustainability performance metrics/perform reporting	X	X	X	
	Issues of information filtering/flows/timing to support decision-making	X	X	X	
	Lack of function integration/cooperation		X	X	X
	Lack of clear responsibility distribution		X	X	
	Difficulties related to decision-making processes	X	X	X	
	Non-adapted performance measurement and incentive systems	X	X	X	X
	Locked-in situation related to capital/ technology investments	X			
Political dimensions/ internal	Difficulty to elaborate business case, conflict, and difficulty to manage trade-offs		X	X	X
	Low priority on agenda, short-term priority	X	X	X	
	Lack of continuity due to changing agenda	X			
	Lack of alignment with other projects	X			
	Power of resisting versus promoting groups	X			
	Lack of financial resources	X		X	X
	Lack of time and human resources	X	X	X	
	Lack of local empowerment (department, business unit, subsidiary)	X		X	
	Lack of R&D/innovative capabilities	X	X		
Human dimensions/ internal	Lack of awareness		X	X	
	Lack of interest/commitment	X	X		
	Lack of involvement and empowerment	X	X		
	Lack of support from management for employees	X		X	
	Lack of skills/knowledge/training		X	X	X
	Difficulties linked to learning process	X			
	Fear to lose creativity/flexibility		X		
	Fear of work overload	X	X		
	Discomfort/uncertainty about topic		X		
	Difficulty to find sustainability ambassadors with necessary set of skills	X			
Cultural dimensions/ internal	Skepticism regarding potential benefits		X	X	
	Lack of entrepreneurial spirit/room for out-of-the-box thinking		X		X
	It is not the company's responsibility		X		
	Sustainability is a distraction		X		
	Language barriers		X		
	Sustainability is "not invented here"		X		
	Sustainability input is constraint/criticism		X		

(*continued*)

Sustainability Barriers, Table 2 (continued)

Factor of sustainability barriers	Barriers	Production	Product	Supply chain	Value proposition
Regulation/ external	Unclear/fuzzy message from regulation		X		X
	Multiple/complex/changing regulation	X	X	X	
	Low pressure from regulation/control	X		X	
	Regulation limits room for innovation				X
Market/external	Unclear/fuzzy message from customers		X	X	
	Lack of understanding/knowledge among		X	X	X
	Low market demand/willingness to pay		X	X	X
	Lack of influence on customers		X		
	Lack of competitiveness	X	X	X	
Technology and tool/external	Dependency on available technology	X	X		X
	High research costs/risks for new technologies	X			X
	Lack of framework/tool customization	X	X		
	Complex/time-consuming/information intensive tools		X		
	Difficulty to make links with other business concerns when using tools		X		
	Lack of industry-specific information/ benchmark/reference cases	X	X	X	X
Value network/ external	Dependency on current infrastructure/value network setting	X		X	X
	Lack of understanding/knowledge among customers			X	X
	Lack of commitment			X	X
	Lack of trust, reluctance to sharing information/making joint investments		X	X	X
	Current/future locked-in situation or lack of bargaining power against other players		X	X	X
	Difficulty to communicate and exchange data across the value network		X	X	
	Difficulty to collaborate within/coordinate the value network		X	X	X
	Discrepancy across accounting/contracting practices/incentives				X
	Risk of scrutiny by stakeholders		X	X	

Source: Adapted from Stewart et al. (2016)

Conclusions and Suggestions for Future Research and Limitations

In order to identify sustainability barriers, a literature revision was performed, and the authors verified that many are the barriers that could detain or make it hard for the companies, industries, and universities to become more sustainable. It is also noticed that most of the studies on the barriers to sustainability are recent. This reinforces the importance and concern of studying this theme and the need to identify means for organizations and society to contribute to a more sustainable world, taking into account the social, economic, and environmental aspects, as well as awareness that we need to meet our current needs, but also taking into account the needs of future generations.

Regarding the limitations of the research, there may be other barriers that hinder the implementation of sustainability and that were not inserted in

Sustainability Barriers, Table 3 Sustainability barriers identified on empirical studies

Factor sustainability barriers	Sustainability barriers	Authors
Administrative barriers	Lack of time and money; staff resistance	Evans et al. (2012)
Conceptual barriers	Limits to conceptual understanding; it is still easy being green	
Individual perceived barriers	Lack of knowledge, about sustainable construction, including practices and principles, availability/accessibility, and information overload; uncertainty and skepticism, about the necessity for, and effectiveness of, sustainable construction practices (both industry stakeholders and end users); distrust in information sources, including consistency, validity, authority, and timeliness; reliance on technology, including new technologies for sustainability and for information retrieval; resistance to lifestyle change, perceived threats including changes in living standards, inconvenience, and cost	Wilson and Rezgui (2013)
Organizational perceived barriers	Information and knowledge sources are fragmented, diverse, unstructured, and nonintegrated; lack of training, including understanding the skills need and raising; work overload and priority to expedite current tasks and activities, including within tight financial margins; lack of time for reflective actions and capitalizing on lessons learnt, lack of information/knowledge sharing	
Wider industry perceived barriers	Lack of government action, to initiate and promote energy positive behavioral change; government focus on regulation, in an industry which suffers from poor stakeholder education	
Barriers to sustainable behaviors	Lack of engagement, communication issues, lack of proper campus infrastructure, and financial concerns	Horhota et al. (2014)
Social factors	Lack of awareness and knowledge of the employees, lack of awareness and interest of management, non-compliance of some social issues in organization, absence of sustainability strategy, absence of adequate governance (social), lack of written policies and reporting practice, cost and resource constraints to comply with social issues, and lack of regulatory framework and enforcement of law	Chowdhury et al. (2015)
Environmental factors	Lack of awareness and knowledge of the employees, absence of pollution control measures, lack of awareness and interest of management, absence of sustainability strategy, absence of adequate governance (environmental), lack of written policies and reporting practice, cost and resource constraints to comply with environmental issues, lack of regulatory framework and enforcement of law, and lack of government incentives.	
Economic factors	Utility supply problem, dependence on imported material, supply disruptions, lack of efficiency of employees, infrastructure problem (port, customs, transportation), shortage and high cost of funds, political instability, operational disruptions, and fluctuation of raw material price and currency price	
Semantic barriers to sustainability	Confusion regarding the meaning of the concept	Paiva Duarte (2015)
Attitudinal barriers	Lack of interest and resistance	
Political barriers	Suppression of sustainability issues through organizational politics	
Systemic barriers	Lack of a globalized view of the world, seeing the whole and not only parts of it	
Macro-systemic barriers	Consumer culture of global capitalism	
Capital/financial barrier	The capital, i.e., the need for financial resources, also tends to be a barrier to sustainable development	Kuppig et al. (2016)

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this study. Regarding future research, the barriers to sustainable development were not identified in the literature by analyzing consumers, i.e., from the perspective of analyzing the barriers that prevent consumers from having a more sustainable behavior. In addition, this study investigated the barriers to sustainability in different segments (companies, industries, and educational institutions). Future research can also deepen this research by analyzing specific segments such as agricultural companies, construction companies, health-care companies, etc. Still, future research can identify and argue about how to overcome those barriers. Another suggestion may be an analysis of possible differences between distinct segments or, if there are differences, between underdeveloped, developing, and developed countries.

Cross-References

▶ Sustainability Barriers

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Sustainability Beliefs

▶ How Worldview Development Influences Knowledge and Beliefs About Sustainability

Sustainability Challenges

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Definition

Sustainability The concept was made popular by the World Commission on Environment and Development in a report "Our Common Future," also known as the "Brundtland Report," before the United Nations General Assembly in 1987. It officially defined the concept of sustainable development as the kind of development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report 1987).

Introduction

The Post-2015 Development Agenda has given prominent recognition to the fact that complex natural and social systems are strongly interconnected, thereby giving an altogether new perspective for development. In this context, the role of higher education institutions (HEIs) goes beyond enhancing enrolments (Owens 2017). They need to focus on their other responsibilities as well, such as research and extension through active partnerships with government and other key agencies to address challenges like poverty eradication, promoting responsible consumption, building peaceful societies, increasing health and well-being, etc. (UNESCO 2016).

The Emerging Role of Higher Education in Sustainability

Higher education (HE) did not feature prominently in the global development agenda till 2015, when the Sustainable Development Goals (SDGs) were announced. Although the Millennium Development Goals (MDGs) mentioned education prominently, it was limited to the universal attainment of primary education (UNESCO 2000). During the 1980s and 1990s, there was a popular misconception that countries would get a greater return on the investments made on primary and secondary education rather than for tertiary and technical training. The several years of underfunding that followed, seriously undermined the development of tertiary education, particularly in developing countries. It has also delayed advances in basic and applied research, teacher training, public health-care delivery, and other essential social building blocks (Owens 2017). Despite the policy bias against the role of HE in the development sector, HE systems have been trying to carve out a role for them in this regard (Ibid). The International Association of Universities (IAU) have been encouraging universities to promote sustainable development since the 1990s and adopted a comprehensive policy statement called the Kyoto Declaration on Sustainable Development in 1993 (IAU Policy Statement 1993). This realization led to the concept of "Education for Sustainable Development" (ESD).

With the objective of integrating the principles and practices of sustainable development into all aspects of education and learning, the United Nations declared 2005–2014 as the "Decade of Education for Sustainable Development" (known as the UNDESD). As a follow-up on the UNDESD, UNESCO published a report "Global Action Programme on Education for Sustainable Development" and a roadmap for its implementation in the post-2014 period. This roadmap identified five key areas: "advancing policy," "transforming learning and training environments," "building capacities of educators and trainers," "empowering and mobilizing youth," and "accelerating sustainable solutions at local level."

The Post-2015 Development Agenda of the United Nations has given a fresh impetus to the role of HE for sustainable development. The SDGs have brought HE to the focus of the development agenda across the world. SDG-4 (quality education) is made up of ten targets out of which Target 4.3 introduces technical, vocational, tertiary, and adult education into the global development agenda. It seeks to ensure equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including universities. There are also two other targets concerning HE. Target 4.B calls for more study abroad scholarships for students from developing countries, and Target 4.7 calls upon schools and universities to build in key sustainability concepts across the curriculum, such as climate change, human rights, and peace studies.

New expectations from HE raise major challenges to align its systems and processes to the requirements of sustainable development. HEIs across the world have taken a range of initiatives to integrate the concerns of sustainability in their activities. Some prominent areas in which such interventions have been made are stakeholder engagement and participation, campus operations, sustainability reporting and assessment, organizational change management, and curriculum development. Such interventions are based on new approaches, concepts, methods, and frameworks (Ramos et al. 2015). However, there are still several challenges which need to be addressed.

Challenges for Sustainability

Despite the planned approach for development followed in most countries worldwide, there are several challenges faced by the global community due to emerging imbalance between the use of resources and their renewal and the pollution associated with impacts on the ecosystem at large (Strange and Bayley 2008). Proliferation of markets and products has dangerously enhanced consumption and is further straining already depleted resources. Further, global warming, climate change, and its potentially devastating consequences are seriously threatening the systems that support life. The rapid but often uncontrolled growth in emerging economies leading to greater demand for energy is likely to further intensify environmental-related problems. There are nations faced with terrible internal conflicts, and the menace of terrorism threatens peace almost everywhere, thus forcing a large percentage of the world population to live in conditions of extreme insecurity and vulnerability. According to the UN estimate, the current world population of over 6.5 billion would increase to over 8 billion by 2050 which is most likely to take the situation to alarming proportions.

All these developments are happening, while global communities have the immediate priorities to address socioeconomic disparities between and within nations, enhance access to clean water and sanitation facilities, and ensure adequate health care and education. Sustainable alternatives for growth hold the potential to reduce such socioeconomic disparities, foster development, and at the same time preserve the environment (Strange and Bayley 2008).

Education can afford gainful employment to vulnerable groups, increase their capacity to access basic health-care facilities, help them to recover from shocks of natural disasters, and build their capacity to participate in scientific practices. The Stockholm Conference in 1972 recognized the vital role of education to foster environmental protection and conservation (Lozano et al. 2015). In the course of time, HEIs have been making efforts to embed environmental education and ESD in their systems and processes. However, despite the enormous scope to contribute to sustainability, there are varieties of challenges to address before HEIs will be able to realize their full potential. These challenges can be divided in two broad categories: firstly, the challenges which have direct bearing upon the HEIs and the way they conduct their business (i.e., the curriculum, research, extension, indigenous knowledge, stakeholders, etc.) and secondly the challenges of a more general nature (i.e., poverty, urbanization, climate change, etc.) to which HEIs also need to respond.

Challenges Which Have Direct Bearing upon HEIs

Investments in Research and New Areas of Skills for the Twenty-First Century

The future generation of decision-makers, leaders, and educators will need new areas of skills to combat worldwide recession, ongoing humanitarian concerns, unexpected ecological crisis, etc. Therefore, aspirants of HE need to be equipped to deal with such complex sustainability changes in diverse professional contexts. Though HEIs worldwide are gearing up their systems and processes to meet such challenges (Ryan et al. 2010), widespread institutional change will require a response far beyond what have been observed to date (Sharp 2002, p. 130).

The emerging concepts of sustainability need to be integrated in HE systems to address these issues. The UNDESD (2005–2014) created a conducive atmosphere for such a strategic framework for sustainability. However, significant perceptive change in HE systems is yet to be made. Moreover, most of the key challenges of sustainability require an interdisciplinary approach which is mostly hampered due to compartmentalized teaching and learning systems in HE. HEIs are yet to develop an integrated perspective on how to address sustainable challenges. This is a crucial area about which HEIs still have to ponder, with focus on disciplinary issues and the understanding of expertise. The strategic framework for sustainable development in HE calls for a relook into academic priorities, organizational structures, and financial and audit systems of HEIs (Ryan et al. 2010). However, substantial innovation is required to achieve these aims (UNESCO 2009). Furthermore, it will require well-planned investments to promote research and innovations targeted to solve global problems and develop professional research capacity. Such investments can be made through effective partnerships between HEIs and governments in selected fields to advance targeted research, as the private sector may be unable or unwilling to invest in such areas in the beginning (Owens 2017).

Interface Between Academia and Government

Development initiatives usually require government interventions and incentives at every level. Poor governance often results in incapacity to take meaningful decisions with foresightedness and leads to a lack of ability to implement the required measures at grass root level. An effective functional relationship between government and academia can improve the quality of governance. Academics can contribute significantly to policy making in a number of ways. The tacit knowledge of the governmental bureaucracy and the structured knowledge of the university academics can blend to explore viable solutions for good governance. Besides good governance, well-placed policies and planning processes are required to support sustainable development.

Academics bring valuable external viewpoints and fresh perspectives and help to bridge skills gaps in specialist analytical and data handling roles (Government office for Science 2013). There have been several initiatives taken by universities in developed countries to bring together academia and government. Several case studies have been documented for the UK government (Government office for Science 2013). Similarly, governments in developing countries are gradually recognizing the need of such functional relationships, and some good practices have started to emerge. An example is the internship scheme between some HEIs and the state government in Madhya Pradesh (India), which led to satisfactory results. Students from centers of excellences (IITs/IIMS, etc.) are identified to work with government for 2 months and then have to give a report to the concerned department. Another example is the revised internship scheme launched by Niti Aayog, which is the apex body for governmental planning in India and which presents a major step toward an effective academic government interface (Niti Aayog 2019). Such interactions need to be more frequent and should be executed in a more organized way. National governments globally need to prioritize their policy issues and develop plans accordingly. Misplaced priorities and the absence of relevant and timely policies can cost sustainability issues dearly and prove to be a hurdle in the achievement of the SDGs (Mangan 2013).

Lack of Awareness

Lack of awareness in communities on issues related to sustainability and sustainable development prevents participation of various stakeholders (Levi and Rothstein 2018). Participation at community level is the most basic requirement of sustainability, as it is the efforts taken in individual capacity which have the most positive impact on sustainability and sustainable development. The existing extension programs of universities therefore need to be strengthened for capacity building at community level. There are several initiatives in this regard that are taken by the universities in developed countries. Relevant guidelines have been developed to mobilize scientific and technical expertise from academia, civil society, and the private sector to support practical problem solving for sustainable development at the local, national, and global scales (SDSN Australia/Pacific 2017). The existing state of affairs, particularly in developing countries, leaves a lot to be desired. It is a challenge for the universities to network with grassroots-level institutions, try to identify areas of potential intervention, and develop suitable capacity building programs. The Unnat Bharat Abhiyan (UAB n.d.) launched by the Government of India has opened new possibilities for such interaction between grassroots-level organization and universities. Such initiatives should involve local actors and aim at developing contextual solutions.

Utilizing Indigenous Knowledge

A need is felt across the world to reconnect to indigenous communities and to tap into their pool of tacit knowledge. Sustainable environmental management can occur with active local support and participation, especially in those areas where people depend directly on the physical environment. Due to livelihood issues, local communities have a genuine interest to protect their local environment. Such communities have developed technologies and sustainable practices which suit local socioeconomic and environmental conditions (Nakashima et al. 2000). The rich pool of tacit knowledge embedded in customs and cultural practices need to be blended with structured knowledge generated by HEIs and utilized to find solutions for sustainable development. It is a challenge for HEIs to involve such indigenous communities, to extract their rich tacit knowledge embedded in their systems and practices and then utilize it for sustainable development practices. Innovation and flexibility will be the hall mark of such initiatives (FAO 2010, p. 30). It will require paradigmatically new approaches to involve indigenous communities, to build their capacities, and to utilize their rich tacit knowledge. Indigenous knowledge and its relevance to environment and development activities through several case studies have been documented in the context of Africa (Lalonde 1991). Similarly, Jaya (2019) has given an account of the role of HEIs to promote indigenous knowledge systems in Zimbabwe. Pandey and Kumar (2018) have visualized a radically new approach of contextualized learning based on practical knowledge and real-life experiences for exploring solutions in consultation with the community.

Skilling the Youth

Developing countries and particularly very low-income countries have a demographic profile in favor of the young population. Most of the population in such countries is young but poorly skilled, which makes them unable to participate in productive societal processes. A large part of this young population participates in informal employment. It has attracted the attention of ILO which has described such employment opportunities as sporadic, poorly paid, and falling outside the protection of the law. The importance of the empowerment, participation, and well-being of the youth has been highlighted in over a third of the 169 SDG targets (ADB 2017).The statistics about the economic status of the youth in developing countries is highly disturbing. As per the fact sheet given on the web site of the Asian Development Bank (ADB 2017), 60% of people aged between 15 and 24 live in Asia and the Pacific. Out of these, about 700 million youths and 85 million young people live in extreme poverty on less than $1.90 a day. The young population therefore constitutes an important segment of society which still needs to realize their full potential. It will be a major challenge for the global community to engage the youth in development and create an environment where every individual has enough opportunities and capacities to exercise his/her economic, social, and cultural rights. SDG-4 categorically highlights the need for ensuring universal youth literacy and numeracy, expanding the global number of scholarships available to developing countries, and ensuring equal access for all to affordable and quality technical, vocational, and tertiary education (SDSN Australia/Pacific 2017, p. 45).

Cross-Disciplinary Research

Though there have been several initiatives for sustainable development in HE, they often lack a holistic perspective. These initiatives often suffer from a compartmentalized approach, thereby leading to a partial view of the issue(s) at stake. Lozano et al. (2015) have presented an extensive analysis of existing literature and found that the topic is largely addressed in a fragmented way. A multidisciplinary approach for knowledge generation is central for the accomplishment of the SDGs. Research has confirmed that the idea of interconnectedness among various disciplines is crucial for sustainability and sustainable development. Therefore, there is a need for integration of theories, concepts, techniques, and the data from diverse bodies of knowledge (Schoolman et al. 2011). HE consists of highly complex systems and therefore requires a holistic approach to deal with sustainable development. Several studies have advocated for a culture of participation within HEIs (Disterheft et al. 2015). It has been observed that institutional obstacles for interdisciplinary work have impacts on the pursuit for sustainability, as illustrated by the engineering discipline (Rahimifard and Clegg 2008). However, during the past few decades, HE systems across the world are gradually embracing interdisciplinary research (IDR), and funding agencies like the National Institutes of Health (NIH) and the National Science Foundation (NSF) are becoming more receptive for such research (Hoidn 2018).

Course Design, Development, and Delivery

The emergence of the knowledge economy has raised new demands and challenges for course design, development, and educational delivery in HEIs. Contemporary societies are witnessing the emergence of knowledge as a resource directly linked to livelihood systems of people. Knowledge explosion and knowledge obsolescence have transformed education into a lifelong activity. HEIs have to devise systems of mass education, improve quality of educational delivery, and make educational programs relevant for sustainable economic development. There are fast-emerging requirements of knowledge at the workplace which need to be taken into account as well. The trans-boundary operations of HEIs are fast emerging, which makes HE truly globalized. SDG-4 refers to the creation of lifelong learning opportunities with the aim of improving knowledge, skills, and competencies, within personal, civic, social, and employment-related perspectives (Owens 2017). Rigid teacher centric systems cannot serve new aspirants who need education at the time and place of their choice. Openness in education is therefore not a matter of choice. It is a compulsion of the age we are living in. The emerging trends of open educational resources (OERs) and massive open online courses (MOOCs) have a potential to revolutionize HE system across the world.

Therefore, HEIs have a major challenge to redesign their ways of educational delivery, explore virtual learning environments (VLEs), and align their curriculum to the requirements of sustainable development. HEIs have to assess the fast-changing knowledge requirements of their target groups, develop content, and design suitable delivery strategies. National policies will have a major role to play in this regard. The governments in different countries will have to align their educational policies to suit the upcoming requirements of HEIs. It requires adequate sensitization at policy-making level, budgetary allocations, and regulatory provisions to support new ways of academic delivery. Regulatory systems have to devise suitable credit transfer schemes among the institutions and ensure recognition and equivalence of degrees. The problems of disparities among the HEIs are more acute in developing countries, which raises a major challenge for sustainable development.

Involving Stakeholders

It is a challenge for HEIs to involve all stakeholders and incorporate their perceptions in strategic planning for sustainable development in HE. The involvement of top management in such processes is vital for sustainable development in HE (Sammalisto et al. 2015). Paradigmatically, new approaches to involve stakeholders in several different contexts have recently emerged. Research further revealed that those academics engaged in multi-stakeholder initiatives have much potential to contribute toward universities' organizational goals (Dentoni and Bitzer 2015). However, there are several factors which can block their engagements. Networking with stakeholders will enable universities to enter into innovative partnerships and explore convergence of resources. It will not only reduce the cost of operations but also reduce fixed costs for universities. Some of the successful models of networking and collaboration between universities have been highly successful in developing countries where resources are limited and change is immediately required.

General Issues to Which HEIs Need to Respond

Militarization and Conflict (Orr 2002)

For any development process to take place, peace and mutual cooperation are one of the most essential prerequisites. Only a stable, secured, and peaceful environment can enable conditions for sustainable development. On the other hand, conflict can slow down and even reverse human development and undermine the overall working of the system (Salti et al. 2016). Any form of conflict or violence has an adverse impact on welfare activities, which in turn has direct bearing on the growth of the economy. It leads to diversion of much needed resources (financial, natural, and human) to tackle conflict situations instead of utilizing them for promoting welfare activities. It also leads to problems of displacement of people, casualties of civil population, poor health conditions, scarcity of basic amenities like food and clean drinking water, etc. Besides, a prolonged conflict situation also leads to disruption of social fabric and social disorganization. It creates condition of fear, insecurity, and anxiety among communities. This fear often culminates into hatred and misconceptions targeting communities and ethnic populations and as such results in affecting the concept of sustainability. The conflict raises a challenge for the sustainable development in HE. It has been found that conflict-ridden societies take a heavy toll on educational access, gender equality, welfare programs of governments, health infrastructure, etc. HEIs can shape behaviors in post conflict areas through principles of freedom, justice and democracy, diversity, empathy, tolerance, and solidarity (Malley 2017; Wilson and Ane 2017). Furthermore, innovative ways of imparting education even in conflict hit areas can assist people to continue with their educational pursuits (Nurul and Pandey 2018). It is a major challenge for HEIs in such areas to promote a culture of dialogue and plan and implement innovative strategies to enhance educational access.

Unsustainable Production and Consumption Patterns (UN 2013)

Growing inequalities in the world have significant impacts on the production and consumption patterns of society. The income levels of some sections of society experience significant increase, which result in enhanced production of goods used by such prospering sections. However, such imbalance creates problems as the production of consumption items by and for the rich often requires more resources on average. Hence, the production of items used by the poor experiences significant decline, thereby making their livelihoods unsustainable. Growth in consumption for the poor to meet their basic needs which can be balanced through reduced material consumption by the rich could be a viable approach (Dahl 2014). In addition, the associated environmental degradation has to be seen not only as a natural phenomenon but also as a social phenomenon (Sanwal 2011). It is more a problem of consumption which is unplanned and excessive/irresponsible. The problem of overexploitation of natural capital will continue to persist till humankind pursues a more responsible consumption pattern. A future agenda for sustainability would have to bring about this transformation in consumption patterns at every level and across generations. Sustainable development therefore poses a challenge to economies, academia, and ecological systems (Rayazuddin and Singh 2010). Consumers are the key driving force for sustainable production and therefore play a central role in sustainable development. Therefore, people need to be provided with appropriate skills and competencies to visualize the negative implications of unsustainable consumption patterns and adopt sustainable consumption behavior (OECD 2008). HEIs have a major role to sensitize communities to adopt responsible behavior and demand a high level of environmentally friendly alternatives. This objective can be accomplished by HEIs through curriculum change, research, innovation, new academic programs, etc. An example is the good practices initiated in OECD countries largely through innovations in the school-based curriculum, which are well documented (OECD 2008)

Poverty/Income Disparity

Education is absolutely critical to escape chronic poverty, to afford people higher wages and thus to prevent the transmission of poverty between generations (UNESCO 2014).The impact of education on inequalities is well documented in the literature and categorically linked to all the SDGs. A review of 64 studies shows that more equitable distribution of educational opportunities reduces income inequality (UNESCO 2014). Shifting poverty levels and income disparities at national level is highly undesirable for sustained economic growth. It undermines prospects for sustainable development by threatening economic and social stability and by constraining the life choices of individuals. Thus, inequality levels in the society have a direct implication for sustainability.

During fast few decades, there is an increased sensitization at policy level in developing countries to adopt flexible and innovative ways of educational delivery. Technological advances have further enabled HEIs to provide academic support services in remote and geographically isolated regions. This has led to a tremendous rise of lifelong learning opportunities through open and distance education (Raditloaneng and Chawawa 2015). The Indira Gandhi National Open University has the distinction of being the largest open university in the world, has an enrolment of more than three million, and constitutes a major role player in HE in India. Other developing countries also have successful open and distance learning systems, which have significantly assisted the governments in these countries to reduce poverty. The development of MOOCs, open educational resources, online educational repositories, satellite-based educational channels, educational radio, etc. have a great potential to further democratize higher education and thereby reduce poverty particularly in developing countries. However, such new opportunities have also raised challenges like poor penetration of mobile/Internet technologies among the socioeconomically disadvantaged communities and the need of content generation for diverse linguistic and cultural settings.

Addressing Diverse Issues in Policy and Practice

Policy interventions to democratize school education have significantly enhanced the pool of aspirants for HE. HEIs have a major challenge to reach out to all the deprived sections of the society at affordable costs, capacitate them, and link them to the job market. The conventional systems of HE are not adequately equipped to respond to such emerging demands for education. It is a major challenge for HEIs to set up functional linkages with job providers, develop curricula, and create competencies as per the expectations of prospective employers. As different countries have differing levels of social and policy contexts on these issues, efforts in this regard have evoked varying levels of impact (Ryan et al. 2010). Moreover, different regions experience different levels of economic growth, complexity of human and natural ecology, ethnic/cultural diversities, and shifts in industrial patterns under increasingly globalized market pressures. Therefore, challenges for sustainability are emerging in a variety of ways. Diverse challenges call for integrated thinking so that interdisciplinary interventions can address such challenges. The Asia-Pacific region has the largest and fastest growing HE sector. The demand for HE has undergone tremendous growth in the Asia-Pacific region. However, the existing levels of participation in different countries are highly uneven, and glaring disparities exist within the countries as well. There is a dire need for HE interventions to address diverse issues at the level of policy and practice to include multiple stakeholders' interests. It has been a matter of serious concern for the HEIs to develop and embed inclusive policy and practice (May and Bridger 2010)

Environmental Degradation/Climate Change

Climate change is a phenomenon which is threatening the very survival of humankind. It has potentially adverse impacts on every aspect of life. According to the UNFCCC (1990), climate change is the one aspect which has bearing on all other aspects related to the achievement of the SDGs. Climate change affects people living in developing countries to a great extent. This is primarily due to poor infrastructure and poor capacities of the people in these countries. Climate change particularly threatens the most vulnerable parts of the population and increases the incidence of poverty, food insecurity, and income inequality, among others. There is an urgent need of capacity building at different levels to enhance preparedness and mitigate the impact of climate change. However, it's a major challenge for HEIs particularly in developing countries where target groups are diverse and socioeconomically vulnerable and possess a rich pool of tacit knowledge. HEIs have a major responsibility to develop contextualized solutions for capacity building for such target groups (Pandey and Kumar 2018). Such capacity building initiatives in developing countries are well documented (UNFCC 2018). HEIs in developed countries have been contributing significantly toward climate change mitigation, e.g., in the United States, where several HEIs have launched a coalition platform (Second Nature 2018).

Gender Discrimination

Gender discrimination creates inequality at all levels, involves all aspects of life, and has a direct bearing on the overall quality of life for populations globally. Any development initiative is incomplete without equal participation of all genders (including recognizing and harnessing of their potential). This can be made possible only when national governments introduce gender-responsive and gender-sensitive policies and investments, which are created taking cognizance of the articulated (both practical and strategic) needs of women. The SDGs regard gender equality of high importance and allocate a prominent role for HEIs in this regard. However, the existing situation across the world still places women in a very unfavorable situation. Several factors, e.g., poverty, geographical isolation, minority status, disability, early marriage and pregnancy, gender-based violence, and traditional attitudes about the status and role of women, hinder their educational pursuits (UNESCO).

The studies carried out by European Institute of Gender Equality (EIGE) do not present a favorable position of women in relation to men (EIGE 2016a). Research and higher education institutions seem to reproduce social values leading to gender bias/discrimination, like other spheres in society (EIGE 2016b).There are horizontal and vertical segregation between men and women. Women generally participate in stereotyped fields like social sciences and humanities (horizontal segregation). However, men appear to be more inclined to study, teach, and/or research topics related to engineering or technology (EIGE 2016b). Though numbers are improving, only 33% of European researchers are women. The percentage is even lower in male-dominated disciplines (EIGE 2016b). It's a challenge for HEIs to remove such stereotypical subject choices of students. It has also been observed that higher education and research institutions have differential participation of men and women. Top hierarchical positions are mostly occupied by men (vertical segregation) which puts the viewpoints, experiences, and needs of half the population at risk of being overlooked or dismissed (EIGE 2016b).

The status of women is even worse in HEIs of developing countries, though the situation is gradually improving. Sharp vertical and horizontal segregation of women and men can be observed. HEIs have been taking several measures to enhance participation by women in educational programs (through special policy measures) and staffing through adequate administrative support (e.g., maternity leave, crèches at work places, etc.) and strict enforcement of "prevention of sexual harassment at work places." In developing countries where open and distance learning systems are gaining prominence, participation by women is picking up. The Indira Gandhi National Open University (IGNOU), the biggest open university of the world, has initiated a range of schemes, e.g., a scheme of special study centers for women, a separate school for gender and development studies (IGNOU 2019a), and projects for empowerment of women (IGNOU 2019b). Such measures taken by the HEIs have enhanced participation by women in HE. However, participation by women from social groups suffering from multiple levels of vulnerabilities like scheduled caste, scheduled tribes, Muslim minorities, etc. is discouragingly low.

Rapid Urbanization

Rapid growth of cities and urban space has created several new sustainability challenges, which are further aggravated by numerous financial, economic, food, and energy crises. These challenges have threatened the ability of many countries to achieve sustainable development. Various requirements related to the urban style of living create demands and promote unsustainable consumption patterns which hamper the sustainability factor (James et al. 2015). Increasing population trends globally have enhanced the pressures on the available resources, including natural capital. Urbanization and growth of cities is by far the most alarming factor which leads to further rise in the demand and consumption of various resources and their further exploitation. Most HEIs are located in urban areas, and therefore such issues directly impinge on their functioning. HEIs need to nurture their relations with their surroundings, develop a rapport with their urban neighbors, and plan strategies for mitigation of urban problems. Several HEIs in developed countries have satisfactorily embraced the role of anchor as part of their civic engagement activities, particularly in the USA since 1960 (Melhuish 2016).

Conclusion

HEIs have a moral responsibility to increase society's ability to create a just and sustainable future. They are favorably placed to implement sustainability primarily because of their unique freedom to develop new ideas, comment on society, engage in bold experimentation, and contribute to the creation of new knowledge (Cortese 1992, p. 8). HEIs can perform this crucial role through education, research, policy development, information exchange, community outreach, etc.

Even prior to the launch of the SDGs, several HEIs have taken initiatives during 2005–2014 to integrate sustainability in their operations through curriculum change, creation of networks, and introduction of new academic programs for sustainable development. The creation of networks of educational institutions is a significant headway made by HEIs, e.g., MESA in Africa, ProsPER.Net in the Asia-Pacific, COPERNICUS Alliance in Europe, ARIUSA in Latin America and the Caribbean, and the Global Universities Partnership on Environment for Sustainability – GUPES – a network of 370 universities across the globe to implement environment and sustainability practices into curricula. Such networks have a great potential to build capacity, share experiences, and expand the influence of education for sustainable development.

The crucial responsibilities assigned to HE in the Post-2015 Development Agenda call for their response to a disastrous anthropomorphic environmental crisis, failing political systems, religious intolerance, and unsustainable and inequitable economic development. Following the launch of the SDGs, there has been an increased sensitization in systems of HE across the world to relate their operations to sustainable development. A range of new initiatives have been taken by HEIs across the world to address the concerns of the SDGs. However, most of such initiatives seem fragmented, and complete integration of sustainability in their operations is still lacking. HEIs have paid less attention to the development of a strong institutional culture of sustainability (Salvioni et al. 2017). There is a need to bring about paradigm shift in the traditional systems of capacity building, development of cross disciplinary studies, rethinking the missions and to re-structure their courses, research programs, and life on campusl (Corcoran and Wals 2004). It will require a much greater leadership role from the managers of HEIs which will help them to combat the challenges they are likely to face in the future.

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Sustainability Commitments, Institutional Level

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Definition

The sum of the many ways individuals and institutions, public and private, including universities, manage their sustainable development policy within the education sector. It includes formal institutions and regimes cooperation and empowerment to enforce international recommendation in the area of education for sustainable development as well as formal and informal arrangements (institutional platforms of cooperation) including higher education initiatives, to implement sustainable development through education and curricula, research, campus operations, and organizational change management.

Introduction

Based on the concept of sustainable development (SD) which concentrates on the three interconnected "pillars" of sustainability, the economic, social, and environmental, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development (Agenda 2030) officially came into force on 1 January 2016. Implementation and monitoring of the SDGs and the 2030 Agenda require the action of governments, stakeholders, and citizens. Goal 17 "Revitalize the global partnership for sustainable development" underlines that a platform of partnerships needs to be formed between governments, the private sector, and civil society to implement the SDG commitments. To achieve the SDGs, Agenda 2030 sets a clear direction by emphasizing that the global community should "enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries and encourage and to promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships" (Agenda 2030), at all levels – international, regional, and national.

During the Stockholm Conference in 1972 (UNEP 1972), the global community recognized education's role in fostering environmental protection. Since then higher education institutions (HEIs) and international organizations have adopted several declarations and documents to support the process of implementation of SD in the area of education. Considering the role of partnerships in the process of the implementation of SD commitments, various instruments to enhance SD have been adopted at different institutional levels, including the level of HEIs themselves. The collaborative initiatives toward SD between hundreds of universities, referred to as the Higher Education Sustainability Initiative (HESI), seem to be the leading cooperative platform for universities and international organizations. This contribution examines why different stakeholders commit to sustainability, presents HESI as a prime example of a global platform of institutional cooperation and commitment toward SD, and provides examples of cooperation between HESI, universities, and international organizations and initiatives by HEIs in terms of measuring and reporting practices.

Why Institutions Commit to Sustainability in the Higher Education Sector

The very first reason why the international community needs to coordinate its actions in the area of SD is the conviction that effective and well-coordinated institutions and strategies are essential to achieve a balanced integration of economic, social, and environmental interests and progress toward SD in all areas, including the higher education sector. Goal 17 corresponds with the concept of good governance, which was first used by the World Bank (WB) in 1989 and found that the crisis in African developing countries is due to a problem with governance (World Bank 1989). Governance is defined as "… the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interests" (UN 1995). Since good governance in different sectors has become a subject of research and embraces not only governmental institutions but also informal and non-governmental "mechanisms" (Rosenau and Czempiel 1992), global cooperation and effective institutional platforms of cooperation (also in the higher education sector) seem to be the crucial for SD implementation.

The second reason for coordinated actions in the area of SD connects with the nature of universities' activities and their mission, which is the responsibility for societal transformation. Universities can implement the SD concept through education and curricula, research, campus operations, and organizational change management (Grindsted 2011; Grindsted and Holm 2012; Leal Filho et al. 2018, a; Mcmillin and Dyball 2009). Associated with this responsibility, universities worldwide signed several declarations/documents concerning environmental awareness and SD responsibility, including the Talloires Declaration (1990), Kyoto Declaration (1993), COPERNICUS University Charter (1993), and many others (Lozano et al. 2013). Most of these highlighted the main issues which should be addressed by universities, which include environmental degradation, unsustainable consumption, the ethical and moral obligation of university leaders, the inclusion of SD throughout curricula and in research, and collaboration with other universities and stakeholders (Lozano et al. 2013; Calder and Clugston 2003; Wright 2004).

Even though there is no evidence that signing declarations has fundamental influence on HEI policy and practice, those universities which are not signatories of any declarations or are not members of any societies are left behind (Lozano et al. 2015). Research indicates that there is an interlinkage between commitment, implementation, and participation in HEI initiatives toward SD. It has been shown that "universities with SD policies have more probability to have initiatives as green campus procedures, SD in the curriculum and joint local/regional SD activities as compared with those who do not. [In addition] the existence of a SD policy in given universities often – but not always – means that other areas (e.g. SD training) are equally developed" (Leal Filho et al. 2017b). Several HEIs, which joined some of the HEI platforms to fulfill SD commitments, provide examples of improvements, not only in terms of environmental factors or the SDGs but also including progress in such areas as labor and human rights standards or anti-corruption practices (SDSN 2017; UNISA 2015).

Cooperation assists with the implementation of SD into education through global education for sustainable development (ESD) initiatives. During the last decade, global cooperation assisted with improvement of whole-school planning and teacher competences, reorienting education policy and curricula and making education more relevant to social, environmental, and economic challenges (UNESCO 2014). Stakeholders (who became more and more aware of the importance of partnerships and collaboration) are increasingly incorporating education strategies, tools, and targets into national sustainable development strategies and use available mechanisms and tools to shape ESD policy and to provide implementation mechanisms at country level (UNESCO 2014). Concluding, even though it is very difficult to assess the effectiveness of different SD initiatives and their influence on good governance in the area of higher education, it seems that without that, it would be much more difficult to implement sustainability into higher education policies and universities' practices.

HESI as Institutional Platform for Sustainability in the Higher Education Sector

Most of the United Nations' (UN) organizations (like ECOSOC, UNESCO, UNU, UN-HABITAT, etc.) are actively involved into the process of SD implementation. The United Nations Development Group (UNDG) which unites the 32 UN funds, programs, specialized agencies, etc. plays the leading role in development initiatives to implement SD goals. However from the perspective of institutional cooperation in the area of sustainability commitments within and cooperation between HEIs, the most important platform seems to be the Higher Education Sustainability Initiative (HESI).

HESI was initiated in 2012 as partnership between the United Nations Department of Economic and Social Affairs, UNESCO, United Nations Environment Programme (UNEP), United Nations Global Compact (UNGC), United Nations University (UNU), UN-Habitat, UNCTAD, and UNITAR as an initiative for HEIs in the run-up to the Rio+20 Conference, with backing of more than 300 universities from around the world at that stage. Although HESI provides a platform for most of the important international organizations to cooperate, it is considered more as an informal organization, typical of a network of stakeholders rather than a structured organization. In this way HESI can be considered as an important role-player to connect international organizations involved with SD, with cooperation of HEIs.

To join HESI, a university needs to commit to the following:

1. Teach sustainable development across all disciplines of study
2. Encourage research and dissemination of sustainable development knowledge
3. Green campuses and support local sustainability efforts
4. Engage and share information with international networks

In these areas HESI provides possibilities for HEIs to share their experiences and strategies for advancing the SD agenda. HESI also facilitates engagement of universities in local government and city development projects. In 2017 HESI organized a number of activities aimed at improving SD implementation by HEIs, including the following: development of an online platform of best practices/partnerships by HESI members, organization of workshops and lectures for HEIs, building a library of resources and best practices on integrating the SDGs into the curriculums offered by HEIs supporting the Sulitest initiative in launching and disseminating learning modules for each of the 17 SDGs, supporting the SDG Accord initiative, building connection and interactions among HESI members, and sharing and coordinating the work of HESI partners in supporting the contributions by HEIs toward the 2030 Agenda (HESI 2017).

Actions by International Partners of HESI

All of the HESI partner organizations are actively involved with the integration of sustainability in education. Examples of such initiatives by HESI's partners include the following:

- **United Nations Educational, Scientific and Cultural Organization (UNESCO)**, which is the leading UN organization responsible for the implementation of SDG Goal 4 and adopted the Incheon Declaration for Education 2030 and "Education 2030" – Framework for Action (Incheon Declaration 2015). It coordinates action to integrate the commitments of the international education community to Education 2030 and the Agenda 2030 and Global Action Programme on Education for Sustainable Development (UN 2014; UNESCO 2014).

  The UNESCO Global Action Programme on Education for Sustainable Development (GAP) was launched in 2014. Universities and higher education institutions play a key role in all GAP Priority Action Areas, including contribution to the need of analysis and diagnosis of sustainability challenges to inform policy, adopting a whole-institution approach, train teachers and decision-makers, engaging students and leaders, and provide expertise and support to local ESD initiatives. There are a number of HEIs which work to expand collaboration for SD, including networks like GUPES (a number of teacher training colleges) or Regional Centres of Expertise on ESD (RCEs) coordinated by UNU. To ensure the integration of all SDGs into teaching and learning, UNESCO has published the Education for Sustainable Development Goals: Learning Objectives guidance framework for education policy-makers, curriculum developers, and educators – which is UNESCO's pedagogical guidance on addressing the SDGs through ESD and contains clear learning objectives as well as suggestions for learning activities for each of the 17 SDGs (HESI 2017).

- **UN–Habitat**, which mission is to promote socially and environmentally sustainable human settlements development and the achievement of adequate shelter for all, has established a partnership with universities worldwide called the UN-Habitat Partner University Initiative (UN-Habitat UNI). Its aim is to create the next generation of urban leaders, managers, researchers, and practitioners and should act as a catalyst, facilitating partnerships between universities and other partners. It supports collaborations under the pillars of education (collaborations on university courses and curricula related to sustainable urban development), research (building an international community of researchers with a common agenda and a focus on urgent urban issues), and professional development (supporting capacity development through experts) (UN-Habitat UNI 2017).

  The UN-Habitat UNI action plan goals are:
  - Supporting action research on key areas that strengthens the implementation of the New Urban Agenda (NUA) and the SDG11;
  - Supporting the development of new curriculum, educational, and learning products focusing on the implementation of NUA and SDG's;
  - Assisting universities to engage with city governments and urban communities in support to their actions to achieve sustainable urban development;
  - Engaging universities in UN-Habitat research and flagship reporting and establishing a two-way collaborative process that taps in resources, knowledge, and expertise that can bring mutual benefits. (UN-Habitat 2017)

  At the end of 2017, UN-Habitat UNI has gathered over 210 university members and nearly 1,500 individual members (scholars, researchers, and university academic staff). UN-Habitat UNI supports the creation of consortia of universities that agree to develop joint projects in education, etc. which engage communities and cities around a common thematic focus. For example, one of the initiatives is the Global Urban Lectures series, which contains 56 lectures related to sustainable urbanization, which has already reached more than 126,000 viewers from 65 different countries (HESI 2017).

- **United Nations Environment Programme (UNEP)**, which organizes several initiatives connected to education. UNEP's leading initiative is the Global Universities Partnership on Environment for Sustainability (GUPES) which aims to promote the integration of environment and sustainability concerns into teaching, research, community engagement, the management of universities, and the greening of university infrastructure, facilities, and operations. GUPES constitute three pillars (education, research, and networking) and several objectives, including the following: provide a strategic platform for mainstreaming of environment and sustainability concerns into university systems across the world; use university education systems to build the professional capacity and leadership needed for responding to sustainability issues; contribute to revitalize the global higher education system and enable it to address current sustainable development challenges with emphasis on UNEP's seven thematic priorities; optimize development opportunities provided by ecosystem services in a sustainable manner and in line with the principles of "Green Economy"; and help prepare the world for the projected impacts of global climate change, disasters, conflicts, etc. (GUPES web). At present, over 800 universities and regional partners/focal points from five different continents are part of the GUPES network.

- **United Nations University (UNU)**, which implements research and educational programs in the area of SD, with the particular aim of assisting developing countries. The mission of the UNU is to contribute, through collaborative research and education, to efforts to resolve the pressing global problems of human survival, development, and welfare that are the concern of the United Nations. To achieve its mission, UNU cooperates with leading universities and research institutes in UN Member States, serves as a think tank for the UN system, and provides a bridge between the UN and the international academic and policy-making communities. The UNU Institute for the Advanced Study of Sustainability (UNU-IAS) is a research and teaching institute which mission is to advance efforts toward a more sustainable future, through policy-oriented research and capacity development. UNU-IAS serves the international community through innovative contributions to high-level policy-making and debates, addressing priority issues for the UN system.
- **The United Nations Global Compact (UNGC) and Its Principles for Responsible Management Education (PRME) initiative**, which is the most comprehensive organized partnership (founded in 2007) between the UN and HEIs and which organizes the relationship between the UN and HEIs for business and management education. This global network includes nearly 700 schools and universities across 86 countries, with millions of students worldwide. The first (from six) principle states that the PRME "develops the capabilities of students to be future generators of sustainable value for business and society at large and to work for an inclusive and sustainable global economy" (PRME SIP). The main goal is to establish a process of continuous improvement among institutions of management education in order to develop a new generation of business leaders capable of managing the complex challenges faced by business and society in the twenty-first century. PRME is governed by the PRME Steering Committee which consists of the UNGC and the main business school accreditation bodies and specialized regional associations: AACSB, EFMD, AMBA, CEEMAN, AABS, CLADEA, ABIS, ACBSP, and GRLI. PRME organized several initiatives, like the Global Forum for Responsible Management Education, and is responsible for the PRME SDG Student Engagement Platform, particularly the AIM2Flourish, WikiRate, and Breakthrough Innovation Challenge platforms. All signatories are required to communicate their progress at least every 24 months by Sharing Information on Progress (SIP) reports, which can be found at the official website (PRME web). PRME also launched the Impact Report to present how the PRME initiative is helping to shape more sustainable business education globally (HESI 2017).

Examples of HESI Initiatives

During the past few years, HESI organized a few high-profile events, including initiatives during the High-Level Political Forum (the United Nations' central platform for follow-up and review of the 2030 Agenda for Sustainable Development), which helped to catalyze increased awareness and interest from HEIs. In addition, the most successful HESI instruments on SDG implementation include the following:

- **Sulitest** (sustainability literacy test) – one of the flagship initiatives of HESI – was launched in 2014. The idea behind this initiative is that in order to address the social, economic, and environmental challenges, all decision-makers urgently need to improve their knowledge, skills, and mindset on SD. Sulitest provides information on trends and knowledge gaps related to the SDGs. Universities are broadly involved into this program. To date, more than 110,000 students from more than 800 universities have taken the Sulitest. Results of the Sulitest were presented in a few reports and show an average score of 54%

of expected answers, with significant differences between SDGs. None of the SDGs was characterized by a very low level of awareness nor by complete awareness (the average score ranges from 39% for SDG 6 to 66% for SDG 8) (Sulitest Report 2018).

- **The SDG Accord** was launched in 2017, "to inspire, celebrate and advance the critical role that education has in delivering the Sustainable Development Goals (SDGs) and the value it brings to governments, business and wider society." To date, there are more than 600 signatories from over 60 countries, with additional endorsement from 75 global education sector networks. The SDG Accord requires signatories to make a commitment to embed the SDGs into their education, research, leadership, operations, administration, and engagement activities. The partnership is a public declaration of an institution's commitment to sharing and reporting on their progress toward the SDGs. There are four different types of signatories: institution, individual, supporting organization, and students' organization. All signatories are encouraged to follow the principles, but institutions are required to:
  - "Align all major efforts with the Sustainable Development Goals, targets and indicators, including through our education, research, leadership, operational and engagement activities;
  - Aim to involve members from all key stakeholder groups in this endeavour, including students, academics, professional staff, local communities and other external stakeholders;
  - Collaborate across cities, regions, countries and continents with other signatory institutions as part of a collective international response;
  - Using our own unique ways, inform, share our learning and account to both local and global communities our progress toward the Sustainable Development Goals;
  - Annually report to the UN High Level Political Forum 'how does my institution contribute to the Goals and what more can we do'." (SDG Accord Report 2018)

Signatories are obliged to deliver an annual report on their progress and to share their best practices with others – both nationally and internationally, which are collected by the SDG Accord and presented annually at the High-Level Political Forum.

Cooperative Initiatives by HEIs and Their Measuring and Reporting Practices

Many HEIs are actively involved in SD implementation processes. They launched numerous networks and cooperation platforms and initiated ranking systems to evaluate their efforts and regularly present reports with examples of good practice in all areas of SD activities.

Universities' Networks for Sustainable Development

There are numerous university forums that cooperate to implement the sustainable development concept. Universities can implement the sustainability agenda through activities related to education and curricula, research, campus management, etc. As a response to the Earth Summit in Rio de Janeiro in 1992, universities worldwide got involved in numerous initiatives to work together for a sustainable future (Waas et al. 2009). For example, the Global Universities Partnership on Environment for Sustainability (GUPES) which today gathers over 800 universities was built on the successes of such programs; Mainstreaming Environment and Sustainability in African Universities (MESA) that was created with over 100 academics from 77 African universities in 32 African countries, involving 29 regional and international partners (UNESCO 2014); Mainstreaming Environment and Sustainability in the Caribbean Universities (MESCA); and the Asia-Pacific Regional University Consortium (RUC).

Furthermore, there is the COPERNICUS Alliance initiative which is a European network of 60 members and project affiliated institutions committed to ESD. An equivalent initiative in Asia and the Pacific is the Promotion of Sustainability in Postgraduate Education and Research Network (ProSPER.Net), which consists of

30 higher education institutions (UNESCO 2014). A similar situation exists in Latin America, where universities established networks such as the Mexican Consortium of University Environmental Programmes for Sustainable Development (COMPLEXUS) in 2000, the Environmental Committee of the Association of Universities in the Montevideo Group (CA-AUGM) in 1991 in Brazil, and the Argentinian University Network for Sustainability and the Environment (RAUSA) in 2009. In 2007, several of the latter networks formed the Alliance of Iberoamerican University Networks for Sustainability and the Environment (ARIUSA), an initiative that includes 13 national university networks representing a total of 228 universities in 15 countries in Latin America and the Caribbean (UNESCO 2014). Under its auspices, new networks have been created to implement training and environmental research projects, such as the Universities Network in Environment and Sustainable Development (MADS), the Research Network for Iberoamerican Science, Technology, Innovation and Environmental Education (CTIE-AMB), the Iberoamerican Postgraduate Environmental Science and Technologies Network (PICYTA), and the Iberoamerican Network of Sustainability and Environmental Research (RINSA) (Sáenz and Benayas 2011). A very successful initiative is the Global University Network for Innovation (GUNi), which is an international network created in 1999 and currently link 210 members from 78 countries.

Measuring and Reporting Practices

HEIs have introduced several sustainability rankings and initiatives aimed at improving the quality of efforts by universities to move toward SD, with associated reporting systems. Among others, the most recognized are:

- **GreenMetric World University Ranking** is an Indonesian University project (Tiyarattanachai and Hollmann 2016). The GreenMetric World University Ranking is a university ranking platform which aims is to evaluate and rank universities all over the world. The number of participating institutions is increasing – from 95 in 2010 when the ranking was first initiated to 719 in 2018. The methodology is based on selected criteria that are generally considered as important for university sustainability, including setting and intrastation, energy and climate change, water usage, waste management, transportation, and education and research. Scores for each item are numeric so that the data can be processed statistically. The final rank presents the results based on a total score but also within each of the category (GreenMetric Report 2018).
- **Global Reporting Initiative (GRI)** is an independent international organization that specializes in sustainability reporting. It does not focus specifically on universities, but it helps businesses, governments, and other stakeholders to understand and communicate their impact on sustainability issues. The GRI focus on creation of standards and guidance to advance sustainable development, harmonize the sustainability landscape, efficient and effective sustainability reporting, and driving effective use of sustainability information to improve performance. The standards are modular and designed primarily to be used to prepare a sustainability report focused on material topics. The three basic standards are used by every organization. Organizations also choose from the topic-specific standards to report on their material topics – economic, environmental, or social. Report provides an inclusive picture of an organization's material topics, their related impacts, and how they are managed. GRI reports are produced in more than 100 countries (GRI web).
- **PRME Sharing Information on Progress (SIP)** is another example of a reporting system but specifically focused on the progress made in implementing the six principles of the PRME (UNGC). These principles constitute the central commitment of any institution participating in the PRME. Signatories are required to communicate their progress at least every 24 months. SIPs must include such elements as a letter signed by the highest executive of the organization expressing continued commitment to the PRME, description of practical actions (i.e., disclosure of any relevant policies, procedures, and

activities) that the institution has taken to implement one or more of the PRME principles during the past 24 months, an assessment of outcomes (i.e., the degree to which previously outlined goals were met or other qualitative or quantitative evaluation of results), and key, specific objectives for the next 24-month period with regard to the implementation of the PRME principles, with strategies and timelines (PRME SIP). There are six levels of involvement with the PRME reporting system. Starting from having commitment (exploring why to report and how to achieve it), through collaboration (identifying and engaging key internal and external stakeholders to prepare report), collection (determining what information and data to collect and how to collect and analyze it), creation (designing a report format that works for a certain institution), communication (sharing and using of report), and continuation (keeping track of achievements through a process of continuous improvement) (PRME SIP). All reports by universities are available on the official PRME website.

- **SDG Accord Report** was delivered to the UN High-Level Political Forum for the first time in July 2018, which allowed the SDG Accord to be officially recognized as a tool of HESI. The report reflects progress and challenges of the higher education sector. The report will be presented annually at each UN High-Level Political Forum until 2030. As a result, the 64 SDG Accord institutional signatories were invited to report between 20 April and 25 June 2018 on their work with the SDGs. There were 37 institutions that submitted reports. The universities that prepared the report were encouraged to consult holistically across their institution to capture data in such areas as education, research, leadership, operations, administration and engagement activities (SDG Accord Report 2018).
- There are also many universities that prepare their own reports, thereby presenting their sustainable development initiatives and projects. Examples of these include Campus Sustainability Report (Michigan State University), Penn State Indicators Report (Pennsylvania State University), University of Florida Sustainability Indicators (University of Florida), Campus Sustainability Report (University of North Carolina), Progress Toward a Sustainable Campus (University of British Columbia), etc. (Litten 2005).

Examples of Areas in Which HEIs Take Action to Commit to SD

Higher education institutions actively participate in the implementation of the SDGs. Several initiatives and different approaches are taken by universities in order to implement sustainability commitments. There are several examples of good practices almost in areas connected to SD, including:

- **Research initiatives**, for example:
  - Aalto University (Finland) launched the Aalto Sustainability Hub to bring together researchers of various fields and promote sustainability throughout the university's operations. This resulted in SD to be the topic of 12% of all publications in 2017 at Aalto (SDG Accord Report 2018).
  - The University of Western Australia (UWA) identified the SDGs as an ideal framework for mapping research activities. From this mapping, UWA identified eight dominant areas of SD research activity: food security, human rights, health for all, sustainable cities, climate change and energy, healthy ecosystems, knowledge and education for all, and governance (SDG Accord Report 2018).
- **Education initiatives**, for example:
  - The University of Sydney developed a new unit of study for the university's Masters of Management titled "Poverty Alleviation and Profitability" which focuses on the relationship between SDG 1 (through its exploration of poverty) and the role of business in its alleviation, to the other goals (SDSN 2017).
  - Monash Business School (Australia) is working on a new module to integrate the SDGs into its school curricula across all disciplines and launched the Monash Sustainable Development institute (HESI 2017).

- **Initiatives related to policy and campus organization**, for example:
  - ESPAE-ESPOL (Ecuador) developed a partnership with the World Business Council for Sustainable Development to integrate environmental issues into its university strategies (HESI 2017).
  - University of Calgary (Canada) prepared an Institutional Sustainability Plan which is an integrated approach and framework for implementation of sustainability commitments to the administration of the campus, research, teaching, and other services provided by the university (U of C 2011).
  - Massachusetts Institute of Technology (MIT – United States) boasts extensive results of work on sustainability, including innovative research and campus sustainability practices, which include organization of the MIT Office of Sustainability (MITOS), whose mission is to transform MIT and provide sustainable campus systems and support initiatives toward the campus as an urban living laboratory, etc. (HESI 2017).
  - Asian Institute of Management actively promoted energy savings through the replacement of fluorescent light tubes and compact fluorescent light (CFL) bulbs with more energy efficient LED bulbs; replacement of CRT television sets with LED or LCD; improvements in AIM cafeteria facilities for more efficient energy use; regular inspections of facilities to ensure that there are no leakages and that recycling of reusable waste materials are taking place, etc. (AIM Report 2016).
- **Cooperation with initiatives by other stakeholders**, for example:
  - Chalmers University of Technology (Sweden) emphasizes the importance of transdisciplinary work with stakeholders outside universities. As an example, the ChallengeLab.org of Chalmers University of Technology provides a broad platform for students to engage in collaboration with industry, governments, and academia (HESI 2017).
  - Business School Lausanne (Switzerland) supports the GAPFRAME – a national and global framework for business and other key stakeholders to work toward a better world (HESI 2017).
  - Stanford University (United States) has a university-wide effort to reduce Stanford's environmental impact, preserve resources, and show sustainability in action and participates in the Sustainable Urban Systems (SUS) initiative – which applies multiple engineering knowledge fields in an integrated way to shape the future of cities (HESI 2017).
- **Human rights and good governance initiatives**, for example:
  - The University of South Africa (UNISA) boasts a significant number of initiatives focused on anti-corruption and awareness of human rights, provided for by several improvements in terms of labor standards and anti-corruption practices (UNISA 2015).
  - The Brazilian School of Public and Business Administration (EBAPE/FGV), inspired by the alarming wave of corruption in Brazil, implemented a project called Coração Valente (Brave Heart), which aim was to promote a debate on and encourage ethically correct practices within the school to avoid such practices being perpetuated by new generations of Brazilian administrators (FGV Report 2017).
- **SDG promotion initiatives**, for example:
  - University of Gloucestershire (United Kingdom) organized a pop-up event in 2017 exploring the SDGs as part of Cheltenham Jazz Festival. The event recorded over 800 meetings with visitors (SDG Accord Report 2018).

Conclusion

In its 2018 Report, the SDG Accord recommended to the UN, among others, to endorse and communicate the important role of higher and further education in contributing to delivery across all the SDGs (not just SDG 4). It also calls on country members to mandate the embedding of education for sustainable development in all educational spheres and activities. In addition they emphasized the need for sustainability assessment and formal reporting on SD implementation progress. All universities and colleges should join the SDG Accord, collaborate, and report formally internally and externally on SDG progress through the reporting process. Universities should also consider to change research reporting to require researchers to indicate which of the SDGs the work contributes and to look for innovative ways to increase staff and student capacity to address the SDGs (SDG Accord Report 2018).

It appears as if international communities already have extensive and relevant experience and a proper understanding how institutional cooperation should look like in future. However, the biggest challenge lies in the numbers as well as diversification of different actions and initiatives. Therefore, instead of continuously creating new initiatives and reporting methodologies, there should rather be improved coordination and exchange of good practices, between those which already exist. There is also a need to enhance coordination and cooperation among all international organizations and agencies that deal with SD and education as well as with governments, which seem to be forgotten in the process of institutional cooperation. In this regard initiatives such as HESI and the SDG Accord can play a crucial role to foster commitment to SD by HEIs in future.

Cross-References

► Sustainability Declarations, Effectiveness

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Sustainability Declarations, Effectiveness

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Definition

An official, public, usually written, not binding statement or document of intent sign by states, international organizations or other stakeholders (including universities) responsible for the education sector, to implement sustainable development through education and curricula, research, campus operations and organizational change management and its ability to be successful and produce the intended results.

Introduction

According to the definition used in the United Nations Brundtland Report (1987), sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This concept is based on three “pillars” of sustainability, the economic, social, and environmental factors, which are interconnected, overlapping, and interdependent. At the Stockholm Conference in 1972 (UNEP 1972), education’s role in fostering environmental protection was formally recognized. Since then, international organizations, states, and higher education institutions (HEIs) have become engaged in implementation of sustainable development goals and development of education for sustainable development (ESD) initiatives.

We can recognize two main approaches to the implementation of sustainability into higher education systems. The first approach (which can be referred to as bottom-up initiatives) is developed by universities, which already signed a declaration (or even more than one declaration), where they committed to implement sustainable development (SD) goals into their research, campus organization, or education programs. The second approach (which can be called bottom-down initiatives) is proposed by international organizations and institutions (like the ECOSOC, UNESCO, UNEP, etc.) at international and regional levels, and the aim of which is to encourage countries to implement SD principles (mostly in the area of ESD) into their education (including higher education) systems.

The first part of this contribution concentrates on universities’ sustainability declarations and reviews some of the most important of these. The second part presents international initiatives, documents, and declarations proposed by international organizations, signed by different stakeholders, including states, which promote actions to implement sustainability into education processes. The final part analyses how successful and effective all these different efforts are to implement sustainability in higher education systems.

Universities’ Declarations: Bottom-Up Initiatives

Due to the nature of universities’ activities and their mission, they are responsible for the society’s transformation, and they also contribute to the development of sustainability. Universities can implement sustainability concepts through education and curricula, research, campus operations, and organizational change management (Leal Filho et al. 2017a). The role of declarations, charters, and partnerships in promotion of sustainable development can be seen in the action of more than 1000 university leaders (Lozano et al. 2013) who signed their commitments to work to advance SD. Those initiatives have been the subject of much research presented in the literature, including Wright (2002, 2004), Waas et al. (2009), Bekessy et al. (2007), Leal Filho et al. (2015, 2018, b), Clarke and Kouri (2009), Lozano (2011), Lozano et al. (2013, 2015), Calder and Clugston (2003), Mcmillin and Dyball (2009).

Universities worldwide became involved in several initiatives about the necessity to work together to preserve the future (Waas et al. 2009) and signed several documents concerned environmental awareness and SD responsibility, including:

- Magna Charta of European Universities (1988), Bologna, University Presidents for a Sustainable Future
- Talloires Declaration (1990), Association of University Leaders for a Sustainable Future
- Halifax Declaration (1991), Conference on University Action for Sustainable Development, Canada
- Urgent Appeal from the CRE, the association of European universities, presented to the

Preparatory Committee for the United Nations Conference on Environment and Development (UNCED), Geneva, August 1991
- Creating a Common Future: An Action Plan for Universities, International Association of Universities (IAU), UN University, Association of Universities and Colleges of Canada, Halifax, December 1991
- Kyoto Declaration (1993), International Association of Universities Ninth Round Table, Japan
- Swansea Declaration (1993), Association of Commonwealth Universities' Fifteenth Quinquennial Conference, Wales
- COPERNICUS University Charter (1993), Conference of European Rectors
- Global Higher Education for Sustainability Partnership (GHESP), (2000)
- Lüneburg Declaration on Higher Education for Sustainable Development (2001), Germany
- Declaration of Barcelona (2004), Spain
- Graz Declaration on Committing Universities to Sustainable Development (2005), Austria
- Abuja Declaration on Sustainable Development in Africa: The role of higher education in SD (2009), Nigeria
- Rio +20 Higher Education Sustainability Initiative (2012), Brazil

Talloires Declaration (1990) as a "Model Declaration"

During the Universities Presidents Conference (which gathered 22 university presidents and chancellors) in Talloires, France, in 1990, it was underlined that "Universities educate most of the people who develop and manage society's institutions. For this reason, universities bear profound responsibilities to increase the awareness, knowledge, technologies, and tools to create an environmentally sustainable future" (Report 1990). Participants spoke of the need for expanded research on the complex interaction of human activities and the environment. "By practicing what it preaches, the university can both engage students in understanding the institutional metabolism of materials and activities, and have them actively participate to minimise pollution and waste" (Report 1990).

The conference concluded with the creation of the Talloires Declaration, a ten-point action plan for colleges and universities committed to promoting education for SD in teaching, research, operations, and outreach at colleges and universities, including such action as (1) Increase Awareness of Environmentally Sustainable Development, (2) Create an Institutional Culture of Sustainability, (3) Educate for Environmentally Responsible Citizenship, (4) Foster Environmental Literacy for All, (5) Practice Institutional Ecology, (6) Involve All Stakeholders, (7) Collaborate for Interdisciplinary Approaches, (8) Enhance Capacity of Primary and Secondary Schools, (9) Broaden Service and Outreach Nationally and Internationally, and (10) Maintain the Movement. The main concerns that this declaration concentrated on was environmental degradation, pollution, depletion of natural resources, and the threat to human and biodiversity survival. Until today, there have been 504 signatories of the Talloires Declaration. This declaration became also an international model and has inspired many other universities' declarations and initiatives.

COPERNICUS University Charter for Sustainable Development

One of the most successful initiatives was the signing of the COPERNICUS University Charter for Sustainable Development (1993). It consisted of a number of guidelines that universities can follow to integrate sustainable development into all parts of their institution. Presently, more than 320 universities and higher education institutions from 38 countries across Europe have signed the Charter and declared that they would give sustainable development an important place in their activities.

In 2000, the Global Higher Education for Sustainability Partnership (GHESP) was formed at the joint meeting of the Association of University Leaders for a Sustainable Future (ULSF), COPERNICUS Campus, the International Association of Universities (IAU), and UNESCO. Its aim is to promote better understanding and more effective implementation of strategies for the incorporation of sustainable development in universities and to identify, share, and disseminate widely effective strategies, models, and good practices for promoting higher education for sustainable development, making recommendations in consultation with the key Northern and Southern stakeholders, and working closely with the UN system to develop and implement this joint action plan addressed to achieve common goals.

During the meeting at the International COPERNICUS Conference, within the GHESP society, the Lüneburg Declaration was adopted in 2001. Apart from the confirmation of rather general obligations and recommendations, the EUA-COPERNICUS, the IAU, and the ULSF committed to achieving the following objectives within 5 years following 2001: (1) create a global learning environment for higher education for sustainable development; (2) promote expanded endorsement and full implementation of the Talloires, Kyoto, and Copernicus declarations; (3) produce an action-oriented toolkit for universities, managers, administrators, faculties, and students designed to move from their commitment to concrete actions; and (4) enhance the development of regional centers of excellence in both developed and developing countries and effective networking among them.

In 2011, a redesigned version was released as "COPERNICUS Charta 2.0" (2011). After these commitments, COPERNICUS Campus – the European university network for sustainable development – took leadership in the European Higher Education Area to mobilize universities and academia around the theme of sustainability and to support higher education institutions in the implementation of initiatives in relation to the Bologna Process. In addition the COPERNICUS Guidelines (2010) provide strategic assistance on how to integrate sustainable development into the degree structure, into the qualifications framework and learning outcomes, and into quality assurance, as well as on how to improve the social dimension and the attractiveness of the European Higher Education Area through the integration sustainable development.

Other Universities' Declarations

After the adoption of the Talloires Declaration, there were several similar universities' initiatives. From 9 to 11 December 1991, the presidents and senior representatives of 33 universities from 10 countries met in Halifax, Canada, to discuss the role of universities regarding the environment and development. Six commitments, of rather similar scope as the Talloires Declaration, were released at the conclusion of the conference as the Halifax Declaration.

In 1993, the Kyoto Declaration was launched in the eighth Round table of the International Association of Universities (IAU). It provided ten recommendations that each university, in its own action plan, should strive to, i.e., making an institutional commitment to the principle and practice of sustainable development within the academic milieu; promoting sustainable consumption; developing the capacities of academic staff to teach environmental literacy; encouraging an environmental perspective, whatever the field of study; utilizing the intellectual resources of the university to build environmental education programs; encouraging interdisciplinary research programs; emphasizing the ethical obligations of the university community; promoting interdisciplinary networks of environmental experts, including the mobility of staff and students; and forging partnerships with other sectors of society.

Very similar recommendation can be found in the Swansea (1993), Barcelona (2004), Graz (2005), or Abuja (2009) Declarations. Calder and Clugston (2003) and Wright (2004) have highlighted the main elements and themes of most of these declarations and charters, collected and presented by Lozano et al. (2013), and which include:

- Environmental degradation, threats to society, and unsustainable consumption
- Ethical and moral obligation of universities leaders and faculties to work toward sustainable societies
- Inclusion of SD throughout the curricula in all disciplines
- Encouragement of SD research
- More sustainability orientated university operations
- Collaboration with other universities and other stakeholders, e.g., public organizations,

governments, nongovernmental organizations (NGOs), and businesses
- Transdisciplinary undertakings across all of the above items (Lozano et al. 2013.

A detailed comparison of the most important declaration was presented by Lozano et al. (2013) – refer to Table 1.

Supporting ESD Through International Organizations Bottom-Down Initiatives

The concept of sustainable development can be promoted by an adoption of relevant declarations within different areas of higher education not only by universities and at the level of universities but also by international organizations and governments by implementation international declarations and documents in the area of Education for Sustainable Development (ESD). ESD is a "learning process (or approach to teaching) based on the ideals and principles that underlie sustainability and is concerned with all levels and types of learning to provide quality education and foster sustainable human development – learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society" (UNESCO Bangkok). ESD through education and learning wants to engage people in sustainable development issues, develop their capacities to give meaning to SD and to contribute to its development. It is also a vision of education that "seeks to empower people to assume responsibility for creating a sustainable future" (UNESCO Bangkok UNESCO Bangkok).

ESD involves numerous stakeholders in sustainable development (i.e., governments, businesses, educational institutions, media, the youth, etc.). Each of these sectors has a different vision of sustainable development and the way they can contribute to its advancement. The challenge of ESD is to bring these different stakeholders together so that they may collaborate in partnerships. Considering that education is the precondition to all initiatives within SD, adoption of legal instruments in this area seems to have critical meaning for the entire sustainable development global policy.

Genesis of ESD

The world's first intergovernmental conference on environmental education was organized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in cooperation with the UN Environment Programme (UNEP) in Tbilisi, Georgia, in 1977. It gathered 265 delegates and 65 representatives and observers. That conference was classified as the first conference on environmental education toward a sustainable future and a milestone for environmental education (UNESCO 2014, 19). At the conference, the Tbilisi Declaration (1977) was adopted by acclamation. It should be emphasized that the conference was organized before the concept of sustainable development was popularized in 1987 with the publication of the "Brundtland Report."

In 1992, during the so-called Earth Summit – the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro – governments adopted the Rio Declaration (Rio 1992a), setting out 27 principles for achieving sustainable development, which were complemented by Agenda 21 (Rio 1992b), a guiding document for sustainable development. Even though the Rio Declaration was complemented by Agenda 21 (especially chapter 36), which viewed education as an essential tool for achieving sustainable development, and identified four areas of action, many considered education to have been a forgotten priority of Rio.

In April 2000, more than 1100 participants from 164 countries gathered in Dakar, Senegal, for the World Education Forum (2000). The conference on EFA in 2000 was anticipated in 1990 by the World Conference for Education for All (Jomtien, Thailand), where by the adoption of the World Declaration on Education for All (1990), governments reaffirmed the notion of education as a fundamental human right. A Framework for Action to Meet Basic Learning Needs was also approved, which spelled out the objectives and strategies for reaching that goal by 2015 (World Education Forum 2000; 8). At the final plenary

Sustainability Declarations, Effectiveness, Table 1 Comparison of the themes of diverse SD initiatives by universities – Lozano et al. 2013)

Comparison of the themes of diverse SD initiatives										
Effort	Curricula	Research	Operations	Outreach and collaboration	Collaboration of universities	Assessment and reporting	Trans-disciplinary approach	Institutional framework	SD through campus experiences	Educate the educators
Talloires Declaration	✓	✓	✓	✓			✓		✓	
Halifax Declaration	✓		✓	✓						
Kyoto Declaration	✓	✓	✓	✓	✓					
Swansea Declaration	✓	✓	✓	✓	✓					
COPERNICUS Charter	✓	✓	✓	✓	✓		✓			1/2 (✓)
GHESP	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lüneburg Declaration	✓	✓		✓					✓	✓
Declaration of Barcelona	✓	✓		✓		1/2 (✓)	✓	✓		✓
Graz Declaration	✓	✓		✓	✓		✓			
Turin Declaration	✓	✓		✓			✓			
Abuja Declaration	✓	✓	✓	✓	✓		✓			

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session in Dakar, the Framework for Action (EFA) was adopted. The Dakar Framework was characterized as "a collective commitment to action" and specified mechanisms at the national, regional, and international levels to coordinate the global push for education for all by 2015 (World Education Forum 2000, 36).

Decade of Education for Sustainable Development and the Global Action Program

Despite all efforts, the reports for the World Summit on Sustainable Development (WSSD) – Declaration of Johannesburg (2002a) and the adopted Plan of Implementation (2002b), the 10-year review of Agenda 21 – revealed that the goals laid out in Rio were still a long way from becoming reality. ESD became the way for the rethinking the concept of SD implementation. Through the adoption of Resolution 57/254 (UN 2002), the international community declared the years 2005–2014 as the Decade of Education for Sustainable Development (DESD) and tasked UNESCO as the lead agency (UN 2002).

At the UNESCO World Conference on Education for Sustainable Development (from 31 March to 2 April 2009 in Bonn, Germany), which gathered 900 participants from 147 countries, the world community moved into the second half of the UN DESD. The participants, including states representations, accepted the Bonn Declaration (2009a), which provided an action plan on ESD and outlined steps for implementing the remainder of the DESD (Bonn Declaration 2009b, 8).

In 2012, the world community, by adoption of the declaration "The Future We Want" during the UN Conference on Sustainable Development Rio+20 (2012) in Brazil, recognized education as an important aspect for a green economy, work, social protection, and training for sustainability. Member governments decided to "promote education for sustainable development and to integrate sustainable development more actively into education beyond the DESD" (Rio 2012, section 232).

By adoption of the Aichi-Nagoya Declaration (2014) at the UNESCO World Conference on Education for Sustainable Development held in Aichi-Nagoya, Japan, the participants, among them 76 ministers of UNECSO members, underlined the achievements made by the UN DESD (Chalkley et al. 2009), called "for urgent action to further strengthening and scaling up ESD" and committed "to building and maintaining the momentum of the launching of the Global Action Programme (GAP)." The Global Action Programme (GAP) was acknowledged by the UN Resolution A/RES/69/211 (UN 2014) as official follow-up to the UN DESD (2005–2014). The main goal of the GAP is "to generate and scale up action in all levels and areas of education and learning to accelerate progress towards sustainable development." GAP presents a twofold approach in order to multiply and to scale-up the ESD action, including integrating sustainable development into education and integrating education into sustainable development. GAP corresponds also with the Agenda 2030, especially SDG 4, ensuring "inclusive and quality education for all and promote lifelong learning."

Furthermore, the UNESCO, together with UNICEF, the World Bank, UNFPA, UNDP, UN Women, and UNHCR, organized the World Education Forum (over 1600 participants from 160 countries), where they adopted the Incheon Declaration for Education 2030 and Education 2030 Framework for Action (Incheon Declaration 2015), which constitutes the commitment of the education community to Education 2030 and the 2030 Agenda for Sustainable Development (Agenda 2030), thus recognizing the important role of education as a main driver of development.

Regional Commitments: Europe

In March 2005, the high-level meeting in Vilnius, Lithuania, adopted the United Nation Economic Commission for Europe's (UNECE) Strategy for Education for Sustainable Development (ECOSOC 2005) and the launch of the DESD in Europe. The UNECE Strategy for ESD was a policy tool that should have helped the countries of the region to introduce and promote ESD in their national formal, nonformal, and informal education (UNECE 2009). Governments agreed to periodically assess the implementation process based on a unified reporting and a clear set of indicators.

The achievements of the UNECE Strategy were discussed on 8 June 2016 at the second high-level meeting of Education and Environment Ministries in Batumi, Georgia, during the Eighth Environment for Europe Ministerial Conference. Delegates reaffirmed their commitment to the Strategy through the adoption of Framework for the future implementation of the UNECE Strategy for Education for Sustainable Development (Batumi 2016a) as well as a Batumi Ministerial Statement on Education for Sustainable Development (Batumi 2016b). Countries recognized the necessity "to use education for sustainable development in implementing the 2030 Agenda for Sustainable Development, in particular to achieve Goal 4 (. . .) but also in recognising ESD as a cross-cutting theme that serves as an efficient tool for the achievement of the other SDGs" (Batumi 2016b).

In addition, most countries in Europe have their own program to provide opportunities for ESD especially in the area of higher education, which is implemented by the engagement of many European countries with the Bologna Process. The Bologna Process was launched with the Bologna Declaration (1999) and is one of the main voluntary processes at European level, implemented in 48 states, which define the European Higher Education Area (EHEA). The EHEA was launched in 2010 to generate and consolidate "comparable, compatible and coherent" systems across the region.

Within the European Union (EU), the Council of the UE (2010) also adopted the "Council conclusions on education for sustainable development," where the Council called the states to "support education for sustainable development and promote these Council conclusions by pursuing ESD within both the EU Sustainable Development Strategy and the Europe 2020 Strategy, promoting research on and knowledge of ESD and promoting networking between educational institutions on the issue of ESD. The Council also invited European Commission (EC) to contribute "to Member States efforts to support education for sustainable development and promote this Council conclusion" (Council of the UE 2010). Even though the EC were called to contribute the ESD implementation process, it is impossible to find anything on ESD in the latest documents of the European Commission Communication (2017) on a renewed EU agenda for higher education.

Additionally, in 2013, more than 40 representatives of governments, international organizations, and NGOs from 14 Mediterranean countries (UNESCO 2014, 47) prepared the Mediterranean Strategy on Education for Sustainable Development (MSESD 2014), which aim is to encourage countries to incorporate ESD into their formal systems of education. MSESD was formally and unanimously endorsed by the 43 Ministers of Environment of the Union for the Mediterranean on 13 May 2014 (UNESCO 2014, 47).

Regional Commitments: Asia and Pacific

The main regional ESD Strategy for Asia and Pacific entitled, "Working Paper: Asia – Pacific Regional Strategy for Education for Sustainable Development" (2005), is an ESD guideline for the Asia and the Pacific region. There are several institutions responsible for the coordination of the implementation the ESD, including the Asia-Pacific Cultural Centre for UNESCO (ACCU), the Asia-Pacific UN Inter-Agency Steering Committee for the DESD, and the Asia-Pacific Regional Consultative Group, facilitated by UNESCO Bangkok (UNESCO 2014, 47). Additionally, the Association of South-East Asian Nations (ASEAN) in 2013 developed an Environmental Action Plan for 2014–2018 as the successor plan to the previous AEEAPs (AEEAP 2000–2005 and 2008–2012), which was ASEAN's contribution to DESD (ASEAN 2007). Its mission "serves to realise a clean and green ASEAN with citizens who are environmentally literate, imbued with environmental ethics, willing and capable to ensure the sustainable development of the region through environmental education and public participation efforts"; it is focused on the formal and nonformal sectors as well as on human resources capacity building, including networking, collaboration, and communication (ASEAN 2013).

Regional Commitments: Africa

Africa launched the DESD by adoption of the Strategy of Education for Sustainable Development for Sub-Saharan Africa (SSAESD) at the meeting of the Association for the Development of Education in Africa (ADEA) held in Gabon in March 2006 (UNESCO 2014). The African Ministerial Conference on the Environment (AMCEN) adopted the Arusha Declaration (2012) on Africa's post Rio+20 Strategy for Sustainable Development. As a direct response, with the cooperation with UNEP, the Africa Environmental Education and Training Action Plan 2015–2024 (UNEP 2017) was prepared. The aim of the action plan is to strengthen the capacity of formal education institutions and actors, strengthen training activities and programs, and strengthen the capacity of policymakers, leaders, and decisionmakers (UNEP 2017, 30).

Education is also an important issue of the Agenda 2036 (2015) of the African Union, which is a strategic framework for the socioeconomic transformation of the continent that seeks to accelerate the implementation of the past and existing continental initiatives for growth and sustainable development (Lotz-Sisitka et al. 2017, 5).

Regional Commitments: Latin America and the Caribbean

The Latin American and Caribbean regional strategy for the DESD was developed as an outcome of the conference Building Education for Sustainable Development, held in Costa Rica in 2006, in collaboration with UNESCO. The strategy recognized the need for coordination with ongoing regional programs, such as the Regional Education Project for Latin America and the Caribbean (PRELAC 2002) that was adopted by the ministers of education in 2002.Within the framework of the PRELAC, the Ministers of Education and other high-level education stakeholders have defined the guiding principles and a roadmap, which include a predominant role for education (UNESCO 2014).

Effectiveness

The major challenge with both bottom-up and bottom-down initiatives is the lack of binding instruments. The documents provided by international organizations are not binding instruments, which means that that they are documents of intent, and, in most cases, they do not create legally binding obligations on the countries which signed them. Declarations signed by universities are documents of intent which create some soft obligation but only for the universities which singed them, not the governments. In addition, signing a declaration does not ensure that the institutions (universities or governments) implement SD within their systems (Bekessy et al. 2007; Wright 2004).

Considering, for example, that Ranking Web Universities classified around 26,400 universities. This means that although there are many more HEIs around the world, a very limited number of them signed SD commitments. The numbers of universities which in general are involved, total around 1000 (Lozano et al. 2013); however, the number of universities which present their results in reports is very low – by the end of first decades of the twentieth century, there are only 15 (Lozano 2011), which shows that the effective implementation of SD by universities is very low.

Research shows that the implementation of SD by HEIs is still rather compartmentalized instead of following a more holistic and integrated approach (Lozano 2015). There are "still numerous challenges that need to be overcome" (Leal Filho et al. 2015). These include obstacles at the institutional level, including lack of support from management, lack of technology, lack of proper buildings, lack of a formal university structure responsible for ESD, lack of legislation, lack of training, and many others (Leal Filho et al. 2017a). As a result universities frequently continue to be traditional and rely on reductionist cooperation methods (Lozano et al. 2013).

Despite some achievements, several challenges remain that are still constraining implementation of ESD, like "the need for further alignment of education and sustainable development sectors; the need to do more work for institutionalising ESD – to ensure strong political support to implement ESD on a systemic level; and, finally, the need for more research, innovation, monitoring and evaluation to develop and prove the effectiveness of ESD good practice" (UNESCO 2014).

However, several reports in the literature indicate a high level of interlinkage between commitment, implementation, and signing of declarations. The HEIs which signed the declaration are much more involved in sustainability initiatives. Even though there is no evidence that such declarations have a fundamental influence on the HEI policy and practice, those universities that are not signatories of any declarations or members of any societies are left behind (Lozano 2015). The existence of SD policies is not a precondition for universities to engage in SD and lack of a SD policy at a university does not automatically mean that it would perform poorly in dealing with environmental or social issues (Leal Filho et al. 2017b). It should be noted, however, that it has been found that "universities with SD policies have more probability to have initiatives as green campus procedures, SD in the curriculum and joint local/regional SD activities as compared with those who do not. [In addition] the existence of a SD policy in given universities often – but not always – means that other areas (e.g. SD training) are equally developed" (Leal Filho et al. 2017b). Several HEIs, which signed the declaration, as a result of the number of initiatives taken in order to fulfil the commitments, provided several improvements, not only in terms of environmental or SDGs issues but also including progress in such areas as labor and human rights standards or anti-corruption practices (SDSN 2017; UNISA 2015).

In addition, as it was presented in the Evaluation Report on the implementation of the UNECE Strategy for Education for Sustainable Development, from 2005 to 2015, the progress of the implementation of ESD during 10 years of the Strategy has been recognized globally. This recognition in particular refers to "the innovations shared on ESD indicators, whole-school planning, and teacher competences, as well as the significant advances made in reorienting education policy and curricula and aligning education objectives with national sustainable development visions and goals" (UNESCO 2014).

According to the final report of the UN DDESD across many countries, several results can be reported, including the following:

- Strong trend can be seen to make education more relevant to the social, environmental, and economic challenges.
- Stakeholders are increasingly taking up education, public awareness, and training to advance sustainable development.
- More and more countries are incorporating education strategies, tools, and targets into national sustainable development strategies.
- Political leadership has helped to create the organizational climate.
- The DESD has helped to reinforce the importance of partnerships and collaboration among stakeholders.
- The use of mechanisms like national coordinating groups has helped to shape ESD policy and provide implementation mechanisms at the country level.
- There is growing recognition that early childhood care and education is the foundation of sustainable development (UNESCO 2014).

To conclude, ESD and implementation of SD by HEIs seems to be a long-term process, and a few decades are not enough to reorient and transform complex educational systems. Certainly, there is a correlation between the SD policies provided by several HEIs and the ESD declarations, on the one hand, and the good practice of SD in HEIs, on the other. The question that still remains unanswered is how to change a "good practice" into just "practice" or "standards." It seems that as long as governments do not actively support ESD and the associated initiatives by HEIs and commit to include their own (legally binding) implementation mechanisms into all levels of education, it will be very difficult to implement SD standards into education and at universities around the world.

Conclusion

Concluding, it seems that declarations regarding ESD and the initiatives introduced at university level, including all declarations and documents that were adopted within last decades, only started the debate and a long process. It is very difficult to assess their effectiveness. Nevertheless, it seems that without them, it would be rather impossible or much more difficult to start the debate on implementation of sustainability into national higher education policies and universities' practices. However, the international community still seems to be far from reaching the goals stated in the documents referred to in this contribution, and the biggest challenge of today is to create integrated and coherent opportunities which will integrate bottom-up and bottom-down initiatives and advance the sustainable development agenda in education after 2015.

Cross-References

▶ Sustainability Commitments, Institutional Level

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Sustainability Dialogues in Higher Education Institutions (HEI)

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Introduction

As a bystander from the discipline of geography, this entry sketches out the emergence of sustainable dialogue in higher education, an interdisciplinary episteme interrogating with a scholarly of though drawing from critical pedagogics among others (e.g., David Orr, Arjen Wals, Stephen Sterling). Sustainable Dialogue in Higher Education Institutions may be defined as an educational approach that aims develop interdiciplinary dialogue to form a knowledge base that adresses the multiplicity of sustianablity challenges as set out in the SDGs. "Sustainable Dialogue in Higher Education captures" a scholarly of didactics that emphasis learning as a process through which students enrich their individual ability to develop methods for knowledge production, rather than transferring knowledge to students themselves. Dialogue is the key of learning, and dialogue-based learning, therefore, is as much about the organizational form under which dialogue develops, as it is about the learning content. Sustainable dialogue possesses a strong normative socio-environmental vision, an organizational form through which dialogue and learning take place and address the role between the student and the teacher (institution). Sustainable dialogue is inspired by action research, civic science, and community/citizenship (Egmose 2015) while drawing on transformative, integrative, and holistic learning (Shephard 2008). As such, dialogue is also a matter of power relations between students, teacher, institution, and the broader society, whereby the role of the educator is to facilitate a learning space that allows students to critically and independently enhance expertise. Sustainable dialogue does not encompass a closed scholarly of thoughts (Orr 1992). Rather, education for sustainability, climate change education, environmental and ecological education, and equivalent approaches represent different traditions and positions on the role of dialogue in education and the degree to which the students engage themselves in positioning sustainability as an organizing principle for higher education (Wals and Jickling 2002).

While the majority of higher education institutions and their teachers find consensus on anthropogenic climate change and sustainability challenges, and being dedicated to the topic (e.g., ISCN, European Society for Engineering Education), disagreement arises when dealing with actions and solutions in educational settings, since a given position legitimizes different agendas, sustainable futures, disciplines, themes, or approaches. Insofar as sustainability is fruitful from an educational perspective, it depends on the degree to which we address its shortcomings as an organizing concept (Wals and Jickling 2002). Some HEI, disciplines, or educations accept sustainability as a theme; others disagree with its slippery, fuzzy, and contingent character. Whether regarded as key concepts for HIE or not, education for sustainable development (ESD) inheres complex dilemmas that immutably tends to frame education as a change agent that socializes students to accept certain kinds of explanations and pre-analytic assumptions based on visions for a sustainable utopias while nurturing critical thinking and independent and free students (Gough and Scott 2007). As for higher education in general, and sustainability discussions in particular, education and science have the role to confront and challenge values and knowledge claims, sustainability inclusive. For HEI addressing sustainability, socio-scientific disputes are predominantly important. Sustainability is a socio-scientific dispute, engaging studies in the conflict over different value systems, norms, and interests, involved in claiming something as learning toward sustainability. Consequently, Wals and Jickling (2002) stress the importance of sustainable dialogue enriched by multiple perspectives on what sustainability may look like in different contexts and advocate for multiple perspectives on the way educations interpret these ideas. Sustainable dialogue in higher education aims to foster pluralism and debate across disciplines, actors, and socio-natural approaches. As such this Anglo-Saxon/Eurocentric article welcomes intercultural enrichment, traditions, and approaches across the world.

Background

Sustainable dialogue as a concept is little established and not well defined. However, in academia, it captures debates that trace back to the 1960s rise of environmental education. Environmental education emerged from natural science, from a measurable and quantifiable positivist paradigm. While based on positivism, it initially focused on sustainable monologue, grounded in behaviorist learning theory. The traditional educational approach is content focused, based on fact, with the idea that informing student on the "facts" about the state of the environment would lead to appropriate behavior change (Fein 2003). The fact-based approach focusses on traditional lectures through which the teacher imparts the right facts, the right answers, and positioning itself on positivist value systems. Hence, the teacher knows what needs to be done. Vare and Scott (2007) label this fact-based approach ESD 1 learning. ESD 1 refers to moral development under "the promotion of informed, skilled behaviors and ways of thinking, useful in the short-term where the need is clearly defined" (Vare and Scott 2007, p. 191). Whereas ESD 1 lean toward behaviorism, ESD 2 learning is about building learners' capacity to think critically about sustainability problems, also "about what experts say and to test ideas, exploring the dilemmas and contradictions inherent to sustainable living" (Vare and Scott 2007, p. 191). This marks a radical transition as far as dialogue is concerned. It follows the dictums of the transmissive method, advocating that if people know, then they will act, "as a relic of Enlightenment." Monologue tends to passivate students while failing to generate the skills or attitudes needed to take action. Further, it marks changes over the right to define sustainable problems and associated solutions. Consequently, sustainable dialogue and power relations between teacher and student have changed from a top-down approach, in which the teacher is the expert and the student the passive recipient (Tilbury et al. 2005) into dialogue-based ESD in which the right actions and solutions are ungiven. Sustainable dialogue therefore develops toward socio-material constructivism as a means for transformative learning. Education for sustainability emerged in response to growing global concern over socio-ecological changes in scale, magnitude, and complexity. While sustainability dialogue is process-focused, is participatory oriented, cultivates life-long learning, and is fundamentally

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democratizing by seeking social change (Huckle and Sterling 1996), multiple ideas and traditions exist with different normative aspirations. Although the role of dialogue has shifted, engaging students toward a critical approach, it still struggles to consolidate this shift. Dialogue about experimental learning with the students may not only better prepare them for dealing with wicked and controversial problems like sustainability, resilience, or climate change. Dialogue about these issues may also make students better understand the "geopolitics" over different socio-ecological futures and dispute over socio-scientific and educational practices that constitute the "object of study" and fundamentally shape the relevance of questions asked and data collected (Grindsted 2015).

Sustainable Dialogue as a Learning Strategy: From Anglo-Saxon/Eurocentric Perspectives

The concept "sustainability" is questionable indeed, and the use of sustainability as a rhetorical instrument is widespread in academia and beyond. Sustainability means different things to different people, and often scientific, symbolic, and political meanings of sustainability blur into one another and are used interchangeably. Both the knowledge base and symbolic meaning are variable, unstable, and questionable. Although the fuzziness of the concept makes sustainability ideal for rhetorical instrumentality, it can, if used with care, deliver significant contributions to facilitate interdisciplinary, integrative, and holistic discussions, Wals and Jickling (2002) argue. The following outlays four aspects of sustainable dialogue as an organizational form, though many more exist.

Sustainability dialogue represents a socio-scientific dispute at its core, and engaging students in the socio-scientific dispute becomes a specific learning strategy. Some interprets sustainable dialogue as a dispute between faculties and disciplines (natural and social sciences) fostering interdisciplinary approaches to problems that are interdisciplinary in nature (Barth et al. 2007). The dispute challenges disciplinary biases (monopolization of truth within disciplines or traditions) by subjecting disciplinary knowledge with interdisciplinary scrutinization. It follows that fights in disciplinary space produce disciplinary "truths," and when subjected to scrutinization in interdisciplinary space, new modes of "interdisciplinary truth finding" emerge. Warburton (2003), for instance, finds deep learning can be inhibited if the existing interests or backgrounds of students have a strong disciplinary focus. Because the range and interconnectedness of environmental, social, and economic issues, interdisciplinary work, and holistic insight are fundamental to sustainability (Barth et al. 2007), interdisciplinary disputes foster deep learning, as Warburton (2003) advocates. In any case, interdisciplinary thinking becomes an organizational foundation for sustainable dialogue.

Others emphasize sustainable dialogue as a dispute over the juxtaposition between value systems (e.g., mechanistic or ecological worldview, complete or incomplete, convertible or inconvertible value systems). According to Wals and Jickling (2002), engaging students in socio-scientific disputes and conflicts over different values, norms, and interests becomes a key factor for learning. As Wals and Jickling (2002) discuss, while sustainability concepts are flawed, they provide no inherent clue about how one should mediate between contesting claims (e.g., different and incompatible value systems). Thus, it masks epistemological layers, and they argue: "Education for sustainability (. . .) breathes a kind of intellectual exclusivity and determinism that conflicts with ideas of emancipation, local knowledge, democracy and self-determination" (Wals and Jickling 2002, p. 222). Sustainable dialogue in higher education should resist temptations to exclude, but embrace, different approaches to environmental thinking and facilitate a diversity of ideas, they argue.

Yet others find sustainability dialogue brings together different groups in society, searching for a common language for socio-environmental issues and hence interrogating into a dispute over the character and interconnectedness of environmental, social, and economic issues. As such, sustainable dialogue in this form draws from critical pedagogics, e.g., Friere, that find the best conditions for deep learning take in emotionally engaging dialogue. Because sustainable dialogue brings together people of different worldviews, takes personal experiences as a starting point, and has an open future, dissonance is created and learning is likely to take place. Sustainable dialogue is learning on the edge, with the socio-scientific dispute, character of emerging knowledge, and values brought to surface. According to Wals and Jickling (2002), student participation in such a dispute is an excellent opportunity to learn about highly relevant, controversially, emotionally charged, and debatable topics at the crossroad of science, technology, and society. Although sustainable dialogue complies with critical pedagogics, critical voices raise concern. As many contend, to facilitate change or "transformative-epistemic learning" is difficult and so is transformation (Thomas 2017). Such interpretations find that sustainable discourse rarely addresses the roots of the problems.

Finally, exogenous and endogenous factors influence the circumstances under which sustainable dialogue in higher education takes place. Formed by a number of exogenous (e.g., HE policy) and endogenous factors (organization structures), knowledge and the learning environment actively influence processes of realization. Sustainable dialogue in higher education is an innovative approach that holds strong normative vision that in theory holds its own agenda and fosters dialogue that arises from the student's situation and potentiality (not from institutional demands). Yet formed by the institutional and exogenous factors that manage higher education, critical scholars seek to emancipate from them, precisely, as they argue. Sustain unsustainable production patterns. As Friere puts it, education is a means that socializes and disciplines students to certain societal structures. Societal power structures that uphold unsustainability and from which we need to emancipate, if, e.g., to envision sustainable development goals. The role of education in many Western countries generally develops around the idea of market-based management (Wals 2014), whereby on conceives processes of realization and education as a linear process of production. The production of competences is a sort of raw material for knowledge society. This instrumental view of education reproduces specific structures in the management of HEI, by ways in which cost-benefit, cost-effectiveness, and competences "ready for the market" are a foci for learning. Narrowly speaking, instrumental views of HE do not always support sustainable dialogue and critical, interdisciplinary, and holistic competences and may or may not support the complicated processes of deep learning (Jickling 2018). As Thomas (2017, p. 2) notes, "Since we exist in this neo-liberal world, those of us wanting to bring about change (specifically implementation of EE and SE) could be more clearly communicating with this world, even using its tools; such as marketing – to promote the changes we seek." No matter the stance, the institutional setting and governmental characteristics form sustainable dialogue (Holm et al. 2012). The socio-scientific dispute over the institutional structures is equally debated, and a branch of ESD scholars finds exogenous factors equally important to address. They adhere to the social dynamics that form the HEI climate and responses to climate change as mutually conditioning (Grindsted 2015). Nevertheless, sustainability in HEI, both by its critics and supporters, often meets criticism for providing little guidance for how any of the proposals could be made to happen, that is, to assist an educator wanting to introduce and implement this type of education in their institution or organization (Thomas 2017). The final section explores some of the suggestions to facilitate sustainable dialogue in HEI.

Dialogue-Based Education for Sustainability

To educate is to form people. Sustainable dialogue in higher education aims to form people personally, disciplinary, and emotionally (Shephard 2008). Good education develops in dialogue with students and lays the foundation for deep learning (Warburton 2003). It follows that education is both individually and collectively organized – as a process through which the teacher develops his and her competences by sharing the process of becoming – as students share their learning process with others. The aim and goal of dialogue as the source for learning arise from the fact that when students are being emotionally affected, it is likely to foster deep learning (Barth et al. 2007). A number of approaches seek to facilitate dialogue-based education for sustainability, e.g., civic science, problem-based learning, action research, community-based learning, and participant-directed learning, to name a few. These are approaches that aim to address sustainability issues based on students' knowledge base and experience. Sustainability requires empowerment of learners by enabling them to work on the resolution of real issues that they themselves have identified, Guerra (2017) argues. Along these lines sustainable dialogue carefully takes into consideration (power) relations between student and teacher, e.g., inspired by Illeris' (2012) four distinctions: a dialogue in which the student (1) drives a project independently; (2) a teacher-led project; (3) a student project in which students do what they think the teacher, an enterprise, or the system "demands"; (4) and collective projects. According to Illeris, the dialogue and circumstances under which the student meets the teacher are significantly important for students to be able to develop from assimilative toward accommodative or transformative learning. For sustainable dialogue in higher education, the dialogical component is to facilitate students' projects, work, and learning process that at best change the students' mindset from assimilative learning to accommodative and transformative learning. Guerra (2017) finds problem-based learning (PBL) is one of the learning strategies used to integrate sustainable development and to address education challenges. By way of example, problem-based learning (e.g., Roskilde or Aalborg models) aims to make scientific questions and critical thinking applicable and meet specific problems in society. Again, the right to define academic problems comes from the students. PBL fundamentally changes dialogue (peer-to-peer discussions and with the supervisor) and holds sustainability as an organizing concept. Students independently design the problem formulation themselves (contrast to the teacher) and work in groups throughout the semester. Implementing and positioning problems are a bedrock for PBL. Illeris suggests PBL as problem-oriented, project work, interdisciplinary, and participant-directed learning, the exemplary principle and teamwork (2012). Thus, PBL is based on learning principles such as contextual, self-directed, experiential, and collaborative learning. Such principles enable students to develop high reasoning skills (e.g., metacognitive knowledge), critical thinking, and interdisciplinary knowledge, problem-solving skills, and communication skills, and Illeris (2012) argues and Guerra (2017) aligns this with ESD. Although PBL and ESD share common learning principles, Guerra (2017) finds their practice presents limitations that challenge the full integration of sustainability, namely, the crowded, strict, and academic-centered curriculum. Even so, arising from student experience, sustainable dialogue, e.g., in PBL, challenges students' propositions and stances and thus makes them re-envision utopias (sustainable futures) central to dialectical and transformative learning. It is precisely the process of becoming and the constant actualization of students' potentiality that is the core of sustainable dialogue. It is through dialogue and examination of individual and collective potentials that we address sustainability challenges, whether it be through the construction of new collective identities and norms, new technologies, socio-technical systems, or social demands.

Education is the exploration of possibilities rather than deduction (spinning out implications of known truths) or induction (discovering general laws regulating what already exists). Sustainable dialogue in higher education incorporates the building of ethical, moral, and political choices (values), into its own process and the construction of knowledge, in academia and elsewhere. Values and goals, then, are "utopian moments of reflectivity" that bridge theory and practice (Shephard 2008). The rise of green value theory, planetary boundaries, sustainability science, or ecological economics exemplifies how socio-ecological dialogue can generate new visions and possibilities. It is through dialogue these visions and possibilities may be actualized.

Conclusion

Sustainability dialogue aims at fostering interdisciplinary, holistic, and critical thinking to address real-world problems in theory and practice, as a means to address sustainable issues with world-changing effects of our time.

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Sustainability Dimensions

► Sustainability Domains in Higher Education

Sustainability Domains in Higher Education

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Synonyms

Areas of sustainability; Sustainability dimensions; Sustainability elements

Definition

Sustainability domains in higher education refer to individual but interrelated areas within which sustainability is integrated. Key sustainability domains in higher education include overall governance, curriculum, research, operations, and community engagement. Together, these domains constitute a holistic approach for integrating sustainability into the higher education system.

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Introduction

In the wake of catastrophes such as the recent tsunami in Indonesia and ravaging hurricanes Michael and Florence in the USA, the Intergovernmental Panel on Climate Change (IPCC) has released a report calling for urgent and widespread action to limit global warming to 1.5 °C above preindustrial levels (Intergovernmental Panel on Climate Change 2018). This report adds a renewed sense of urgency to previous calls to ensure survival of ecosystems and global communities. Following these initial calls, local and international communities came together to discuss ways that the needs of the present generation can be met without compromising those of future generations (Brundtland 1987). Participants in initial environmental conferences such as the Stockholm Conference of 1972 agreed that societies and institutions needed to rethink their relationship with the environment, and identified education as important in leading the way to realizing environmental protection and sustainable development. Since then, education institutions, including higher education (HE), have sought ways to champion action towards building a sustainable society (Wals 2009, 2014; Tilbury 2011).

In particular, higher education institutions have a great responsibility to educate future leaders, develop innovative solutions to current problems, and produce knowledge that will help societies be better equipped to tackle future uncertainties (Stephens et al. 2008). In recognition of the important role that they play in society, studies show that higher education institutions (HEIs) are working individually and in collaboration with other institutions and partners to address the issue of sustainability. Recently set goals to meet the UN 2030 Agenda and Sustainable Development Goals (SDGs) place HEIs in a unique position to be drivers and key players in realizing a more sustainable future.

To better understand how HEIs can successfully engage with this complex issue of sustainability, scholars have been examining and sharing best practices, challenges, and opportunities from various regions around the world. While there are several exemplary cases of engagement with sustainability, studies show that there is still compartmentalization of sustainability in individual areas as opposed to a holistic approach that focuses on an entire institution's system (Sterling 2004; Lozano et al. 2014). Therefore, to achieve a holistic approach, studies have identified key areas or domains that need to be addressed within HEIs. These include the domains of overall governance, curriculum, research, operations, and community engagement. The aim of this entry is to provide an overview of these sustainability domains, better understand how HEIs are integrating sustainability into their systems, and suggest ways for further engagement. The following section outlines the details of each sustainability domain, including the type of initiatives taking place in each domain and the extent to which each is addressed in HEIs. The entry concludes with suggestions for which aspects need further attention to continue building a holistic process of integrating sustainability in HEIs and beyond.

Key Sustainability Domains in Higher Education

Sustainability domains refer to individual but interrelated areas that constitute the HE system and in which sustainability is integrated (Cortese 2003; Lozano 2006). Reviewed literature shows that these domains, also referred to as elements or dimensions, include governance, curriculum (teaching), research, operations, community engagement, and assessments and reporting (Sylvestre et al. 2013; Vaughter et al. 2013; Lozano et al. 2014; Cortese 2003; Lozano 2006; Stephens et al. 2008). While earlier studies focused on the domains of curriculum, research, operations, community engagement, and assessment and reporting (Cortese 2003; Lozano 2006; Stephens et al. 2008), more recently assessment and reporting have been discussed under the domain of governance (Sylvestre et al. 2013; Vaughter et al. 2013, 2016). For the purpose of this entry, the discussion will be focused on the five domains of governance (including assessment and reporting), curriculum, research, operations, and community engagement. Each of these domains is discussed in detail in the rest of this section.

Governance

The domain of governance in HE focuses on leadership in sustainability from senior administrators, board of governors, and other leaders whose role is to ensure proper functioning of HEIs. Studies show that strong commitment and support from HE leaders play a significant role in shaping the direction that institutions take towards integrating sustainability in their institutions (Ávila et al. 2017). According to Lee et al. (2013), HE leaders show commitment to sustainability through publicly espoused goals, mission, policies, and other institutional strategies and priorities.

Signing sustainability declarations has been found to be one of the most visible ways that university presidents and other senior administrators express their commitment to sustainability (Elliott and Wright 2013). Declarations constitute the initial steps towards engagement with sustainability and play an important role in setting the path for other stakeholders within HEIs (Wright 2002; Bekessy et al. 2007; Lozano et al. 2011, 2013, 2014; Christie et al. 2013; Elliott and Wright 2013). While some studies show that signing a declaration does not always translate into implementing sustainability (Wright 2002), they nevertheless have a positive correlation with implementing sustainability initiatives in some cases (Lozano et al. 2014; Beveridge et al. 2015).

Recent studies have focused their attention on policy related to sustainability as an integral part of governance. For example, studies in Canada have evaluated the extent to which HEIs are developing sustainability policies and plans and/or incorporating sustainability priorities in broader institutional policies and plans (Vaughter et al. 2013, 2016; Beveridge et al. 2015). These studies show that 50% of Canadian HEIs have a sustainability policy or plan (Beveridge et al. 2015), indicating a significant level of commitment at the governance level. Similar studies of policy and strategic planning in sustainability have focused on Europe, Asia Pacific, United States, and Australia (Ryan et al. 2010; Lee et al. 2013; White 2014; Jorge et al. 2015).

In order to ensure that HE leaders implement their espoused commitment to sustainability, it is important to establish accountability strategies (Bekessy et al. 2007). Assessment and reporting have been found to be essential tools that can help HEIs track their progress in integrating sustainability into their systems, and several studies have been conducted to examine the type of evaluations taking place across the domains of sustainability (Roorda and Martens 2008; Lozano 2011; Caeiro et al. 2013; Ceulemans et al. 2014; Velasco et al. 2018). While there are several sustainability assessment and reporting tools, studies have identified common ones to include: *Sustainability Tracking Assessment and Rating System* (STARS) and *Campus Sustainability Assessment Framework* (CSAF) in the USA and Canada; the *Assessment Instrument for Sustainability in Higher Education* (AISHE) in Europe; the *Alternative University Appraisal* (AUA) in Asia-Pacific; and *Mainstreaming Environment and Sustainability into African Universities* (MESA) in Africa (Roorda and Martens 2008; Togo and Lotz-Sisitka 2013; Vaughter et al. 2013). There are limited sustainability assessment tools in South America, and some institutions have been using STARS to measure their sustainability efforts (Velasco et al. 2018).

Compared to other sustainability domains, HE stakeholders have been found to be less familiar with assessments and reporting (Lozano et al. 2014). Similarly, studies show that there is a lack of support from administrators (Velazquez et al. 2005, 2006; Ávila et al. 2017), therefore hindering holistic integration of sustainability into the HE structure. Whereas HEIs want to position themselves as leaders in sustainability to attract more students (Ávila et al. 2017), their leaders are often caught up in the profit mentality that prioritizes cost savings at the expense of long-term systemic changes (Velazquez et al. 2005; Bieler and McKenzie 2017). Because lack of strong leadership from administrators impedes on successful integration of sustainability (Kanyimba et al. 2014), higher education leaders could be doing more to commit and support sustainability.

Curriculum

Efforts to integrate sustainability in the teaching and curriculum domain have increased over the years, and several scholars have embarked on reviews to understand the ways that institutions are incorporating sustainability in education (Sherren 2006; Holmberg et al. 2008; Lozano et al. 2014; Grindsted 2015; Sidiropoulos 2018). Faculty have been found to integrate sustainability in curriculum through including topics of sustainability in existing courses, designing new courses focused on sustainability, and developing entire sustainability degree programs within institutions (Rose et al. 2015; Sidiropoulos 2018).

Consequently, researchers have conducted research to evaluate which academic programs tend to incorporate sustainability effectively. Their research shows distinct patterns of disciplines that have traditionally focused on sustainability such as those in Science and Technology, Arts, Humanities and Social Sciences, and emerging disciplines that are recently taking on this responsibility such as Business and Engineering (Sherren 2006; Holmberg et al. 2008; Grindsted 2015).

Beyond examining the distribution of sustainability within various programs, other work has focused on the outcomes of these programs on students' learning of sustainability (for example, Rose et al. 2015). Integrating sustainability in the curriculum domain is particularly important as it focuses on students' learning, a core responsibility of HEIs. Sustainability frameworks in the curriculum help students develop critical thinking and analysis skills and empower them to take action in building a sustainable future (Zimmerman and Halfacre-Hitchcock 2006). Also, given that teaching is an important part of curriculum, scholars emphasize that faculty need to use innovative teaching methods such as role-playing, debates, case studies, among others, to enhance students' learning (Cotton et al. 2007; Christie et al. 2013; Zeegers and Francis Clark 2014; Mulder et al. 2015; Remington-Doucette and Musgrove 2015; Portman and Teff-Seker 2017).

Similar to other sustainability domains, there are barriers to integrating sustainability within the curriculum. These have been shown to include: lack of professional development programs for academic staff, disciplinary silos that inhibit interdisciplinarity, which is key to sustainability education, lack of time, and incentives for faculty (Cotton et al. 2007; Holdsworth et al. 2008; Wright and Wilton 2012; Bothun 2016; Wood et al. 2016; Alkaher and Avissar 2018). To address some of these barriers, various programs have been put in place to provide professional development for faculty members (Blake and Sterling 2011; Wood et al. 2016).

Research

In addition to teaching, faculty members are playing and could play a bigger role in sustainability research. Sustainability research is defined as "all research conducted within the institutional context of a university that contributes to sustainable development" (Waas et al. 2010). As such, the research domain includes sustainability research projects that are led by individual faculty, as well as in collaboration with other faculty, students, and external stakeholders (Lidstone et al. 2015; Macgregor 2015). While individual faculty research is often conducted within their departments, collaborative research is carried out through established research centers and institutes and also through student-led projects embedded in their coursework (Vincent et al. 2015).

Sustainability research can focus on issues pertaining to an individual campus and/or broader societal issues. Common topics at the societal level include: "depletion of resources, maintaining biodiversity, managing municipal waste, disposal of nuclear waste, developing and promoting organic agriculture. . .health governance, management of socio-ecological systems, and management of socio-technical transitions to sustainability" (Gaziulusoy and Boyle 2013, p. 140). In terms of campus focused sustainability research, an analysis of research articles published from 2000 to 2013 in the *International Journal of Sustainability in Higher Education* showed that researchers covered topics such as: "environmental management, university greening, and the reduction of the university's ecological footprint" (Leal Filho et al. 2015, p. 116).

Because research is largely dependent on faculty interests in a particular topic, studies have found that it is challenging to establish an institutional mandate that requires all faculty to integrate sustainability in their research (Beringer and Adomßent 2008). As such, faculty commitment to sustainability is key to successful integration of sustainability in the domain of research. Further, a comparison across the five sustainability domains in HE as considered in this entry shows that integration of sustainability is lowest in the research domain (Vaughter et al. 2016), perhaps because of the fragmented nature of research – by individual faculty as opposed to institutional-wide mandates (Beringer and Adomßent 2008).

Given the complexity of sustainability, its successful integration in the research domain needs to include a wide range of stakeholders (Gaziulusoy and Boyle 2013). In other words, it needs to be transdisciplinary in nature (Stephens et al. 2008; Yarime et al. 2012; Gaziulusoy and Boyle 2013), involving internal and external stakeholders. Faculty are establishing institutes and centers that have the capacity to carry out a wide array of sustainability topics and facilitate effective inter-/transdisciplinary collaboration with multiple stakeholders (Vincent et al. 2015). It is through these collaborations that HEIs and communities will be able to enhance diverse capabilities to build resiliency for a sustainable future.

Facilities and Operations

In order for governance, research, teaching, and other HE activities to run smoothly, facilities and operations need to function effectively for all stakeholders (Ceulemans et al. 2014). Sustainability in the facilities and operations domain is described as "campus greening initiatives" that constitute formal polices that guide procurement, building maintenance, or informal initiatives (Macgregor 2015). There is overwhelming agreement among scholars that integration of sustainability in HEIs tends to focus heavily on facilities and operations.

In examining the reasons for the prevalence of sustainability in operations, a study conducted in North America showed that several HIEs in this region have a sustainability office or officer, who are more likely to focus on operations (Beringer and Adomßent 2008). Similarly, Zimmerman and Halfacre-Hitchcock (2006) found that local government policies require that HEIs adhere to building standards that align with sustainability, and are therefore more likely to be implemented. Another reason is that sustainability initiatives in operations are considered low hanging fruits because they are easy to implement, measure, and often result in cost saving (Beringer and Adomßent 2008).

The types of initiatives that are taking place in the operations domain include: responsible procurement practices, recycling and waste management, reducing carbon emissions, building energy efficient buildings or retrofitting old ones, using less harmful pesticides in the grounds, establishing campus gardens, sustainable transportation, among others (Moore 2005; Beringer and Adomßent 2008; Macgregor 2015; Dyer and Dyer 2017). These initiatives are an important aspect of the overall commitment to sustainability, and their success is dependent on the cooperation of all stakeholders within HEIs. Although the strong sustainability focus on operations contributes significantly towards achieving sustainability overall, scholars have called for HEIs to shift attention to other areas such as the curriculum and research domains (Christie et al. 2013; Sylvestre et al. 2014; Dyer and Dyer 2017).

Community Engagement

Lastly, sustainability in the community engagement domain is the interaction between HEIs and the broader communities (White and Harder 2013). Because HEIs do not exist in a vacuum, meaningful engagement with the broader community is considered important for both the institution's existence and the community and is emphasized in several international declarations on sustainability (Zilahy et al. 2009; Karatzoglou 2011). In addition, community engagement provides a valuable avenue for HEIs to put their knowledge and innovations into practice, creating positive change and the opportunity to act at the local level (Wells et al. 2009). It also provides opportunities for research and case studies for teaching and learning.

Sustainability initiatives in the community engagement domain involve multiple stakeholders such as faculty members, students, nonprofit organizations, governments, and businesses (Mickwitz and Melanen 2009; Dentoni and Bitzer 2015; Lidstone et al. 2015). Studies have articulated the value of co-creating knowledge between community and HEIs, developing local capacities and strong collaborations among stakeholders, and examining local contexts to enhance sustainability implementation (Bodorkós and Pataki 2009; Chalker-Scott and Tinnemore 2009; Mickwitz and Melanen 2009; Zilahy et al. 2009).

While community engagement is considered an important element of sustainability in HEIs, studies show a lack of attention to this domain in HEI's strategic plans (Bieler and McKenzie 2017), perhaps given the complexity in crossing institutional boundaries. Some of the challenges to effective community engagement have been shown to include lack of adequate time for collaboration and relationship building, few academic staff who are open to learning from community members, poorly established organizational structures, stakeholder training, incentives for academic staff, and inadequate funding (Chalker-Scott and Tinnemore 2009; Mickwitz and Melanen 2009; Karatzoglou 2011).

Conclusion

Given the great responsibility that HEIs have in supporting society transition to a sustainable future, this entry has sought to provide an overview of sustainability domains in HE. The aim of the entry is to provide a better understanding of how HEIs are integrating sustainability into their systems and to suggest ways for further engagement. The five domains of overall governance, curriculum, research, operations, and community outreach constitute key elements towards a holistic integration of sustainability in HEIs. This entry has provided an overview of studies that show significant progress in all five sustainability domains, with room for improvement.

While sustainability in HE is heavily focused on operations (Dyer and Dyer 2017), it seems that attention is shifting into the other four domains. Perhaps one reason for this is increased collaboration with different stakeholders, an important aspect of integrating sustainability into HEIs (Ceulemans et al. 2014). Evidence of these collaborations is seen through community engagement, where institutions are reaching out to stakeholders outside of HEIs (White and Harder 2013). Similarly, stakeholders within HEIs, such as students, need to be considered as they play a key role in contributing to sustainability (Murray 2018). Further collaboration is happening through interdisciplinary teaching, transdisciplinary research, partnerships with local governments on operations, and working with organizations to enhance HE leadership and assessments (Vincent et al. 2015). In relation to governance, HE administrators have shown their commitment through signing sustainability declarations and setting up institutional policies and strategies (Lee et al. 2013). While these have been lauded as important initial steps, scholars have called for a commitment to implement these plans, and set up strategic goals to measure the progress and success of these initiatives (Bekessy et al. 2007).

At a time when the consequences of unsustainable practices are becoming increasingly evident, calls to respond to and mitigate future calamities are more urgent. The sustainability domains discussed here provide a roadmap for HEIs to engage with sustainability in a holistic approach. In so doing, these institutions champion the way towards leaving a habitable planet for future generations.

Cross-References

▶ Community Outreach on Sustainability
▶ Dimensions of Sustainability in Higher Education
▶ Engagement with the Community and Sustainable Development
▶ Higher Education and Sustainability Initiatives

▶ Incorporation of Sustainability
▶ Knowledge Management and Sustainable Development
▶ Sustainability in Higher Education
▶ Sustainability on Campus
▶ University Operations for Sustainable Development

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Sustainability Education

► How Worldview Development Influences Knowledge and Beliefs About Sustainability

Sustainability Elements

► Sustainability Domains in Higher Education

Sustainability Evaluation

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Introduction

The purpose of this article is to present the topic of how to assess or evaluate sustainability and its difference from sustained systems. As, generally speaking, these assessments are of interest to the academia for development projects implemented by the public sector – or by the academia itself – to determine the techniques and procedures utilized in university teaching or in higher education in general, this can be its contribution, especially given the current situation in which the concept of sustainable development has gained relevance as of the United Nations approval in September 2015 of the 17 Sustainable Development Goals (SDG) in the 2030 Agenda framework whereby

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the Member States committed to reaching the said objectives and its targets, in a period of 15 years.

Thus, the 193 Member States of the UN, having accepted the formal commitment to achieve the SDG's and targets, have the responsibility before the international community requiring its governments to coordinate actions with civil society stakeholders, private sector, indigenous population, and other social sectors to implement diverse projects to that end.

The higher education system has different levels of autonomy in each country, depending on their national legislation, and every university or higher education facility determines the courses, programs, and research projects deemed convenient; however, it is evident that the 2030 Agenda commitments also entail a responsibility in the training of human resources by providing enough skills to contribute to its implementation. This requires not only education but also evaluation of both the education methodologies and the development projects. In this article, we will only make a short presentation of the type of parameters that, in our opinion, should be applied to assess sustainable development and compliance to its commitments and targets. We suggest the following parameters: (1) a clear distinction between sustained systems and sustainability, (2) awareness of planetary boundaries, (3) use of a holistic paradigm that is neither reductionist nor economist, and (4) consideration of the indigenous worldview or the cultural customs of each country.

Sustained Systems and Sustainability

The widely known concept of sustainable development was introduced into the international lexicon in 1987 when the famous Brundtland Commission Report suggested it is development that meets the needs of the present generation without compromising the ability of future generations from doing the same. A supremely complex concept was being proposed, as it simultaneously includes an **objective dimension** – present and future "generations" – and a **subjective dimension**, the needs of the people. Furthermore, the objective dimension implies the existence of a **social structure** which possesses an environmental context, i.e., **ecological**, and a political system where decisions are made and in which circumstances can be authoritarian or democratic.

It is, therefore, a **holistic** and **interdisciplinary** concept (Sachs 2015) that simultaneously encompasses the **material objective** (economy and environment), the **intersubjective** (Habermas 1988), **human needs** (Maslow 1943) (Manfred Max-Neef et al. 1986), and the **prospective** (Michel Godet 2007) because studies or research takes place considering that ***future generations*** – our children and grandchildren – will not only have, to a lesser or greater degree, the same (or similar) needs but will demand the same (or similar) resources.

It is remarkable that a single two-word concept has such a complex meaning and so many innovative ideas associated with the traditional view that confined development to the economic arena, disregarding its human, sociopolitical, and cultural dimensions. In view of this new notion, these are – individually or as a group – sufficiently interconnected so as to topple any analysis that disregards them. In this sense, it is worth noting that since the 1987 report by respected individuals from around the world, it was evident that poverty is not inevitable and that it can be erradicated by "extending to everyone the opportunity to attain their hopes for a better life" while being clear on the fact that sustainable development has limits set forth by technology and natural resources (the "capacity of the biosphere to absorb the effects of human activity" or the *carrying capacity* of the Earth), meaning that although managing both (technology and resources) can be improved by "opening the way to economic growth," total awareness of the ***limits*** of said growth is required.

On the other hand, the Brundtland report also highlights the fact that growth must deal with the ***social exclusion*** problem, because in order for **everyone** to meet their human needs, the poor must receive a fair share of resources that support growth and to which they are entitled. This poses a demand on **social equality** (which is undeniably reappearing in the UN SDGs and in the 2030 Agenda) that demands the political system ensures "the effective participation of citizens in making decisions" and a more in-depth approach to democracy in the international decision-making process, as stated in SDG 10 ("Reduced inequality in and among nations"). Sustainable development is, essentially, a synthetic concept, and exploring its components demands a complex analysis (Humanity has the ability to make development sustainable – to ensure that it meets the need 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. But technology and social organization can be both managed and improved to make way for a new era of economic growth. The Commission believes that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes. Meeting essential needs requires not only a new era of economic growth for nations in which the majority are poor but an assurance that those poor get their fair share of resources required to sustain that growth. Such equity would be aided by political systems that secure effective citizen participation in decision-making and by greater democracy in international decision-making": World Commission on Environment and Development (1987) ***Our Common Future***, Oxford, New York University Press; p.8.).

The concept of sustainability is also a normative and ethical outlook on the world, which – as stated by Jeffrey Sachs– uses a holistic, theoretical framework to establish goals that seek to expand economic progress while poverty is reduced and social trust is encouraged through policies that strengthen the community and the environment is protected from human-induced degradation ("Sustainable development is also a normative outlook on the world, meaning that it recommends a set of goals to which the world should aspire. The world's nations adopted SDG's precisely to help guide the future course of economics and social development on the planet. In this normative (or ethical) sense, sustainable development calls for a world in which economic progress is widespread; extreme poverty is eliminated; social trust is encouraged through policies that strengthen the community and the environment is protected from human induced degradation. Notice that sustainable development recommends a holistic framework in which society aims for economic, social and environmental goals. Sometimes the following shorthand is used: *SDGs call for socially inclusive and environmentally sustainable economic growth.*" Sachs, Jeffrey (2015): *The Age of Sustainable Development*, Columbia University Press, New York, p.3.).

Consequently, a differentiation is needed between the concept of ***sustained systems*** referring to earthly ecosystems and ***sustainable development*** (A summary reads: ***sustained systems*** refer to the conservation of ecosystems, given their cyclical nature, and have to do with maintaining equilibrium in the survival of any species, hence, their close relationship with biodiversity in the field of natural sciences. It is also related to social sciences since it is here where human actions are sustained in the long term without depleting resources or adversely affecting the environment. This means that society is capable of using said resources responsibly without exceeding its *carrying capacity* or the Earth's planetary boundaries, therefore, not risking access to said resources for future generations. ***Sustainability*** refers to the ability to remain valid, to last in time, and ***sustainable development*** is the process used to attain balance between different factors such as sociopolitical, ecological, and economic. These are all required to guide human actions and public policies in any given state.), which refers to the political process governments need to enforce in order to meet the medium- and long-term goals (i.e., UN SDG 17 and its targets in the 2030 Agenda) and specifically refers to the medium term to achieve specific goals: less polluting agriculture and industry that seeks to recycle most of their input and reduce waste, garbage, and wastage, innovative transnational companies that foster research in science and technology, etc. In summary, a distinction must be made between the concept of *sustainability*, which refers to the development process (presupposing a linear flow from a lower state onto another considered superior), and that of *sustained systems* which refers to ecosystems that work in cycles, i.e., that although an ecosystem recycles its components in a lasting manner, it does not move from one place to the next in a *linear* way. Instead, it returns to the starting point in a *circular* manner to restart again, as it happens with the natural cycles in the earthly ecosystems or with the vital cycles of living beings.

The latter allows us to correlate two main concepts: *need*, which refers to the fact that sustainable development seeks to fulfill human needs (in this sense, it is comparable to human development), and *sustained systems*, a concept that alludes to the idea of self-sufficiency, to maintaining oneself and not rely on external factors. Thus, the natural cycles of the Earth (rotation, which determines day and night, and translation, which determines the seasons, precipitation, ocean currents, and atmospheric changes) and of living beings (wakefulness and slumber; life and death) are permanent cycles sustained by a circular movement where everything comes back and resurges incessantly in a self-generated, endogenous motion. We must not forget that, in the case of planetary ecosystems, the Sun is consubstantial to the Earth, as it is not only found in the origin of life itself, as the main source of renewable energy, but because the said energy (due to photosynthesis) is an essential component of every ecosystem. Hence, solar energy and light should also be considered as an Earth's endogenous force.

Consequently, it is evident that for the sociopolitical and economic aspects of sustainable development to be sustainable, they need to be generated endogenously. This means that processes have to originate internally in each country, region, or community in order to attain "cyclical durability." In other words, if the main goal of every development process is the fulfillment of human needs, then ideally (We use "ideally" because evidently, except for a few truly exceptional cases that tend to disappear, no human society is autarkical. Trade solves the problem of scarcity in the different societies and states (e.g., vehicles or electronic devices have to be imported if they are not manufactured domestically). What is evident is that basic subsistence needs (food, housing, health) and others such as education, participation, identity, recreation, affection, or knowledge have to be met by internally generated satisfiers in order to be self-dependent and to make processes sustainable.) all satisfiers have to be generated by the own nation or community responsible for its cyclical reproduction. This explains the fact that SDG 2 states that the governments must seek to "end hunger, achieve food security, improve nutrition and promote sustainable agriculture." Therefore, to be sustainable, it is fundamental that development not only take place in harmony with nature and earthly and marine ecosystems but that it be self-generated internally in each society. This is why it is so important that decisions be made in a democratic and participatory manner in the sociopolitical realm (which refers to SDG 16), as plainly stated in the Brundtland report by contemporary authors like Jeffrey Sachs – in an institutional framework and according to the rule of law, otherwise, if the population directly involved is not considered, it can lead to undesirable results, as is the case, for example, when the interest of an important sector of a country's population is disregarded in a commercial negotiation or when determined financial resources come from abroad (An article by Laura Carlsen from the *Center for International Policy*, published by *The New York Times* on November 24, 2013, states: "NAFTA has cut a path of destruction through Mexico. Since the agreement went into force in 1994, the country's annual per capita growth flat-lined to an average of just 1.2 percent –one of the lowest in the hemisphere. Its real wage has declined and unemployment is up. As heavily subsidized U.S. corn and other staples poured into Mexico, producer prices dropped and small farmers found themselves unable to make a living. Some two million have been forced to leave their farms since NAFTA. At the same time, consumer food prices rose, notably the cost of the omnipresent tortilla. As a result, 20 million Mexicans live in "food poverty." Twenty-five percent of the population does not have access to basic food, and one-fifth of Mexican children suffer from malnutrition. Transnational industrial corridors in rural areas have contaminated rivers and sickened the population, and typically, women bear the heaviest impact. Not all of Mexico's problems can be laid at NAFTA's doorstep. But many have a direct causal link. The agreement drastically restructured Mexico's economy and closed off other development paths by prohibiting protective tariffs, support for strategic sectors, and financial controls. NAFTA failure in Mexico has a direct impact on the United States. Although it has declined recently, jobless Mexicans migrated to the United States at an unprecedented rate of half a million a year after NAFTA. Workers in both countries lose when companies move, when companies threaten to move as leverage in negotiations, and when nations like México lower labor rights and environmental enforcement to attract investment. Farmers lose when transnational corporations take over the land they supported their families on for generations. Consumers lose with the imposition of a food production model heavy on chemical use, corporate concentration, genetically modified seed, and processed foods. Border communities lose when lower environmental standards for investors affect shared ecosystems. The increase in people living in poverty feeds organized crime recruitment and the breakdown of communities. Increased border activity facilitates smuggling arms and illegal substances." Cf.: https://www.nytimes.com/roomfordebate/2013/11/24/what-weve-learned-fromnafta/under-nafta-mexico-suffered-and-the-unitedstates-felt-its-pain. Another example of unsustainability due to absence of internal sustained systems has to do with family remittances (in countries such as Guatemala, remittances are the main source of foreign currency), because in the long run, migrant workers will settle down definitely in their receiving country and will cease to send money.).

Obviously, meeting the basic needs of the population is the human dimension of the sustainable development concept, while the ecological dimension lies in the limits imposed on the growth by the planetary boundaries. We will explore this topic next.

So, although the SDGs should not be understood as opposing growth (SDG 8 refers to growth and states, *"Promote sustainable economic growth and Employment for all."*), they do impose a *quantitative* change (not to exceed the ecological boundaries) and a *qualitative* change (must be socially inclusive). Social inclusion is key, therefore, in any assessment of sustainable development – by reason of teaching or within its specific operation project – and has to be present in any evaluation of state redistributive policies and the main human needs at stake.

Planetary Boundaries

We have said that for economic growth to be sustainable, it needs a limit in the carrying capacity to deliver or to sustain the planet, be it at a global, country, regional, or even a local dimension. Planetary boundaries refer to the amount of resources that human beings have within their reach to subsist and reproduce without prejudice to the environment. Boundaries are, therefore, the limits that said resources represent to economic growth or development (Jeffrey Sachs 2015:181–218). They are, in reality, the true ecological boundaries – the acidification of oceans, the hole in the ozone layer, the use of fertilizers, global warming, etc. – which go beyond the carrying capacity of the planet. This is happening nowadays in the **Anthropocene** (Zalasiewics et al. 2008; Brauch et al. 2016), as a result of the **great acceleration** (International Geosphere Biosphere Program (http://www.igbp.net/globalchange/greatacceleration.4.1b8ae20512db692f2a680001630.html)) (Padilla 2017) that, having trespassed three planetary boundaries (climate change, loss of biodiversity, and changes in the global cycle of nitrogen, as stated by Leach et al. 2013), risk not only the diverse species inhabiting the planet but also our own species and the equilibrium of the land and marine ecosystems (Thus, the *carrying capacity* is equivalent to the planetary boundaries set forth by the boundaries in which humankind can work within adequate safety margins Leach et al. (2013a). Melissa Leach, Kate Raworth, and Johan Rockström, in a UNESCO and International Social Sciences Council, refer to planetary boundaries as follows: "Anthropogenic pressures on the Earth System have reached a scale where abrupt global environmental change can no longer be excluded. We propose a new approach to global sustainability in which we define planetary boundaries within which we expect that humanity can operate safely. Transgressing one or more planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental- to planetary-scale systems. We have identified nine planetary boundaries and, drawing upon current scientific understanding, we propose quantifications for seven of them. These seven are climate change (CO2 concentration in the atmosphere <350 ppm and/or a maximum change of +1 W m-2 in radioactive forcing); ocean acidification (mean surface seawater saturation state with respect to aragonite $\geq$ 80% of pre-industrial levels); stratospheric ozone (<5% reduction in O3 concentration from pre-industrial level of 290 Dobson Units); biogeochemical nitrogen (N) cycle (limit industrial and agricultural fixation of N2 to 35 Tg N yr-1) and phosphorus (P) cycle (annual P inflow to oceans not to exceed 10 times the natural background weathering of P); global freshwater use (<4000 km3 yr-1 of consumptive use of runoff resources); land system change (<15% of the ice-free land surface under cropland); and the rate at which biological diversity is lost (annual rate of <10 extinctions per million species). The two additional planetary boundaries for which we have not yet been able to determine a boundary level are chemical pollution and atmospheric aerosol loading. We estimate that humanity has already transgressed three planetary boundaries: for climate change, rate of biodiversity loss, and changes to the global nitrogen cycle. Planetary boundaries are interdependent, because transgressing one may both shift the position of other boundaries, or cause them to be transgressed. The social impacts of transgressing boundaries will be a function of the social–ecological resilience of the affected societies" Cf. http://www.worldsocialscience.org/documents/wss-report-2013-part-1.pdf#page=21).

By the way, it is convenient to remember that the loss of biodiversity is closely related to the increased demand of land for agricultural and animal grazing activities. In other words, destructive deforestation of the natural habitat results in a serious imbalance of the land ecosystems and is threatening our own survival, because, as expert paleontologists (Wake and Vredemburtg 2008) state, humankind is already in the middle of its *sixth great extinction*. Contrary to those that occurred in the past geological times, this is manmade, while the five preceding extinctions were the result of geological events (Wake and Vredemburg state that, "The possibility that a sixth mass extinction spasm is upon us has received much attention (9). Substantial evidence suggests that an extinction event is underway. When did the current extinction event begin? A period of climatic oscillations that began about 1 Mya, during the Pleistocene, was characterized by glaciations alternating with episodes of glacial melting (10). The oscillations led to warming and cooling that impacted many taxa. The current episode of global warming can be considered an extreme and extended interglacial period; however, most geologists treat this period as a separate epoch, the Holocene, which began ≈11,000 years ago at the end of the last glaciation. The Holocene extinctions were greater than occurred in the Pleistocene, especially with respect to large terrestrial vertebrates. As in previous extinction events, climate is thought to have played an important role, but humans may have had compounding effects. The overkill hypothesis (11) envisions these extinctions as being directly human-related. Many extinctions occurred at the end of the Pleistocene, when human impacts were first manifest in North America, in particular, and during the early Holocene. Because naive prey was largely eliminated, extinction rates decreased. Extinctions were less profound in Africa, where humans and large mammals coevolved. Most currently threatened mammals are suffering from the effects of range reduction and the introduction of exotic species (12). In contrast to the overkill hypothesis, an alternative explanation for the early mammalian extinctions is that human-mediated infectious diseases were responsible (13). Many scientists think that we are just now entering a profound spasm of extinction and that one of its main causes is global climate change (14⇓–16). Furthermore, both global climate change and many other factors (e.g., habitat destruction and modification) responsible for extinction events are directly related to activities of humans. In late 2007, there were 41,415 species on the International Union for Conservation of Nature Red List, of which 16,306 are threatened with extinction; 785 are already extinct (17). Among the groups most affected by the current extinction crisis are the amphibians." Wake, David & Vredemburg, Vance: *Are we in the midst of the sixth mass extinction? A view from the world of amphibians. Proceedings of the National Academy of Sciences,* USA, Aug. 12, 2008. Complete text available online: http://www.pnas.org/content/105/Supplement_1/11466).).

Another "planetary boundary" relates to the population itself. Its growth cannot be boundless or else it would deplete the capacity of the planet to sustain us as a species. Sustainable development, although it reduces poverty by favoring social mobility and a spontaneous reduction in birth rates in the middle classes, it is also the result of the empowerment of women (SDG 5 refers to gender issues and recommends to promote gender equality and the empowerment of girls and women.) who are now able to plan their pregnancies, thanks to reproductive health programs. Nevertheless, the problem resides in the rate at which this happens, which is not frequent enough to have a significant impact in reducing demographic growth as is required in the medium term for the poorer regions in the sub-Saharan Africa, the Middle East, several countries in South East Asia, or populations that experience dire social exclusion, such as farmers and indigenous populations in Latin America and other regions. Hence, it is essential to implement complementary policies as part of the SDG related to health and to maintaining the Earth's carrying capacity or its environmental sustainability, preserving and increasing natural resources, promoting a reorientation of technology, adopting measures for risk control, and affording coherence to the economic policy related to environmental policies to uphold the UN provisions as a "boundary," which states that population will be close to 10.9 billion by the end of the century.

Importance of the Holistic Paradigm

We have already seen why the very essence of the sustainable development concept has to include the objective dimension (economy and society), the subjective dimension (the human person and his/her needs), the intersubjective dimension (culture, political action), and the natural dimension (land and marine ecosystems), all of which are managed to correctly apply it and to assess its practical results in the sustainable development processes – or when teaching in the university. Our focus here is to remember that all the cases in which a single or a variable dimension is predominant will be flawed. Obviously, what has prevailed in the development world is a partial vision that reduces all public policy to the main objective of achieving greater economic growth, even if it is at the expense of social inclusion or the protection of the national heritage or ecosystems. All the more reason to be aware of the words by German scholar Maja Göpel, who says:

> Thus, a transformational sustainable development agenda needs new 'software' that opens up the imaginary and thus political space for radically different development solutions and systems. And I feel we might be at a turning point: the first 40 years of sustainable development agenda left the economic paradigm widely unchallenged. Instead of integrating economic, environmental and social dimensions of development—as mandated by the Bruntland Report defining sustainable development—social and environmental concerns have been inserted into an economic way of seeing and therefore governing the world. As a result, quantification and marketization in the service of endless 'growth' has become the dominant mode of organizing ever more areas of life. Diversified governance solutions have been homogenized to fit in with this paradigm. (Göpel 2016, 5)

Worldview of the Indigenous Peoples

Another key aspect that needs to be considered to assess both the teachings and the processes in sustainable development, at least for those countries with indigenous population or originary peoples with ethnic and cultural differences from social segments (usually dominant), established by the so-called conquest, colonization, invasion, or similar processes, is the worldview of these subordinate populations.

In this sense, new constitutional legislation in countries such as Ecuador and Bolivia is exceptional, not only because of the widespread participation of indigenous peoples in the discussion and approval of the new normative but also because although according to traditional philosophy of law theory only individuals have rights, it is worth noting that the representatives that enacted the new constitutions in both countries were in the position to approve a radical paradigmatic change. Therefore, the new constitutional norms established the granting of rights to "*Mother Earth*" or "*Pachamama*," as the rights any citizen can demand if she/he feels being violated. This has obvious implications in sustainable development, given the importance of its ecological dimension.

The new Constitution in Bolivia, for example, quotes the *rights of Mother Earth* 5 times, and the Constitution of Ecuador does so in 27 occasions. In the case of Bolivia, the concept is afforded as a spiritual significance, and it is rooted in the indigenous customs: "We populate this sacred Mother Earth with different faces [. . .] Fulfilling the mandate of our peoples, with the strength of our Pachamama and thanks be to God, we have reestablished Bolivia" (Barié 2017:54).

The *Pachamama*, as a benevolent and fertility deity in Aymara and Quechua, also translates as *Madre Mundo* – very similar to the term *Santo Mundo*, used by certain Mayan ethnic groups in Guatemala. In Ecuador, the Mother Earth deserves a special chapter in the Constitution, and it is considered a rights holder, so it can be said that: ". . . Nature or the Pachamama, where life reproduces and happens, has the right to have its existence wholly respected as well as the maintenance and regeneration of its vital cycles, structure, functions and evolutionary processes. Any person, community, people or nationality can demand from the public authorities the enforcement of the rights of Nature" (Barié 2017, 55.). The Ecuadorian Constitution seems to be more advanced from the standpoint of its relationship with a deeper ecology, as it possesses a biocentric approach, contrary to the Bolivian, which continues to be anthropocentric (Gudynas 2017).

Conclusions

Sustainable development has a very close relation with the social realm, as one of its main purposes is human development from the novel notion of human needs that include the need for identity. This, in turn, is closely related to the worldview of indigenous peoples and to the environmental realm, i.e., a true "natural boundary" for economic growth, as we have seen.

Now, sustained systems – in the sense that they are found in the natural ecosystems – and sustainable development, which is both a sociopolitical and economic/ecologic concept, (Bruntland 1987; Sachs 2015) need to be reoriented in their specific actions to the fulfillment of human needs, which should be considered an essential priority. It is important to highlight this because until now, sustainable development has been primarily led by the dominant economic paradigm (the "*mainstream economics*"), which considers growth as the main objective of economic development in a reductionist manner.

This interpretation is mistaken – among other reasons – because sustainability depends on natural ecosystems as the foundation of all societies, and all natural cycles are founded on planetary cycles (rotation and planetary translation, resulting in night and day, seasons, and life and death). So, the linear trajectory of the development processes needs to adapt correctly, or it will be doomed to failure in the long run, which is what usually happens.

Consequently, for development to be sustainable, it first needs to be sustained – it needs to be correctly linked to the natural ecosystems. It must seek to not violate the planetary boundaries: the oxygen we breathe, the water we drink, the soil, the fauna and flora that nourish us, the forests that give us rain, the oceans, the marine, and land biodiversity. Otherwise, we will risk the survival of our own species in this Anthropocene epoch.

If we insist on violating the biosphere boundary with greenhouse gases by burning fossil fuels – coal, gas, and oil– contributing to the increase in temperatures and the frequency of natural disasters, whose origin is climate change, and polluting our environment, then we find ourselves at the risk of turning Lovelock's lovely Gaia (1985) into the terrible Medea from Peter

Ward's sixth extinction (2007, 2009). She will devour us for not paying her the attention owed to every loving mother.

Evidently, this is not about establishing an autarkic system similar to that of Tikopia, the small island in the South Pacific (Diamond 2007), with its three millennia of duration. Rather it is about becoming aware that if something is comparable to this minuscule island lost in the ocean, it is our small planet, alone in the solar system as a living one, lost in the immense interstellar space. Earth is like our minute-island spaceship whose habitat we must preserve for the benefit of future generations. This is what sustainable development requires of us. We need to remember, however, that this is unattainable if we first do not disengage production (Göpel 2016) from unsustainable modalities. This means doing things *better*, discontinuing the use of nonrecyclable raw materials (such as plastic) and nonrenewable sources of energy (i.e., hydrocarbons) without forsaking the fact that we must also produce things *well*, meaning they will be used to fulfill human needs and not to increase the growth indexes or individual enrichment.

Our final reflection is that sustainable development must be assessed on the parameters of the new holistic and comprehensive paradigm – of human development and cyclical sustained systems – and not by referring to the old paradigm that is characterized by the worldview of the dominant system (growth, income per capita, linear sustainability). It must always seek to establish if government and societal commitments are in accordance with the SDGs and if they are being met in the appropriate way. The 2030 horizon set forth for us by the UN agenda is not distant. For this reason, we must apply a strategy of change and transformation for the benefit of future generations.

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Sustainability in Economics and Management

► *oikos*, International Student Organization for Sustainability in Economics and Management Education

Sustainability in Higher Education

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Definition

A higher education institution that engages with sustainability by way of a whole-of-institution approach integrates sustainability in many areas (or domains) of the organizational fabric of the institution, most often bucketed into five main categories: governance (e.g., mission statements, strategic planning), campus operations (e.g., food procurement, greenhouse gas emissions), research (e.g., research centers' foci, sustainability innovations), community outreach (e.g., partnerships with local communities), and education (e.g., curriculum, pedagogy)

Introduction

Given the increasingly alarming climate crises facing our world, and their implications for human survival, many political leaders throughout the globe have taken up the cause. Cities are planning to implement municipal-wide single stream recycling, divert waste from landfills, and create fossil-fuel targets for existing buildings, while specifying low-energy design targets in all new construction (Bloomberg and Pope 2017; Jepson and Edwards 2010; Saha and Paterson 2008). Businesses are strategizing to increase internal carbon pricing, improve energy efficiency, and engage in innovative funding such as on-bill financing, green pricing programs, and sustainability bonds (Business Strategies to Address Climate Change 2017; Crane and Matten 2016; Epstein 2018). Hospitals are pledging to reduce greenhouse gas emissions, become mercury-free, and provide locally sourced food to patients and staff (Climate Action Playbook for Hospitals n.d.; Health Care Worldwide Calls for Action on Climate Change n.d.; Johnson 2010). However, given our continued complex sustainability challenges, it is higher education that remains the single most promising mechanism for addressing these critical environmental- and sustainability-related issues.

Sustainability in Higher Education

In response to the imminent danger of climate change, citizens have been urged to adjust their actions to reverse the deteriorating trajectory of environmental and sustainability problems (Adelsman and Ekrem 2012; Smith and Pangsapa 2008). Growing fears about human impact on our natural environment, along with the survival of our current (and future) social and economic systems, has led policymakers to cite the key role that higher education institutions (HEIs) have to play. Indeed, these HEIs can help our society fulfill the needs of the present without destroying future generations' right to life and prosperity (Chase et al. 2012). Considering that sustainable citizenship is defined as "pro-sustainability behaviour, in public and in private, driven by a belief in fairness of the distribution of environmental goods, in participation, and in the co-creation of sustainability policy" (Dobson 2011, p. 2), it follows that higher education, long recognized as an incubator for preparing students for the democratic participation necessary to improve society, is the most effective site for cultivating sustainably engaged citizens (Gamson 1984; Stevens et al. 2008; Thomas and Hartley 2010; Veysey 1973). Formal classroom learning, combined with co-curricular activities, enables HEIs to effectively drive society toward change (Crossley 2008; Gaston-Gayles et al. 2005; Rhoads 2009). As higher education students advance into citizens of society, their every decision will have profound implications for the present and future (Baker-Shelley 2016; Fadeeva and Mochizuki 2010; Wals and Jickling 2002; Wright 2002).

In the wake of international meetings and declarations surrounding the incorporation of sustainability into higher education (beginning with the Talloires Declaration in 1990), institutions are now, a fortiori, preparing students for responsible citizenship by weaving sustainability throughout the fabric of HEIs worldwide (Clugston and Calder 1999; Cortese and Hattan 2010; Meyer et al. 1997; Kolenick 2016; Noyola-Cherpitel et al. 2016; Orr 2004; Rowe 2002). In a variety of ways, HEIs contribute to the sustainability forefront. They experiment with innovative approaches toward environmental management and sustainable practices that serve as a model for the broader society (Ferrer-Balas et al. 2008; Stephens et al. 2008). They serve as laboratories for conducting and disseminating innovative sustainability research and test sites for sustainable practices (Chase et al. 2012; Stephens et al. 2008). However, HEIs' most unique contribution to the sustainability movement, and their strongest impact, is in educating students about sustainability, thereby arming them with the information, skills, and tools to advance the overall knowledge, attitudes, and behaviors that define a more sustainable society (Chalkley 2006; Chase et al. 2012; Colucci-Gray et al. 2006; Stephens et al. 2008), where citizens are equipped with the knowledge and skills to combat unprecedented sustainability challenges (Cortese 2003; Orr 2004; Rowe 2002). Higher education, therefore, reserves a critical role in graduating students who will become influential decision-makers, professionals, and citizens (Sterling 2013).

Nevertheless, a wide body of research shows that most HEIs fail to deeply infuse sustainability throughout their entire institutional culture. Instead, they address it haphazardly – in isolated, insular, and compartmentalized ways (Tilbury 2011; Van Weenen 2000). This compartmentalized approach to integrating sustainability in higher education occurs when individual departments merely integrate sustainability into their already-existing practices; for instance, when sustainability subject matter is limited to specifically classified sustainability courses, or when (outside the classroom) campus operations originates a recycling initiative on their own. But time is of the essence, and limited to these isolated areas, HEIs cannot maximize their contributions towards a more sustainable future. As such, scholars (as will be further discussed in the following section) have identified different models for effectively infusing sustainability into institutions, stressing that a comprehensive implementation of sustainability is the optimal approach to infusing it into HEIs worldwide (McMillin and Dyball 2009; Sterling 2013). As well, an overwhelming consensus agrees that the most effective method to achieve this is for HEIs to infuse sustainability throughout the whole institution.

Whole-of-Institution Approach to Sustainability

Before defining the whole-of-institution approach to sustainability, it is important to first granularly understand each of the components of the full concept. According to the Merriam Webster dictionary, the term *whole* is defined as comprising the full extent; entire, full, or total; undivided. Universities, referred to here as *higher education institutions*, signify institutions of degree-awarding postsecondary learning. The term *approach* can be understood as a method or steps taken in setting about a task. While a hotly contested topic, for the purpose of this entry, sustainability can be understood using the most widely accepted definition of the word in the higher education field (Agyeman et al. 2003; Clugston and Calder 1999; Merkel and Litten 2007). The Brundtland Commission's (1987) report entitled *Our Common Future* defines *sustainability* as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (p. 1). Taken together, then whole-of-institution approach to sustainability, according to McMillin and Dyball 2009, can be understood as an "integrative approach in modelling sustainability in the core functions and systems of the university" (p. 56). McMillin and Dyball (2009) refer to this concept as "whole-of-university approach to sustainability." For the purpose of this entry, which ought to be applicable to all institution types (research universities, liberal arts colleges, community colleges, etc.), the more inclusive term *whole-of-institution approach to sustainability* is used.

Core Domains of a Whole-of-Institution Approach to Sustainability

As defined by Sterling (2013), an institution that engages in a whole-of-institution approach to sustainability (Sterling (2013) refers to an institution that engages in a whole-of-institution approach to sustainability as a "sustainable institution") is "one that through its guiding ethos, outlook and aspirations, governance, research, curriculum, community links, campus management, monitoring and *modus operandi* seeks explicitly to explore, develop, contribute to, embody and manifest—critically and reflexively—the kinds of values, concepts and ideas, challenges and approaches, that are emerging from the growing global sustainability discourse" (Sterling 2013, p. 23). To accomplish this, though, HEIs must integrate sustainability in many areas (or domains), most often bucketed into five main categories: governance (e.g., mission statements, strategic planning, administration processes), campus operations (e.g., food procurement, greenhouse gas emissions), research (e.g., research centers' foci, strategic research priorities, sustainability innovations), community outreach (e.g., partnerships with local communities), and education (e.g., curriculum, pedagogy) (Bieler and McKenzie 2017; Vaughter et al. 2016). As such, incorporation of sustainability into all five domains, or engaging in whole-of-institution approach to sustainability, is the ideal.

A whole-of-institution approach to sustainability aims to cultivate an institutional culture for the emerging sustainable society (Gough 2005; Sterling 2013). Thus, an HEI must intentionally engage with sustainability within the aforementioned five main domains of sustainability practice (governance, campus operations, research, community outreach, and education), while explicitly engaging students with sustainability practices within each one. As faculty, staff, administrators, and students reflect and collaborate on the HEI's sustainability performance, it is the whole-of-institution approach to sustainability that succeeds. And, as sustainability cannot be accomplished in a silo, individuals from across the HEI must work together. In other words, this approach confirms that all core functions of an HEI – such as those traditionally understood to solely provide logistical support – become an intentional part of the curriculum, eclipsing an HEI's self-analysis of its own ecological footprint. Rather, it would merge this operations-specific task with students' learning such that they can connect it with what they are formally learning in the classroom, e.g., learning how energy, land, and water are used (or perhaps misused) within their own HEI community (McMillin and Dyball 2009). Collectively, the presence of sustainability in all corners of an HEI can reorient its very fabric, resulting in a more holistic learning environment (Tilbury and Wortman 2005).

Benefits of Whole-of-Institution Approach to Sustainability

The benefits to engaging in a whole-of-institution approach to sustainability are legion. Most prominently, through deliberate connection of the core functions of the HEI (like governance and operations) to the curriculum (and in turn, students' learning experiences), a whole-of-institution approach to sustainability provides students with a real-world application of a sometimes vague concept (McMillin and Dyball 2009). Consequently, benefitting from exposure to innovative and interactive pedagogies (which in turn enhances their learning), they acquire a deeper understanding of how it can be applied to their lives as citizens. This approach also inspires interdisciplinarity, encouraging, and recognizing students' voices (Sterling 2013).

In addition, the HEI's sustainability profile is increased, offering innovative solutions to sustainability problems, and building trust among students, staff, administrators, and faculty (McMillin and Dyball 2009), as it can help to ensure that "curriculum, programs, practices, and policies of an educational institution are engaged to contribute to building a more sustainable future. In this approach, sustainability is lived as well as taught" (MCKeown and Hopkins 2007, p. 22). With curriculum linked to campus and community, the HEI then engages with the community and important external stakeholders. Ultimately, the HEI itself benefits, as well, via financial savings, improved risk management, and demonstration of its commitment to environmental and social responsibility (Sterling 2013). In fact, many scholars (e.g., Gough 2005; McMillin and Dyball 2009; Orr 2004; Sterling 2013) go so far as to declare that – due to its integrated mix of social, institutional, and curricular actions and involvement – it is the only approach to truly achieve sustainability.

Importance of Whole-of-Institution Approach to Sustainability

Borne of a series of international meetings and declarations regarding sustainability in higher education, HEIs are to some extent integrating sustainability across the aforementioned five main domains (governance, community outreach, operations, and research education; (Bieler and McKenzie 2017; Vaughter et al. 2016). But this alone is insufficient. As noted, they must also intentionally connect each of their sustainability initiatives across all five domains in order to engage in a whole-of-institution approach to sustainability. And while this has many purposes and benefits, one stands out above all. Given the increasingly daunting climate crises threatening us, many entities (as noted) such as cities, businesses, and hospitals, have risen to the occasion with direct action, implementing pro-sustainability practices to effect change (Bloomberg and Pope 2017; Crane and Matten 2016; Epstein 2018; Johnson 2010).

However, given the complex sustainability challenges facing our world, many, including policymakers and scholars, have emphasized higher education as the most promising site for addressing sustainability and transforming today's students into a sustainably engaged population. As such, integrating the whole-of-institution approach is crucial for this purpose. HEIs have the greatest force and most unique impact on the sustainability forefront within the education domain, by way of their ability to instill sustainability behaviors in their students (Chase et al. 2012). HEIs educate students about sustainability through curricula that challenge them to connect classroom-learned knowledge to their lives and to the world, and cocurricular activities that provide experiences in community projects to stimulate social change (Anderson 1993; Checkoway 2001; Kennedy 1997). Therefore, the connection of sustainability initiatives throughout the whole institution is imperative. Our survival depends on it.

Lack of Whole-of-Institution Approach to Sustainability in Education

It is worth noting here that while the whole-of-institution approach to sustainability is ideal, especially for the sake of students' learning, it does not happen frequently enough. Perhaps, as stated by Cortese (2003):

> Designing a sustainable human future requires a paradigm shift toward a systemic perspective emphasizing collaboration and cooperation. Much of higher education stresses individual learning and competition, resulting in professionals who are ill prepared for cooperative efforts. Learning is fragmented, and faculty, responding to long-established incentives (e.g., tenure, research) and professional practices, are often discouraged from extending their work into other disciplines or inviting interdisciplinary collaboration. (p. 16)

Additionally, another reason why whole-of-institution approach may not be happening with the frequency it needs to in order to cultivate a

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more sustainable future is that within the contemporary higher education landscape, faculty are mainly rewarded on research productivity, not just teaching well (Boyer 1990; Tien and Blackburn 1996; Toutkoushian and Bellas 1999), especially regarding subject matter outside of their discipline, like sustainability (Rowe 2002; Svanström et al. 2008). Without this financial incentive, they may not feel inspired to devote their time (when, say, they could be engaging in research that would earn them a salary raise) to better learn how to teach about sustainability. Therefore, not only lack of resources but also specific incentives for good teaching of sustainability throughout coursework should be addressed.

Conclusion

This entry portrays the ideal approach to integrating sustainability into all corners of higher education institutions worldwide, namely the whole-of-institution approach to sustainability. While some institutions are exemplars and doing this well, to date, most HEIs still fall short. Given that higher education is the most promising mechanism for making the future of our world more sustainable, this ought to be the model to strive towards.

Cross-References

▶ Dimensions of Sustainability in Higher Education
▶ Higher Education and Sustainability Initiatives
▶ Incorporation of Sustainability
▶ University Operations for Sustainable Development

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Sustainability Indicators

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Introduction

Sustainable development is a concept defined in the Brundtland report as a development that pays attention to the needs of the present generation without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development 1987). Since it established, became common in scientific and political contexts, the development of guidelines, frameworks, and tools to assess the sustainability of technologies, processes, and systems (Rösch et al. 2017; Mukherjee 2017). To Sikdar (2012), if we can define what is sustainable, it must be possible to describe the characteristics (e.g., indicators) of a dynamic system that remains the same through the variations of the attributes that define (system variables).

In an analysis that considers the three traditional dimensions – environment, society, and economy – it is useful to be able to compare sustainability between types of products or services, as well as for managers of urban and natural systems to be able to identify if the system is approaching or moving away from sustainability (Sikdar 2012).

Sustainability requirements can be adjusted with the aid of different operational tools, for example, sustainability criteria, sustainability standards, certifications, or the combination of two or more engines with intention of keeping the processes from the perspective of sustainable development (Pavlovskaia 2014).

The sustainability of processes and systems is typically evaluated by indicators (Mukherjee 2017). In a general sense, an indicator is a parameter that leads to knowledge of information and describes the state of a process or phenomenon and can provide quantitative measures and qualitative assessments of human activities and their impacts (Pavlovskaia 2014).

The indicators point to the changes and trends and allow comparisons of values, standards, and other types of analyses. A good indicator signals the existence of a problem and points to the need for action in order to mitigate or eliminate it. The combination of indicators provides a measurement system to monitor information about past, current scenarios, and future directions, in order to assist decision-making (Phillips 2014).

Several communities, regions, and countries identify, design, and adopt indicators as a way to aid in the assessment of the conditions of their territories (Phillips 2014).

Furthermore, Moreno-Pires (2014) points out that there are several examples of countries trying to integrate a common set of sustainability indicators at regional level, as in Europe (European Commission work, Eurostat's Sustainable Development Indicators, and European Environmental Agency core set of indicators), in Northern Europe (Nordic set of indicators), in Latin America and Caribbean (Sustainable Development Indicators in Latin America and the Caribbean), and in Northeast Asia (Northeast Asia Sustainable Development Indicators), or on a subnational level (UK common indicators, regional Algarve region in Portugal).

At the global level, the Department of Economic and Social Affairs (DESA) of the United Nations Secretariat published in 1996 (United Nations 1996) a set of sustainability indicators, with updated editions in 2001 (UNCSD 2001) and in 2007 (UNCSD 2007). The edition published in

The articles used as references for this chapter were searched through the database *Springer Link*, using the following keywords: "sustainability"; "sustainable development" and "indicator". The choice of references attained to the following criteria: From 2010 to 2018, English. In addition to those, other productions of distinguished authors in the field of sustainability were consulted.

2007 (UNCSD 2007) identifies sustainable development indicators, 96 of which 50 are highlighted as Central, organized into 14 themes: (1) poverty; (2) governance; (3) health; (4) education; (5) demographics, (6) natural hazards; (7) atmosphere; (8) land; (9) oceans, seas, and coasts; (10) freshwater; (11) biodiversity; (12) economic development; (13) global partnership; and (14) consumption and production patterns. These indicators represent a benchmark for the countries to adapt and develop their own indicators able to reflect the conditions of their territories (Wong 2014).

In 2017 was published a new list of indicators through the adoption of the resolution A/RES/71/313 (United Nations 2017) in the General Assembly on the Work of the Statistical Commission on the 2030 Agenda for sustainable development (United Nations 2017). This list has undergone refinements, and the latest version published in 2018, including 232 indicators (United Nations 2018).

Applied sustainability indicators are tools used to check and evaluate specific criteria of sustainability, as well as progress toward sustainable development. To achieve the proper functioning of this mechanism demands time and commitment. Often this process requires intensive data collection, monitoring of multiple locations, and repetition of these actions at the appropriate time intervals (Pavlovskaia 2014).

Sustainability Indicators

The indicators are the most common and popular tools for measuring progress toward sustainable development and to any analysis of sustainability. They are useful to communicate ideas, thoughts, and values that can lead to better decisions and more effective actions, simplifying, clarifying, and providing information to systems managers (Rösch et al. 2017) and are quantitative and or qualitative measures that aim to interface and evaluate different areas of social development, environmental, economic, territorial, and institutional (Moreno-Pires 2014) and thereby predict setbacks related to the same (Rösch et al. 2017).

In general, the intention is to achieve one or more of the following objectives: (1) evaluate the sustainable development conditions and trends related to time and space; (2) monitor progress conditioned to goals and objectives; (3) provide information for planning and decision-making; (4) compare different places and situations; (5) raise awareness and political and behavioral changes; (6) promote public participation; and (7) improve communication in debates on sustainability (Moreno-Pires 2014).

An indicator must be clearly formulated and have relatively simple application (Pavlovskaia 2014) but also with a scientifically enlightened understanding of how they are used in the analysis of sustainability (Sikdar 2012).

The development of the indicator is facing various challenges and requirements as your appropriate number, to allow substantiate the goals and management analysis and communication of results (Rösch et al. 2017). When a set of indicators is identified for a particular system to be studied, it is important to ensure that all are necessary and sufficient to define sustainability. Usually, a large number of indicators are used to characterize a system. However, although some indicators are considered essential, they may not be relevant to the definition of a specific system. So should be selected only the indicators able to distinguish the options of sustainable processes of non-sustainable processes. Thus, it is essential that the selection of the indicators to be applied is based on the relevance to a specific system, because a reduced set of indicators facilitates the management and performance of the analyses (Mukherjee 2017).

Sikdar (2012) suggests that (1) the system to be analyzed is closed; (2) are considered the quantifiable indicators that best characterize the system; (3) inclusion priority gave to a sufficient number of indexes; (4) an original research was carried out that quantified the benefits environment, economics and socials costs for the system; and (5) the method or algorithm should allow decisions to made from comparable scenarios.

For Pavlovskaia (2014), there is no alignment or consensus among the different organizations and scientists about a selection of most appropriate indicators or efficient. There are different interpretations, methods, and approaches to develop them and apply them. So, regarding the sustainability indicators, would be recommended: (1) reflect about the process and the function to which they relate; (2) that are sensitive enough to record changes over time and between different systems; (3) there is feasibility in relation to the time, cost and level of skills required application; and (4) which are understandable and relevant to end users.

The literature on sustainability offers many tools and indicators. The main problem in the evaluation of sustainability is not the lack of methods. Instead, the limiting factors are the availability of data, the implementation practice, and understanding of how the impacts are interconnected and exceed the dimensions (environmental, social, and economic) (Karvonen et al. 2017).

The sustainability indicators help to operationalize the concept of sustainable development in relation to time and space, stimulating decisions and actions of multiple actors in dynamic contexts and promoting environmental, economic issues, social, cultural, institutional, and even changes of values through the provision of new information and knowledge (Moreno-Pires 2014).

Sustainability Indicators in Higher Education Sector

Higher education institutions (HEI) have an important role in sustainability. Universities are seen as ideal fields are experimenting with new participatory processes to foster a transition to a more sustainable paradigm (Disterheft et al. 2016). They can contribute including sustainability in the training of students and teachers and adopting sustainable principles in their activities and services, in order to be models of sustainability for society (Tauchen and Brandli 2006; Fouto 2002).

According to Shriberg (2002), a sustainable HEI is one that strives to integrate environmental, social, and economic issues into their core functions of teaching, research, services, and operations. For Velazquez et al. (2006), so that recognized as sustainable, must take care, embrace, and promote the reduction of environmental impacts, local or global level. Cole (2003) states that sustainable education institutions are those that allow the campus community to have attitudes that protect and enhance the health and quality of life of the population, internal, and external, as well as their ecosystems.

Higher education's sustainability implementation has been advanced over at least the last two decades and brought sustainability assessment on the research and policy agenda of Decade Education for Sustainable Development (ESD) and sustainability science (Disterheft et al. 2016). The assessment of sustainability in higher education (HE) has been conducted with the support of various tools based on specific indicators, generated in conceptual structures consistent with the objective of quantifying the advancement of HE sustainable proposals. This assessment goes beyond the choice, construction, and measuring indicators and covers strategic aspects of the planning of each institution.

Different models of sustainability assessment have been adopted in the context of HE. Many institutions seek global recognition and implementation structures, adapting models designed for other types of organizations, such as the Global Reporting Initiative (2013). However, although widely used by HEI, the structure of GRI's sustainability indicators presents limitations in some areas of evaluation of environmental management in HEI and does not cover broadly all pillars – research, teaching, and extension. Although possible, the use of GRI sustainability evaluation in HEI is restricted (Brandão et al. 2015).

In other cases specific assessment tools have been developed for HE, such as Campus Sustainability Assessment Framework (Cole 2003), the set of indicators proposed by Madeira et al. (2011), the Sustainability Assessment Model Socioambiental (Freitas 2013), INDICARE model (Disterheft et al. 2016), and the Sustainability Assessment for Higher Technological Education (Drahein 2016).

According to Brandão et al. (2015), the literature has advanced in the search for mechanisms for measurement and analysis of sustainable practices in HE. Thus, indicators of sustainability are thought of as suitable tools to map the information base to include social, environmental, and economic aspects, making it possible to provide assistance in the formulation of public policies, make more simple studies and reports, and allow to compare different realities in the HE sector.

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▶ Higher Education's Sustainability Assessment Procedures

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Sustainability Integration

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Introduction

As society experiences an increased interest and anxiety related to sustainability initiatives, all institutions bear the responsibility of helping society respond to the challenges of SD (Sustainable Development) (Lozano et al. 2013). Over the last few decades, a growing number of declarations and charters have emerged which state that HEIs (Higher Education Institutions) play a significant role in promoting SD. Lozano (2011) selected the main elements and themes of the declarations, charters, and partnerships: (i) focus on environmental degradation, threats to society, and unsustainable consumption; (ii) ethical or moral obligation of university leaders and faculties to work towards sustainable societies, including the intergenerational perspective; (iii) inclusion of SD throughout the curricula in all disciplines; (iv) encouragement of SD research; (v) move towards more sustainability-orientated university operations; (vi) collaboration with other universities; (vii) stakeholder, e.g., public, governments, nongovernmental organizations (NGOs) and businesses, collaboration, engagement, and outreach; and (viii) transdisciplinarity across the previous points. HEIs demonstrated a high level of activity in sustainability, trying to lead by example and to incorporate a sustainability-related approach in their main domain of activities (Wemmenhove and de Groot 2001; Boks and Diehl 2006; Shephard 2008; Ceulemans et al. 2011; Lozano et al. 2013). The first declaration that focused on the role of HEIs in promoting and fostering SD was The Stockholm Declaration 1972. The rich history of SD includes a great number of important milestones such as the signing the Talloires Declaration by over 500 university leaders in over 50 countries, and the adoption of Agenda 21, which increased the number of universities, incorporating sustainability into their systems (UNESCO; Habib and Ismaila 2008; Calder and Clugston 2003). Nevertheless, sustainable development in higher education is still far from being integrated in a holistic and organic manner by university leaders (Lee et al. 2013; Milutinovic and Nikolic 2014). Some scholars consider the rate of change too slow at HEIs and think that more fundamental and radical changes are needed. Universities are supposed to more aggressive goals and targets and make clear strategies to achieve a sustainable development of the institutions and the society (Koester et al. 2006; Fadeeva and Mochizuki 2010; Ferrer-Balas et al. 2010; Wright 2004, 2010; Godemann et al. 2014; Amaral et al. 2015). According to a number of authors, the reason universities and higher educational institutions struggle to support “sustainable development” is their limited understanding of the concept (Leal Filho 2000, 2011; Wright 2010; Waas et al. 2011; Shriberg and Harris 2012; Wright and Horst 2013). The understanding of the concept can also be influenced by differences between cultures and countries (Khalil et al. 2013). The most popular definition of sustainable development was given by the Brundtland Commission. According to the given definition, sustainable development is “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987). Lozano categorized SD into five different perspectives, which included the following types:

(i) The conventional economist perspective, (ii) The non-environmental degradation perspective, (iii) The integrational (encompassing economic, environmental, and social aspects) perspective, (iv) The intergenerational perspective, and (v) The holistic perspective. The holistic perspective is the most complete because it comprises: (a) the integrational and the intergenerational perspectives, and (b) a balance between economic, environmental, and social aspects as well as the short-, medium-, and longer-term perspectives (Lozano 2008).

Sustainability Integration and Implementation Within HEI

In recent years, universities have started a wide range of initiatives to catalyze a societal transition toward sustainability, expressed in making clear policies, goals and targets, strategic planning, and time frameworks (Stephens et al. 2008; Lozano et al. 2013; Foo 2013; Hoover and Harder 2015). Some of the initiatives focus on a complex commitment to advancing SD (Velazquez et al. 2006; Lukman and Glavic 2007; Lambrechts et al. 2013; Newman 2012; Verhulst and Lambrechts 2014; Fischer et al. 2015; Lozano et al. 2015). While others are more fragmented and focus on one or several selected main activities of HEI: research, education, campus operations, community engagement/outreach, institutional framework, on-campus experiences, and assessment and reporting (Shriberg and Harris 2012; Hesselbarth and Schaltegger 2014; Fischer et al. 2015; Lozano et al. 2015). Many authors have noted the usefulness of using a variety of approaches and models to define principles and steps towards sustainability in HEI, but these approaches are still criticized for failing to take into account the processes by which change takes place (Stephens and Graham 2010). The development and application of sustainability assessment tools can partly solve this problem. Nowadays, tools like Auditing Instrument for Sustainability in Higher Education (AISHE) (Roorda 2002; Shriberg 2002; Wright 2007; McCoshan and Martin 2013; Lozano et al. 2013; Marans 2015), Graphical Assessment of Sustainability in Universities (GASU) (Lozano 2006; Lozano et al. 2013), and the Sustainability Tool for Auditing University Curricula in Higher Education (STAUNCH®) (Lozano and Peattie 2011) assist in detailing the scope of changes needed in order to help HEI to advance SD. There is a variety of approaches towards sustainability implementation. Whether it is a “top-down” or “bottom-up” approach, sustainability implementation can be based on different groups of stakeholders. Stephens et al. (2008) defines five groups of key stakeholders of HEIs, which are: (i) leaders: rectors, presidents, and directors (Wright 2010); (ii) faculty: researchers and professors (Christie et al. 2015); (iii) administrative staff (Jones et al. 2013); (iv) students: students and alumni (Figueredo and Tsarenko 2013; Wachholz et al. 2014; Zeegers and Clark 2014); and (v) external stakeholders (local or regional) (Lewis et al. 2006; Waas et al. 2010; Koscielniak 2014). The behavior and attitudes of stakeholders within an organization is crucial for implementing principles embodied in and implied by sustainable development. In case of the “bottom-up” approach, change agents will be represented by the students, staff, and faculty members (Newman 2012; Lee et al. 2013). Often, independent projects are performed by individuals who undertake initiatives to incorporate sustainable development, even without financial or other support (Newman 2012; Hoover and Harder 2015). In case of the “top-down” approach, changes are facilitated by senior administrators (e.g., presidents, vice chancellor). Communicating SD-related topics to staff and students will help to enhance their ability to integrate SD. According to Adams, the process of sustainability integration based on a “top-down” approach can be divided into four phases: (i) develop a sustainability vision for the university; (ii) develop the mission (the who, what, and why for future actions); (iii) enact a sustainability committee to create policies, targets, and objectives; (iv) develop sustainability strategies in four domains of activity, including education, research, outreach and partnership, and campus sustainability (Velazquez et al. 2006). Sustainability can be diffused from campus operations to curricula and then to research and outreach. If sustainability is adopted and put into practice consistently until widespread implementation has occurred, then, it becomes integral to the institution's culture (Van de Ven et al. 1999; Lozano 2006).

Another "top-down" approach is proposed by the Guide for Universities, Higher Education Institutions, and The Academic Sector Produced by the Sustainable Development Solutions Network (SDSN). HEI need to follow five steps in order to implement sustainability.

The first step refers to mapping what HEI is already doing. Mapping what each university is already doing to support and contribute to the SDGs across all areas or within specific areas of the university is a starting point for discovering possibilities for deeper engagement. It is also a powerful tool for audit. The second step includes collaboration and partnership within and across organizations and communities by bringing all of those involved in the life and work of the university on board to both champion the work already underway and to create substantial ownership of these actions. Building capacity and ownership of the SDGs requires understanding the current knowledge of and commitment to the SDGs across research, learning, teaching, operations, governance, and culture. The third step includes identifying priorities, opportunities, and gaps. Key to the completion of this step will be setting a realistic and incremental foundation for any actions that the university takes to integrate its commitment to the SDGs. Step 3 involves bringing together key stakeholders – students, staff, community members – to arrive at a common determination of priorities for action on the SDGs and to identify opportunities for working cohesively and collectively on achieving the SDGs. The fourth step looks to identify the best way of integrating and implementing commitment and actions on the SDGs. To complete this Step, HEI needs to make decisions that are clear and widely supported about how the SDGs will be mainstreamed in all key university strategies and policies. These strategies and policies might include university's strategic plan, research framework, learning and teaching framework, corporate engagement framework, and future students messaging. The fifth step stands for monitoring, evaluating, and communicating. The way in which universities evaluate and celebrate their contributions to the SDGs is key to informing and shaping future engagement and action.

Regular meetings on specific topics, exchange of key performance data, can all be useful mechanisms for creating linkages across organizational units. Integration mechanisms mediate the relationship between structural differentiation and integration and can be distinguished between formal and informal mechanisms. Where formal mechanisms are meant to coordinate and integrate differentiated activities through preestablished mechanisms, informal mechanisms refer to emergent social properties.

Barriers

HEIs are leading partners in global sustainability efforts. In order to advance SD, HEIs should be aware of the barriers to implementation (Aleixo et al. 2016). Verhulst and Lambrechts (2014) categorize barriers into three groups: barriers related to lack of awareness, barriers related to the structure of higher education, and barriers related to the lack of resources. Many authors note that one of the barriers related to lack of awareness is a partial understanding of the concept (Lozano 2006; Wright 2010; Leal Filho 2000, 2011; Waas et al. 2011; Shriberg and Harris 2012; Wright and Horst 2013). The understanding of the concept can also be influenced by differences between cultures and countries (Khalil et al. 2013). As a result, HEI may lack policies or declarations to promote sustainability (Bottery 2011; Hancock and Nuttman 2014). Without sustainability policies or declarations, it is very difficult to engage key stakeholders to participate in sustainability initiatives (Lee et al. 2013). Another barrier is the lack of interest and involvement of the majority of the students and staff members, faculty management, and policymakers (Weber and Duderstadt 2012; Waas et al. 2012; Lozano et al. 2013; Verhulst and Lambrechts 2015). A further barrier is the lack of teacher training in sustainability (Lozano et al. 2013; Jorge et al. 2015; Verhulst and Lambrechts 2015). Finally, SD is seen as a threat to academic freedom and credibility (Peet et al. 2004).

Resistance to change associated with behaviors, practices, or initiatives is one of the barriers related to the structure of higher education (Weber and Duderstadt 2012; Waas et al. 2012; Adams 2013). Other barriers include: the lack of communication on sustainability and shared timely information both top-down and bottom-up; lack of interdisciplinary research as a result of insufficient coordination and cooperation (Ferrer-Balas et al. 2008; Sibbel 2009; Larran and Andrades 2013) and overcrowded curriculum (Abdul-Wahab et al. 2003; Chau 2007).

Lack of time and financial resources are the most common barriers related to the lack of resources. According to a number of authors, a lack of financial resources and funding is one of many obstacles preventing the success of sustainability initiatives in Higher Education Institutions (Shriberg and Harris 2012; Waas et al. 2012; Figueredo and Tsarenko 2013). Higher Education Institutions play an important role in the promotion of sustainability, and an increasing number of stakeholders expect them to be sustainable organizations. However, this can only be achieved when barriers and challenges are overcome.

Accents in Sustainability Implementation

University systems have the following elements: Education (referring to courses and curricula), Research, Campus Operations, and Community Outreach (Cortese 2003). These elements are interlinked and interdependent. It is important that these efforts are assessed and reported, internally and externally (Lozano 2006).

Education and Research

Historically, universities have played a role in transforming societies, by educating decision-makers, leaders, entrepreneurs, and academics (Cortese 2003; Lozano 2006). Higher education is a unique intellectual contributor to society's efforts to achieve sustainability, through the practices of skills, consultancies, trainings, and exchange of knowledge. University researchers are the first alarms to alert the public about environmental challenges and assist in spearheading multidisciplinary, technical solutions (Foo 2013). Universities need to provide a clear sustainability vision and strategy and build sustainability awareness through clear dissemination and communication strategies. Among the necessary measures are: (i) creating interdisciplinary and collaborative research and learning processes, which are critical to developing understanding and sustainability practices; (ii) supporting existing role models that would engage academics in sustainability as this would facilitate learning from existing practice; (iii) providing staff with the time and financial resources necessary in order to embed sustainability within the curriculum; (iv) embedding sustainability into academic processes and research structures by putting specific structures in place, such as creating research grants and recognizing of research conducted into sustainability. A range of approaches have been identified for how sustainability can be integrated into the curriculum. Strategic options can be distinguished based on whether they emphasize vertical or horizontal integration (Ceulemans and De Prins 2010; Watson et al. 2013). Vertical integration involves adding a specific sustainability course to the curriculum whereas horizontal integration can range from providing some coverage of sustainability issues in an existing course, intertwining sustainability in existing courses, offering a sustainability specialization within an existing program or designing a specialist sustainability degree. The risk with vertical integration is that it may not provide an adequate counter to "unsustainability" which may be reflected in other courses in the program or that the isolated nature of the sustainability content will not enable students to incorporate it into their professional practice (Peet et al. 2004).

Campus Operations

Campus operations initiatives have been developed and applied principally in the area that has become known as "campus greening" (Shriberg and Tallent 2003; Brinkhurst et al. 2011; Finlay and Massey 2012; ISCN Secretariat 2014).

Technological solutions include initiatives such as the design of smart buildings (McGibbon et al. 2015), investment in recycling programs, and the promotion of energy-saving technology. To accomplish this purpose, universities are implementing environmental management systems (Clarke and Kouri 2009; Wright and Wilton 2012). The key concerns in universities' environmental management system are energy consumption, waste management, pollution prevention, and resource conservation (Jain and Pant 2010). A number of international studies have been published in this field.

- Conserving Energy and Natural Resources

  In order to conserve energy and natural resources, HEIs may concentrate efforts to address the Energy efficiency, recycling, and resource conservation. More precisely, these efforts can include such initiatives as lighting, water, HVAC, and information technology energy upgrades, implementation of efficiency design standards, LEED certification, conversion to zero or lower-carbon energy sources by installing onsite generation, and switching to lower-carbon fuels such as natural gas and biofuels. In context of living green, students and stuff of HEIs can also contribute to conserve energy and natural resources.
- Wastewater Treatment

  Wastewater treatment is one of the main issues of green living which requires a number of complex initiatives. The role of HEIs is to promote a conscious approach towards water usage. Tsinghua University launched a green initiative in order to increase awareness of sustainability among its faculty, staff, and students. This initiative was used as a social learning tool for the university community to engage in green living and contribute to sustainable development. In case of Tsinghua University, many professors welcomed this initiative and were involved in enlightening the students on sustainability by conducting special lectures and seminars. Afterwards, the students accepted that the course called "Water Resources and Water Crisis" helped them realize all the problems that concern water protection.
- Waste Management

  In order to cultivate students' sustainability awareness, HEIs undertake a lot of initiatives like projects on reduction, re-usage, and recycling. HEIs can start with programs promoting voluntary simplicity and discouraging excessive consumption of material goods, implementing waste sorting, or greening students' dormitory. As for recycling initiatives, Institutions are recycling paper products, metals, plastics, construction waste, food scraps, and landscape trimmings.

Community Outreach

Although scholarship acknowledges the contribution technological advances have made toward a sustainable world, for example, in terms of maximizing material and energy efficiency (Bocken et al. 2014), technical solutions alone are not enough.

If universities and HEIs are to fulfill their potential role as technical, cognitive, and cultural role models of sustainability for this and the next generation's students and leaders as well as the wider stakeholder community, they need to "undergo significant cultural change and transformation" (Linnenluecke and Griffiths 2010). This implies a change of attitude and developing a new set of values and behaviors: in short, an organizational culture for sustainability.

The aim for sustainable development in universities is for graduates in their later professional lives to take social, environmental, and economic costs and benefits into consideration when making decision (Svanström et al. 2008; Lozano et al. 2013).

Due to the unique role they play in society, universities have a responsibility to educate the next generation about ensuring a sustainable future (Leal Filho 2000). As recognized in Agenda 21 and related international declarations and initiatives directed to higher education, universities have the potential to contribute to the social, environmental, and economic sustainability of communities (Cortese 2003; Ferrer-Balas et al. 2010).

Conclusion

HEIs can be more than the suppliers of good ideas, whether through education, research, or outreach. They can contribute to the changes required by facilitating new approaches at their institutions that foster innovative and sustainable ideas. Such ideas need to link theory and practice, from the designers to the users, in order for sustainability to be integrated throughout the world.

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Sustainability Learning Outcomes

► Learning Outcomes for Sustainable Development

Sustainability Literacy Test

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Definition

Sulitest is an international movement led by an independent NonGovernmental Organization (NGO) whose mission is to support expanded sustainability knowledge, skills, and mind-set that motivate individuals to become deeply committed to building a sustainable future and to making informed and effective decisions. Sulitest develops a set of online tools (https://www.sulitest.org) to raise awareness and to improve understanding of the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda.

Introduction

Sustainability and education have been increasingly intertwined from the creation of UNESCO in 1945 to the adoption of the 2030 Agenda's 17 SDGs in September 2015. Education plays a major role in empowering individuals and future decision-makers so that they are able to face the complex and key challenges of the twenty-first century, including enabling change and collectively building a sustainable future. Higher education has an important role to play in this agenda by creating change agents. An abundant literature documents the role of higher education in promoting sustainability (Bullock and Wilder 2016; Yarime and Tanaka 2012) and in enhancing sustainability knowledge, skills, mind-sets, and/or

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behaviors (Cotgrave and Kokkarinen 2011; Missimer and Connell 2012; Swaim et al. 2014).

Academic research extensively documents both the efforts made by universities to incorporate sustainability into their core activities and the challenges they are facing (Lozano et al. 2013; Leal Filho et al. 2015; Aleixo et al. 2018). However, few studies estimate the impact of these efforts on the sustainability knowledge of their students and graduates. This chapter highlights the contribution of the Sulitest initiative to fill this gap by collectively building online tools to raise awareness and to provide empirical data mapping sustainability literacy. It aims at emphasizing the role of the community to co-create and to improve Sulitest's tools. It provides an overview of these tools and the diversity of their potential uses.

Sulitest's best-known tool – the Test – is an online, easy to use, multiple-choice-question format that uses an algorithm to select questions from an expert-approved database. The selection of the questions relies on a foundational matrix, ensuring that each session of the Test covers a comprehensive scope of sustainability and a systemic perspective between topics. Every question comes with a learning statement to provide information and to motivate the candidates to learn more. The database also associates each question with one or more goals of the Global Agenda, making sure to raise awareness of the 17 SDGs and helping to create a large database mapping citizens' awareness. Sulitest has become an active contributor to the 2030 Agenda by providing tangible indicators to map sustainability literacy and to monitor its progress.

ESD and Sustainability Literacy to Achieve the SDGs

In September 2015, heads of state from all around the world gathered at the United Nations headquarters to adopt the 2030 Agenda for Sustainable Development, an ambitious "plan of action for people, planet and prosperity," with 17 Sustainable Development Goals (SDGs) and 169 targets, aimed at nothing less than "transforming our world." The agreed focus for countries, organizations, and citizens over the next 15 years, is to "mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind." The SDGs offer a coherent framework and roadmap to coordinate multiple stakeholders' initiatives and to accelerate the transition towards a sustainable future.

The role of education is crucial. It is empowering citizens so that they are able to face the complex and key challenges of the twenty-first century and to become change agents. This mission is highlighted in SDG 4 defined as *Quality Education* and supported by the UNESCO *Global Action Program on Education for Sustainable Development (ESD)* (https://en.unesco.org/gap). More specifically, Target 4.7 states that by 2030 "all learners acquire the knowledge and skills needed to promote sustainable development [. . .] through education for sustainable development, sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development." (https://www.un.org/sustainabledevelopment/education/)

Higher education has an important role to play in this agenda. As stated by Wood et al. (2016), the integration of ESD in Higher Education Institutions (HEIs) results from a long process. Wals and Blewitt (2010) identify three stages capturing the integration of ESD in higher education. During the 1970s–1980s, the focus was more environment-oriented (e.g., green chemistry curricula). In the 1990s, ESD progressively integrated students' awareness (good practices, green behavior). Since the 2000s, a paradigm shift requiring new pedagogical approaches has been called.

A major turning point occurred during the United Nations Conference on Sustainable Development (UNCSD) RIO + 20 and the establishment of the Higher Education Sustainability Initiative (HESI) (https://sustainabledevelopment.un.org/sdinaction/hesi). This initiative gathers more than 300 HEIs in partnership with United Nations Department of Economic and

Social Affairs, UNESCO, United Nations Environment, UN Global Compact's Principles for Responsible Management Education (PRME) initiative, United Nations University (UNU), UN-HABITAT, UNCTAD, and UNITAR. For the first time in the context of UN initiatives, HEIs acknowledged the responsibility they bear in the pursuit of a sustainable future and agreed to act collectively and to share practices. The broad scope of initiatives aimed at integrating sustainability in higher education includes pedagogy and learning, academic research, campus management, organizational practices and community impact.

Key questions emerge from this starting point: How can HEIs engage students, faculty and staff members in a meaningful and culturally relevant way? How can HEIs evaluate the awareness of their students and adapt their pedagogical approach? How can HEIs monitor learning outcomes on global systemic topics like the SDGs?

The question of learning outcomes, and more broadly the impact of ESD on graduates, is critical. Knowledge and awareness are key outcomes expected from the incorporation of sustainable development in higher education. The literature also identifies skills, mind-sets, and attitudes as a "powerful influence on their sustainability intention, which in turn affects behavior" (Swaim et al. 2014). Students can acquire these skills thanks to competence-based education or collective learning (Cotgrave and Kokkarinen 2011; Missimer and Connell 2012). In practice, this means enabling students to develop critical, holistic, systemic, interdisciplinary thinking (Mather et al. 2011; Sipos et al. 2008). Project-oriented learning is another proven method of supporting integrative approaches to sustainability in higher education (Leal Filho et al. 2016). The combination of these dimensions defines the concept of Sustainability Literacy as "the knowledge, skills, and mindsets that help compel an individual to become deeply committed to building a sustainable future and allow him or her to make informed and effective decisions to this end" (Décamps et al. 2017). Learning about sustainable development requires multidisciplinary approaches and exploring various themes (e.g., soil quality, forest health, social inclusion, etc.) as well as the interconnectedness of these themes to support and develop system thinking (Rieckmann 2012; Svanström et al. 2008; Wiek et al. 2011).

As a tangible implementation of HESI developing and mapping sustainability literacy, the Sulitest initiative is one important answer to this pressing need.

The Sulitest Initiative

Sulitest is a movement whose mission is to support expanded sustainability knowledge, skills, and mind-set that motivate individuals to become deeply committed to building a sustainable future and to making informed and effective decisions to this end.

Inspired by the UNCSD RIO + 20 (Article 47 of the final document) and created in the context of the UN HESI in September 2013, Sulitest became one of the first featured initiatives of the UN Partnerships for Sustainable Development Goals in 2016. Led by an independent NGO and co-created with a community of users and a network of contributors, Sulitest is supported by 39 international institutions and networks such as UNESCO, UN Environment, UNGC PRME, UNDP, GRLI, IAU, and UN DESA.

Working to provide free, accessible, global, and locally relevant tools, Sulitest currently offers an initial set of online tools to raise awareness and to improve understanding of the 17 Sustainable Development Goals (SDGs). More tools are currently being developed.

Tools and Community

Sulitest's best-known tool – the Test – is in an easy to use, online, multiple-choice-question format. Each organization mandates "Examiners" who can organize a Test Session with the automated online tool and invites his/her students or colleagues to participate. The "Examiners" can choose between several modules available to design their Test sessions, the main module being the International Core Module (only mandatory module in a Test session).

The International Core module consists of a set of 30 international questions that are selected from an expert-approved database by an algorithm. This core module covers global issues and is taken by everyone regardless of their country of origin. An individual's test results are provided with a comparison to the global average of other test-takers. The questions developed by Sulitest for its International Core module are based on verified and reputed sources that are subject to a broad consensus in the community of researchers and practitioners in the field (international texts and reports, UN conventions, specialized national agencies, etc.). A Senior Advisory Board (SAB) with representatives from international organizations and UN agencies validates the questions, the sources, the learning statements, and the iteration of the tool.

To achieve the objective of measuring and improving sustainability literacy for all, Sulitest applies key criteria:

- Questions must assess an individual's current knowledge of sustainable development and provide an informative "learning statement" that motivates additional learning and action. The number of questions should not overwhelm the test taker.
- The overall experience of taking the test should help learners to understand the bigger picture, to be touched and inspired by specific stories or facts. Topics should be balanced between alarming news and inspiring actions. Learners should be able to establish inter-linkages between topics.

To reach these ambitious objectives, the test is designed with: (1) a foundational matrix that provides a coherent, educational, and systemic framework; (2) questions tagged with up to three thematic tags to ensure balanced representation of concepts within each Test; (3) an alignment with the SDGs' framework to provide indicators on the 2030 Agenda.

The Sulitest core mission is to ensure that every decision-maker, and all of us, are "sustainability literate," which includes sustainability knowledge, skills, and mind-set. The Foundational Matrix of Sulitest is designed with all three elements (The full details of the Foundational Matrix and the list of Tags can be found here: http://www.sulitest.aleaur.com/files/source/Sulitest%20V2%20-%20Architecture%20and%20tags.pdf). Finding relevant and universal sources acceptable to everyone worldwide is never an easy task. It is simpler to find consensus on questions based on "knowledge" facts and concepts, as opposed to the more complex approaches needed to investigate skills and mind-set. For this reason, and because the International Core module is used as a common entry point to sustainability literacy worldwide, the current test questions used in this module focus primarily on the knowledge section and are linked to the SDGs. However, other modules aspiring to include the skills and mind-set elements are currently being developed (examples are given in the next section).

The knowledge subjects are divided into four themes ranging from the macro perspective to the individual's role. They include:

- Sustainable humanity and ecosystems on planet earth, including ecological and social perspectives
- Global and local human-constructed systems to answer humanity's needs, including social and economic systems, such as governance, education, water, energy, food, and other systems
- Transitions towards sustainability, with examples and concepts regarding how change happens
- The role of individuals to create and maintain individual and systemic changes, including awareness of functions and impacts, and how an individual can effectively create change

To sharpen the interpretation of the results, each question is tagged with up to three thematic tags (in addition to one subject from the matrix).

Each question is also linked to (up to) three of the SDGs, providing tangible indicators for monitoring the progression of core literacy in all 17 SDGs. These indicators are communicated on a yearly basis to estimate how well citizens are equipped to face the challenges covered by the SDGs and to achieve the 2030 Agenda.

They constitute the Sulitest contribution to the Partnership Exchange for the SDGs during the High-level Political Forum (HLPF) at the UNHQ (Carteron and Décamps 2017; Carteron et al. 2018).

Sustainability awareness also integrates local or specific issues. That is why the International Core module is usually combined with a specialized module with 20 additional questions. Locational modules cover national, regional, and cultural specificities (environment, laws and practices). The commitment to culturally relevant tools is one of Sulitest's unique attributes. The Regional/National Expert Committees (RNECs) lead the development of Sulitest in their local environment by coordinating diverse stakeholders to develop local questions, translating content into their own language when needed and engaging local HEIs in using the Test. As of January 2019, 17 countries/regions have already developed their own set of local questions. Eleven other countries are currently adapting their questions to the new format (see the map below). RNECs are crucial for the formal development and the sharing of local modules. In addition, every individual is encouraged to propose content and to contribute to the evolution of the tool. Hundreds of people around the world have at some point contributed their time, energy, ideas, and goodwill to the project and the community; and they continue to do so (Fig. 1).

Topical modules focus on a variety of issues. To support understanding of the SDG framework, Sulitest and UN DESA have developed a module on the SDGs' overall conceptual framework in 2017. In support of the in-depth review of SDG 7 at the 2018 session of the HLPF, the Division for Sustainable Development of the United Nations Department of Economic and Social Affairs (DSD/UN DESA) – the Secretariat of the HLPF – led a process to create a Sulitest SDG 7 module for use by all. A specific module to address SDG 11 challenges focusing on holistic waste management was developed in 2018 by Sulitest and the UN Environment – International Environmental Technology Centre (IETC) in Osaka, Japan. Other topical modules are currently being developed such as SDG 4: Inclusive and Equitable Quality Education, in partnership with UNESCO.

Finally, an optional anonymous survey is provided to the respondents at the end of each session to collect data for research purposes, including sociodemographic characteristics, interests, and sensitivity to sustainability issues. If the candidates are students, Sulitest adds some questions about prior education on sustainable development.

Sustainability Literacy Test, Fig. 1 Map of Sulitest RNECs (July 2018)

All these tools are free and available online (www.sulitest.org) as a common good for any HEI, corporation, institution, NGO, or other type of organization willing to raise awareness on sustainability challenges among its students, faculty, staff, or other stakeholder and to collect indicators on progress. Initially deployed in the academic world, more than 115,000 people from 890 universities and organizations in 68 countries have already taken the Test as of January 2019.

In addition to the Test, a second tool is provided as a common good on the Sulitest platform: the Quiz. This tool is designed to ease students and staff engagement in a shorter time with a playful mode. The facilitator displays the Quiz on a projector screen and gamers use their computer, tablet, or phone to connect. Played as an interactive game between several teams, the Quiz is based on 10 questions that can be taken from the International Core module or from a Specialized module. Each question appears in real time and team scores are displayed on a graph, along with a learning statement. At the end, a summary displays the overall results and the winning team. The Quiz game can be used during board meetings, classes, and other events for quick, fun engagement and to help raise awareness of sustainability.

Other Tools Available with a Premium Access

When launching a project for the common good and ensuring its future, one key responsibility is to make this project financially sustainable. In order to fulfill its mission – to raise and map Sustainability Literacy worldwide – Sulitest learning tools are available online free of charge for any academic institution or organization. To achieve financial sufficiency and as an independent nonprofit organization, Sulitest is:

- Offering services with fees to academic and nonacademic organizations, such as a Premium Access, which allows an organization to create customized questions and unlock tools like the Explorer mode
- Obtaining public grants/funds
- Accepting donations from corporations, institutions, foundations, and individuals.

When purchasing a Premium Access, some organizations choose to create Customized modules with a specific set of questions adapted to their own needs and culture (CSR strategy, sector or profession, etc.). These customized modules open a variety of question types (ranking, likert, open-ended, etc.), which may be used in learning modules, exam modules, or surveys to:

- Understand perceptions, expectations, and motivations of key stakeholders – students, faculty, and staff
- Collect feedback from students on pedagogy, course, and program design
- Assess brand image and reputation
- Provide indicators and tangible data to external auditors
- Customize staff and managerial training programs

Several examples of Customized modules used for different audiences are cited below.

Example 1 The "Rebalancing Society" Module by the UNGC PRME (Principles for Responsible Management Education), an Academic Network Providing a Module for Its Members
Paralleling the HLPF in 2017, UNGC PRME (in collaboration with McGill University and Kedge Business School) launched a worldwide questionnaire based on Mintzberg (2015) major contribution on "Rebalancing Society." The aim of this module is to estimate the students' current perception and willingness to rebalance society. This questionnaire is conducted iteratively to monitor the evolution of students' perspective to "rebalance society" and to inform UNGC PRME.

Example 2 Beta-Testing a "Mindset" Module by UNGC PRME
Through its working group on *Sustainability Mindset*, a network of academics in over 35 countries, the UNGC PRME initiative is working with Sulitest to manage a module on Mind-set. Knowledge of the 17 SDGs provides both a path for possible actions and a vision for a "world that works for all," in the words of previous UN

Secretary-General Ban Ki-Moon. There is a need to develop a particular mindset, since the mindset is the lens through which we analyze information and make meaning. This includes systems thinking to understand causes and effects not only in linear ways, but also the cyclical, circular and web-like interactions. Furthermore, a mind-set for sustainability relies on the ability to unleash creative thinking in order to imagine and reinvent how we produce, source, or distribute services and goods. It incorporates the "being" dimension, which includes awareness of the values that anchor our identity and that manifest in our decisions and behaviors, as well as aspects of our higher self, such as purpose and personal missions.

Questions in the Mind-set module enable students to explore their emotional reactions to the data, their assumptions, their contributions to the problems, and how their current behaviors are not sustainable, or are creating positive change. Questions involve personal reflection, without a right or wrong answer. Educators can create dialogues in their classrooms to address these key aspects that help develop the mind-set for sustainability.

Example 3 The "Design" Module by Cumulus, a Professional Network
In October 2017, a module for designers was co-produced by Kedge Design School and the Cumulus network. It was presented at the World Design Summit in Montreal during the workshop, "How can we assess and report on sustainability's impact in our programs and be sure that we are producing sustainability-literate graduates?". This module will be made available to members of the Cumulus network as soon as next academic year.

Example 4 The "Responsible Manager" Module by Onet, a Corporation
Onet, one of the first corporate partners of Sulitest, has used this tool since 2017 in its curriculum at the Responsible Manager Center. In the context of Onet University, managers were able to learn more about the major global issues. They were also able to test themselves on the actions carried out under Onet's responsible development policy, "A present for the future!". This application of Sulitest opens up new opportunities with the current partners who are already interested, and with new prospects.

Example 5 The "Create, Share, Care" Module and Course Specific Modules by the Kedge Business School, an Academic Institution
For 2 years, this school has used customization at two different levels. The first level takes place at the arrival of new students on campus. They take the Core International module as well as a module on the CSR strategy of the school. Sample questions include: "To what extent did Kedge Business School's CSR and sustainability policy influence your decision to enroll into the school?" and "Do you think that knowledge about CSR and sustainable development will be useful in your professional life?". Those questions help the school understand better the sustainability awareness and affinity for specific actions by their incoming students.

The second level is customization for a specific course. Before the course, students are invited by their teacher to take a specific module relevant to that course, for instance, responsible finance, sustainable supply chain, or others. This snapshot gives an idea of the subjects on which the students are stronger, and on which the teachers have to focus on.

A Continuous Improvement Process toward Sustainability Literacy for all

Sulitest is organized as a collaborative initiative since the pilot version launched in September 2013. It is engaged in a continuous improvement process building on the feedback and contributions from its community. After a pilot phase (2013–2016) with 44,000 tests taken, Sulitest launched the current tools in September 2016 to offer powerful engagement and educational opportunities. They include a revision of: (1) the foundational matrix on which the test questions were based, (2) the test questions themselves, and (3) the web platform.

Additional development and research will further enhance the initiative and should overcome three main accepted limitations of the tools.

Firstly, the results of the test's Core module are comparable in a limited way. While the question bank (and the selection process) is the same for everyone, the condition under which the tests are taken can be different depending on the university's choice (duration of the session, learning statement, etc.). Secondly, the question bank is still not large enough. Even if all the subjects of the matrix are covered, there is a pressing need to produce more questions. Thirdly, the test is currently a powerful raising awareness tool, but it needs more academic and scientific tests to become a robust assessment tool.

Three phases are now supporting the Sulitest movement and will help overcome these limitations.

Phase 1 includes the currently available revised tools. The International Core Module is now the anchor with a focus on "knowledge" questions. Optional Specialized modules (Locational or Topical) are also available. Demographic data is collected for research purposes and the Quiz is made available for all. Explorer and Customized modules are also available for a fee.

Phase 2 includes new tools and initiatives requested by the community that are currently in development. Key tools include:

1. The Community Platform that will further increase the community's ability to co-create Sulitest questions and modules (similar to a wiki concept with additional expert review features), and that is beta tested in one university in France in September 2018.
2. Tools for teachers such as discussion questions, sample slide decks, case studies, and curriculum examples that will be made available on the Sulitest website for the 2019 school year.

Initiatives to take Sulitest to the next level regarding research and robustness are also under way. The first International Collaborative Strategy Session with researchers took place in June 2018, and kicked off a coordinated discussion of the international research community around Sulitest. Two of the pilot studies focus on the rigor of the tools developed by Sulitest and how to sharpen the interpretation of the data collected. These studies will help to scale up the initiative. The objective is to move from an interesting engagement tool to a robust assessment tool in the future phases of the initiative.

Phase 3 includes areas to develop in the future. With the increased rigor expected from Phase 2, Sulitest looks at the possibility of creating a Certificate. In addition, a Sulitest tool that includes not only a Knowledge Test but also the Mind-set and Skills components may be developed, which together would make a comprehensive test of Sustainability Literacy. Sulitest is also committed to creating culturally relevant tools for any region in which there are people who would like to engage and become active in the community. Sulitest looks forward to establishing more national committees that can create relevant modules for their areas and to translating tools into more languages.

Conclusion

This chapter explores the effort of an international and collaborative initiative to achieve sustainability literacy for all. Sulitest is developing online tools to advance citizens' sustainability awareness and to monitor progress. By providing tangible indicators on the awareness of the SDGs, it is contributing to the Global Agenda and to the literature on ESD.

Firstly we highlight the role of collaboration and co-creation inside the Sulitest community to improve the tools and to accelerate their adoption. The importance of co-creating global tools as well as culturally relevant and country/region-specific tools has emerged from the community. Secondly, the Sulitest initiative aims to enhance sustainability literacy based on a systemic perspective. It means expanding citizens' awareness on a comprehensive scope of sustainability challenges and on their interlinkages. It also needs to cover the three dimensions of sustainability literacy, which are knowledge, skills, and mind-set. Finally, the diversity of the tools and their potential uses provide multiple ways of engaging citizens in the path toward building a sustainable future.

The future phases of the initiative will bring two main developments. A collaborative platform will enhance the ability of the community to collaborate in an efficient way. This platform will increase the question bank and allow any individual to propose new content or to improve the tools. The second development is the formation of a research group conducting pilot studies to sharpen the robustness of the tools and to help build a certificate.

The Sulitest community is active, and it is growing rapidly. It will push the momentum further to achieve sustainability literacy for all and to build a sustainable future. Join in! (www.sulitest.org).

Cross-References

- ▶ Awareness of Sustainability Issues
- ▶ Innovative Approaches to Learning Sustainable Development
- ▶ Learning Outcomes for Sustainable Development
- ▶ Students' Perspectives on Sustainability
- ▶ Sustainability in Higher Education
- ▶ Sustainable Literacy
- ▶ Transferring Knowledge for Sustainable Development

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Sustainability Management System

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Introduction

An institution can declare the most ambitious sustainability goals possible, but without a means to advance toward those goals, to guide and track efforts to reach them, the declarations remain empty. *Sustainability management systems* (SMS) have evolved, and continue to evolve, to provide just such a means. These systems may vary in scope from an entire institution to a single academic unit, but if higher education is to fulfill its role in "helping societies worldwide, to achieve sustainability" (Lozano García et al. 2006), educational leaders must find workable SMS solutions for their institutions.

This comes from the fact that higher education can play the role of both catalyst and multiplier in fostering sustainable development worldwide. Through the "application of values, especially integrity and fairness and the awareness that people share a common destiny" (Lozano García et al. 2006), those charged with managing higher education exercise broad influence on society's development (Viebahn 2002). Higher education can both model and teach a sustainability mind-set, as well as direct research toward emergent problems. Institutes of higher education serve as catalysts for the future, sharing knowledge and providing role models for innovation projects that worked out and important lessons for those initiatives that did not. Ramos et al. (2015) state it bluntly: "Education is an imperative for societies to become more sustainable."

At the same time, institutes of higher education consume resources and produce waste, sometimes at the level of small cities (Alshuwaikhat and Abubakar 2008). Practical learning opportunities thus arise for students whose diverse perspectives can be used to foster sustainability innovation and improvements for a campus that they know and care about. Sustainable campus management can be a testing ground for innovation (Müller-Christ et al. 2014). However, to lead the way, any sustainability communication and content, including curricular elements related to sustainable development, must be backed up by the actions of the institution (Mcmillin and Dyball 2009). For full learning experience and competence development, the institution must, as is said, walk the talk (Sammalisto et al. 2015) – or it risks losing credibility not only with students but also with the stakeholders in its network.

Toward this end, in 1990 leaders of multiple universities committed to the first sustainability declaration in higher education (Sylvestre et al. 2013), a ten-point action plan called the Talloires declaration (ULSF 1990). The plan aims at increasing awareness, educating for citizenship, practicing institutional ecology, and broadening national and international collaboration. As of February 2018, the Talloires declaration had been signed by 503 institutions (ULSF 2018), and exemplary implementation experience has been documented in the literature (Koester et al. 2006). Other sustainability declarations have followed the Talloires declaration; a review of can be found in Sylvestre et al. (2013).

Measures to manage sustainability begin with sustainability declarations, but they must evolve to include transparent management of all sustainability dimensions for the core activities of a school. These activities are recognized to include education, research, community outreach, and operations (Ceulemans et al. 2015a; Lozano 2006a; Cortese 2003). The operations dimension is sometimes simplified to green campus management and is often the first step many universities tackle. Less common is a closer integration of the operations initiative into a sustainable development curriculum. Müller-Christ et al. (2014) differentiate between a *formal* curriculum, where the campus is used as a resource for learning, and a *hidden* curriculum, where, for example, the way buildings and resources are managed and operated has effects on learning about sustainability. A curriculum hidden in green campus management can provide a "starting point for exploring the other dimensions of sustainable development," as Sammalisto et al. (2015) concluded from their survey-based research.

Managing sustainability across all four core activities and in the context of higher education, where leadership is distributed among many actors with different goals and overlapping responsibilities (Birnbaum 1991), presents unique challenges for an SMS. These can only be understood within a framework that encompasses the broad scope of higher education.

Framework for Managing Sustainability

Managing sustainability requires a framework to guide decision-making. This is not a trivial problem in higher education. Velazquez et al. (2006) note: "What is missing is a clear orientation on what exactly a sustainable university should be." Sustainability goals can be so broad that they leave management without clear guidance. Clarity can be won by thinking through sustainability, management system, and higher education from their distinct perspectives. Then senior-level decision-makers have a framework to evaluate their SMS options.

Sustainability

To today's reader, the terms *sustainable* and *sustainable development* may seem self-explanatory. But both concepts are relatively new. Analyzing the occurrence of the two terms using Google's NGram tool shows that while *sustainable* had begun to emerge in print by the mid-1970s, *sustainable development* only entered the world with the publication of the UN-sponsored Brundtland Report "Our Common Future" (WCED 1987). Translators around the world were faced with the task of interpreting this new idea, leading to a multiplicity of understandings. Here is the Brundtland definition:

> 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. (WCED 1987)

This definition indicates *sustainable* and *sustainable development* are to be understood as a balance between the "needs of the present" and those of "future generations." What exactly is included under "needs," and when is a need satisfied? Management is left with the difficult problem of translating this idea into normative and precise guidance for an SMS.

Management Systems

The International Organization for Standardization (ISO) defines a management system as

> a set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives. (ISO 2016)

This underscores three key requirements for an SMS: first, the key internal and external stakeholders must collaborate (Disterheft et al. 2012). In higher education, these include academic faculty; administrative faculty; university staff; the student body; diverse community stakeholders, including alumni and parents; and state interests.

Second, an SMS runs on policies and objectives. To rationalize the use of resources, clear objectives, milestones, and strategy are needed (Ferreira et al. 2006). But most importantly, policies and objectives set direction for management. Change in many systems, including environmental management systems such as ISO 14001, is managed as continual improvement in a Plan-Do-Check-Act (PDCA) cycle (Asif et al. 2013; Nunhes et al. 2016; Domingues et al. 2016). First objectives and processes are established (P), the process is then implemented (D), then monitored and reported upon (C). Based on this, management takes action (A) to achieve continual improvement (ISO 2015).

Third, the ISO definition calls for "processes to achieve those objectives," so management must have a system to report on sustainability, to determine if the institution is meeting its declared goals, and to trigger corrective actions. Auditing is thus a key function performed within an SMS (Ferreira et al. 2006), and audits require sustainability indicators or metrics. The set of indicators identified for management tracking by an institution informs the design, development, and deployment of an SMS. Ideally, the "metrics should provide reliable, relevant, and useful information about one or several elements to be audited in the system" (Velazquez et al. 2006).

Sustainability Management Systems

There is a "plethora of management system standards and guidelines" that relate to sustainability (Gianni et al. 2017). The most relevant, certifiable management systems for sustainability include the Occupational Health and Safety Assessment Standard (OHSAS) 18001, ISO 9001 for quality management, and ISO 14001 as well as the Eco-Management and Audit Scheme (EMAS) for environmental management (Bernardo et al. 2015; Nunhes et al. 2016; Souza and Alves 2018; Asif et al. 2013; Domingues et al. 2016). Other systems include ISO 50001 for energy management, Social Accountability (SA) 8000 for labor conditions and AccountAbility's AA 1000 standard for sustainability accounting frameworks (Rebelo et al. 2016; Gianni et al. 2017). It has become obvious that organizations struggle with integration of these systems into one comprehensive sustainability management system (Souza and Alves 2018), and there is still no consensus what the term sustainability management system actually means (Esquer-Peralta et al. 2008). In the corporate world, which has a significantly broader application experience than higher education, the use of ISO 14001 and EMAS, as a basis for sustainability management, prevails.

ISO 14001 and EMAS

ISO 14001 and EMAS are both environmental management systems (EMS), meaning they are comprehensive, systematic action plans including sustainability assessment and certification. Organizations implement an EMS to support their environmental policies; the EMS affects the structure, planning, and resources of the organization. These two represent the most widely used systems for sustainability management (Esquer-Peralta et al. 2008). When they are extended to the full sustainability scope, they use selected reporting metrics, to allow tracking of sustainability goals deemed most relevant to the specific organization (Comoglio and Botta 2012; Azapagic 2003). While such implementations are by nature not standardized, standard sustainability reporting metrics such as the Global Reporting Initiative (GRI) can be used as a reference (Hřebíček et al. 2011).

ISO 14001, first published in 1996 and significantly revised in 2004 and 2015, provides process guidance within a framework of certifiable standards. This allows organizations to manage the environmental impact of their products, services, and operations (ISO 2015). It is the most widely used certifiable EMS today. As of 2016, the number of global certifications had reached almost 350,000 (ISO 2017).

EMAS, developed in 1993 by the European Union and revised in 2009 (European Parliament 2009), has similar objectives to ISO 14001 but establishes higher standards. It is more demanding with, for example, its requirement for a verified environmental declaration (Alshuwaikhat and Abubakar 2008), so its implementation rates have stalled. As of October 2016, only 3865 organizations in the EU had complied with the requirements of EMAS (UBA 2018).

Sustainability Indicators

Many indicators exist for multiple aspects of sustainability, from labor practices to energy consumption. Hák et al. (2016) find no "exhaustive account" of what they estimate as several thousand indicators in the literature. Yet without the right performance indicators, management lacks the information it needs to lead change. Performance indicators are also needed to identify improvement opportunities through comparison with a meaningful peer groups (Bennett et al. 2006).

A good starting point for selecting indicators is using current reporting tools and standards. Lozano (2006a) investigated some of the most commonly used, investigating, among others, the Global Reporting Initiative (GRI), ISO 14000, OECD Guidelines for Multinationals and Local Agenda 21. Lozano found that none consider all four of the core activities of higher education. Notably absent are education and research, but community outreach also warrants metrics unique to higher education. Still, Lozano concluded the GRI Sustainability Guidelines provided the best option available at that time.

GRI Sustainability Reporting Standards

The Global Reporting Initiative is an international independent standards organization that in 1999 introduced the GRI Sustainability Reporting Standard, or simply GRI. It is the most referenced system of sustainability indicators (Asif et al. 2013) and the "best known framework for voluntary reporting of environmental and social performance of business and other organizations worldwide," it aims to be a broadly accepted standard that replaces the multiple standards previously used (Brown et al. 2009). Designed along the lines of financial accounting standards to encourage widespread adoption, GRI engages a range of international organizations and stakeholders in the continual development of its standards (Levy et al. 2010).

GRI provides a sophisticated sustainability indicator catalogue for any organization contemplating an SMS. Its standards encompass general performance indicators, as well as the three dimensions of sustainable development – economic, environmental, and social. Under each are pertinent concerns, e.g., "materials" as an environmental or "employment" as a social sustainability concern. Under each concern are a number of individual indicators, with detailed and comprehensive guidance. This makes GRI an excellent source from which to derive SMS metrics.

GRI also provides specific guidance for selected sectors, but those do not include higher education (GRI 2018a). Even so, 58 universities issued a GRI report in 2016, out of 6870 organizations that have done this in the same year (GRI 2018b). This makes GRI the most widely used sustainability reporting standard.

To address GRI's lack of specific guidance for higher education, Lozano (2006a) proposes the "Graphical Assessment of Sustainability in Universities" (GASU). The GASU provides 11 additional SD indicators for education and 13 additional SD indicators for research. Survey findings show good alignment of these SD indicators with campus activities (Ceulemans et al. 2015b). So the GRI extension through GASU, into the areas of education and research, can provide a basis to establish SMS metrics for higher education.

Other Sustainability Reporting Standards

Since 2006, two relevant sustainability reporting standards have emerged: the Sustainable Development Goals (SDG) and ISO 26000. No study similar to Lozano's review has surfaced to evaluate the suitability of these standards for higher education, but both likely have roles to play.

In November 2010, ISO 26000 was published (ISO 2010), offering guidance on social responsibility to clarify the meaning of this concept to organizations. In this context, "social" denotes an organization's relationship to society understood in its broadest sense. ISO 26000 lists sustainability guidance for internal and external assessment of any organization. It can serve as a foundation, not only for institutions that have started on sustainability initiatives (Souza and Alves 2018). It offers a set of sustainability indicators similar to those in GRI (GRI 2011). In fact, GRI was involved from the start in ISO 26000 development and has published guidelines to help organizations relate GRI indicators to ISO 26000 clauses (GRI 2011). Institutions can use the ISO guidance as an alternative to GRI, in order to create their specific set of sustainability indicators for their SMS.

In September 2015, as part of the UN's wider 2030 Agenda for Sustainable Development, all 193 member countries agreed on 17 Sustainable Development Goals (SDG) (United Nations 2015). The aim in elaborating the SDG was to identify those indicators most relevant for future policies and to structure them into a system amenable to standardization (Hák et al. 2016). The indicators address all three dimensions of sustainability and show promise for SMS use. To date, no studies have been published on the adoption of the SDG by organizations; however, they have become a frequently used tool in initiatives in both higher education and business (Daimler 2016). The importance of the SDG for sustainability management will likely increase over the next decade.

In addition to these two standards, there are a number of national sustainability initiatives, many of which have parallels with GRI. One example is the German Code of Sustainability (DNK), which has also been adapted to the needs of higher education in a beta version (Zwick 2017). Due to local focus and unavailability in English, most of these national standards do not play a global role.

Materiality Analysis

Regardless of the indicators selected for an SMS, the concept of materiality, or material relevance, applies. The concept arose in accounting as the criteria by which decisions are made about what to include in financial reports, namely, that which "could make a major difference to an organization's performance" (AccountAbility et al. 2006), e.g., a pending liability or capital expense requirement. The concept today is widely accepted in sustainability management as a deliberate process that separates indicators of critical importance from those of minor weight (GRI 2017; Jones et al. 2016). Such thinking, or materiality analysis, is necessary so management can focus on those outcomes that make the biggest difference.

Whitehead (2017) states that GRI provides the best guidance on conducting sustainability materiality analysis across the value chain. GRI specifies materiality as that which reflects "the reporting organization's significant economic, environmental, and social impacts; or substantively influences the assessments and decisions of stakeholders" (GRI and GSSB 2016). The result of materiality analysis is an organization-specific list of issues defining the focus of sustainability management in that organization. Materiality analysis works for any organization, provided the analysis reflects the interests of all key stakeholders (GRI 2017).

Summarizing the line of thought in section "Sustainability Management Systems," we may say a framework for a sustainability management system uses established environmental management systems, such as ISO 14001 or EMAS, as a basis. The tracking signals for the broader sustainability perspective can be derived from dedicated sustainability reporting standards, such as GRI, together with the GASU indicators for education and research. Conducting a materiality analysis specific to the organization then provides the short list of the indicators to manage through the SMS.

Higher Education

The standards discussed in section "Management Systems" were developed with companies and corporate SMS needs in mind. Reasonable overlap exists in the indicators used to track SD efforts. But the four core activities of higher education – education, research, operations, and outreach – establish objectives for an SMS in higher education different from those in business.

The World Declaration on Higher Education defines higher education to include:

> all types of studies, training or training for research at the post-secondary level, provided by universities or other educational establishments that are approved as institutions of higher education by the competent State authorities. (WCHE 1998)

Implicit here is recognition of universities as complex systems, each distinctive in its way (Mora and Martin 1998; Disterheft et al. 2012). Alshuwaikhat and Abubakar (2008) compare universities to small cities due to their size, population, and the diverse activities they are home to. In contrast, businesses have "greater functional simplicity," which impacts decision-making. While most businesses work in well-defined hierarchical structures, universities are more democratic (Mora and Martin 1998). Moreover, university leadership in many countries is shared between senior academic and senior administrative ranks. An SMS for higher education must support the needs of both.

But the greatest difference between corporate and educational SMS objectives comes from the fact that the direct sustainability impact of university operations is relatively small (Mora and Martin 1998). So of the four core activities, the one activity shared in common with corporations – operations – is the least significant for an educational organization.

The largest impact of universities comes from the indirect benefits of the other three core activities – education, research, and outreach (Clarke and Kouri 2009). Providing sustainability education to students, contributing to sustainability research and supporting community needs comprise the key contributions an educational institution makes to society's sustainable development (Alshuwaikhat and Abubakar 2008). Managing these aspects becomes the central function of an SMS for higher education (Mora and Martin 1998).

This is particularly true given that businesses mostly implement an SMS to meet regulatory requirements or to support marketing strategies. Educational institutions work from more diverse motives, often implementing an SMS from the broader perspectives (Clarke and Kouri 2009).

Sustainability Management Systems in Higher Education

Because of its special role, higher education has more complex requirements regarding sustainability management systems. A good basis, and typical starting point, is the introduction of an EMS.

The Role of EMS in Higher Education

It bears reiterating that higher education faces unique management challenges because the three sustainability areas – environmental, economic, and social – intersect with the four core activities of education, research, operations, and community outreach. As discussed in section "Framework for Managing Sustainability," only in operations do corporate and educational sustainability objectives overlap. In addition, universities are multipliers of sustainable development, with a societal impact that is presumably higher than the impact of any other single sector of society, due to their strong community interaction and the education of the next generation of leaders (Disterheft et al. 2013; Cortese 2003; Lozano 2006b). Ideally, the objectives embedded in an SMS for higher education would reflect that.

Still, Lozano et al. (2016) emphasize that sustainability reporting can be key driver for change in any organization, as solutions have to be found to assessment and reporting that require senior-level decisions. Thus an EMS approach can serve to drive continual improvement, which in turn may support the broader objectives of an institution's sustainability management plan. In fact, case studies show that while implementing an EMS in a democratic institution takes more time and effort than in a corporation, it is also the best approach for "conscientious changes in individual behavior" (Ferreira et al. 2006).

Other authors see EMS as a proven approach to managing the environmental impact of campus operations because it provides the structure and resources for implementation of an environmental policy (Ferreira et al. 2006; Alshuwaikhat and Abubakar 2008; Barnes and Jerman 2002; Price 2005). The stakeholder engagement elements in the EMS provide clarity and opportunities for involvement by students, staff, and faculty across an institution (Ferreira et al. 2006). An ISO 14001-based EMS has even served as the "key structure for the integration of sustainable development in all activities" at Gävle University (Sammalisto et al. 2015).

But debate about whether an ISO 14001-based EMS fits the needs of higher education does exist. Some in academe have called for a dedicated EMS model to address the special role of education in society (Savely et al. 2007; Viebahn 2002). Others have emphasized the lack of support for social or economic objectives in an EMS (Alshuwaikhat and Abubakar 2008). This has led some institutions to seek specially designed SMS approaches.

SMS Approaches Designed for Higher Education

The most frequently mentioned approaches to sustainability assessment and management for higher education include (Clarke and Kouri 2009; Amaral et al. 2015):

- The Auditing Instrument for Sustainability in Higher Education (AISHE) (Lambrechts and Ceulemans 2013; Roorda et al. 2009.
- An empirically developed managerial model for a sustainable university (Velazquez et al. 2006.
- The Environmental Management System Implementation Model for US Colleges and Universities (Savely et al. 2007.
- The Campus Sustainability Model (Alshuwaikhat and Abubakar 2008)
- The Osnabrück Model (Viebahn 2002)

Overall, these provide valuable guidance for planning, but none meet the comprehensive requirements of sustainability management systems. Two of them are not even management systems: AISHE is a dedicated auditing instrument that may provide guidance in identifying the SMS scope, while the EMS implementation model of Savely et al. focuses on the process of implementing an ISO 14001-based EMS. The "Osnabrück model" is a management approach, but it does not cover all key aspects of sustainability management systems. Savely et al. (2007), for example, demonstrate that it lacks coverage for 6 out of 16 key requirements in the EMS-standard ISO 14001. In addition, the "Osnabrück model" addresses only environmental sustainability.

The Campus Sustainability model by Alshuwaikhat and Abubakar (2008) and the model developed by Velazquez et al. (2006) address all sustainability dimensions, and they also include the core institutional activities of education and research. This makes them very relevant approaches for an SMS in the literature. However, a workable management system requires clear process guidance and an approach that can be replicated independently of individual actors, as is provided by ISO 14001 (ISO 2015). These two models do provide valuable high-level frameworks, but they do not provide guidance on implementation or on certification, both key requirements for an SMS.

Compared to the well-documented use of ISO 14001 and EMAS in higher education, there is little to no evidence in the literature that any of these alternative approaches are used outside the domain of the inventing institution. So while a dedicated EMS for higher education could provide additional value, the proposed methods have not been adopted nor has a viable standard emerged. As 5 years have gone by since research was last published, it appears the educational community has settled on ISO 14001 and EMAS, regardless of their deficiencies.

Peer Practices

Compared to other public service organizations, educational institutions are more advanced in implementing sustainability reporting (Domingues et al. 2017). However, within academe, wide degrees of differentiation exist.

Disterheft et al. (2012) state that implementing an EMS can be seen as "a sign of the institution's orientation towards incorporating sustainability at an advanced level." That is, the authors see implementing EMS as a sign of institutional maturity. This view finds justification in the fact that relatively few educational institutions even take a systematic approach to making their campuses more sustainable (Alshuwaikhat and Abubakar 2008). Disterheft et al. further observed a rise in the numbers of EMS implementations, with 47 in 2012 just among European institutions. Of these, 81% used a formal, certifiable EMS (EMAS or ISO 14001); interestingly, it was mainly smaller institutions of less than 10,000 students that used the premium EMAS instrument. ISO 14001 was distributed equally across all institutional sizes.

Patterns worldwide may differ. Clarke and Kouri (2009) found Canadian and New Zealand universities primarily pursue nonformal EMS and do not seek certification.

Performance Impact of an SMS

The key objective of an EMS or an SMS is to increase the sustainability performance of an institution (Bennett et al. 2006). Operational benefits include reductions in resource consumption and costs; community outreach benefits include increased goodwill and acceptance (Nunhes et al. 2016). Both benefits imply significant improvements in sustainability performance, but is there evidence management of sustainability actually leads to improvement?

Gianni et al. (2017) observe a "decoupling" of sustainability performance measurement and reporting from sustainability management. This would imply a break in the Plan-Do-Check-Act (PDCA) cycle discussed in section "Management Systems." It makes little sense to collect data that decision-makers cannot use, yet that is what happens when measurement and management – C and A – are decoupled.

There are few studies documenting the impact of sustainability management systems on performance (Nunhes et al. 2016). However, an investigation in the English university sector showed that initiatives to improve environmental performance had little impact (Bennett et al. 2006). A decade of practice has passed since then, but the results do make us ask what factors lead to a successful SMS implementation.

SMS Success Factors

Implementation of an SMS only makes sense as part of a drive toward sustainable development. Any such drive needs direction, i.e., goals. This means not only should a university articulate clear objectives but senior leadership must also support pursuit of those objectives (Alshuwaikhat and Abubakar 2008; Lozano-García et al. 2009; Price 2005). This fact is made cogent by a recent survey showing that the lack of suitable support from university leadership remains the top implementation barrier to sustainable initiatives (Domingues et al. 2017).

This lack of support cannot be taken as a lack of ambition. Wright and Horst (2013) surveyed 32 faculty leaders of different Canadian universities and found they all wanted to incorporate sustainability in education, research, and operations. But for most of them, their ambition remains a nebulous desire, lacking the specifics that are required to implement a viable SMS.

Developing sustainability objectives through the thinking described in section "Sustainability Management Systems" implies a readiness from senior management to invest the time and effort needed to develop a workable sustainability plan. Implementing that plan further requires university leadership establish a suitable structure for their SMS, be it a department or a committee, and provide the resources needed for management of the initiatives in the plan (Alshuwaikhat and Abubakar 2008).

A successful SMS will engage all stakeholders. Indeed, lack of awareness across groups, from students to faculty, is often reported as a reason for failure (Disterheft et al. 2012). Communication among stakeholders is critical (Müller-Christ et al. 2014), especially if the SMS is meant to include core activities beyond operations. The silo mentality prevalent in academe can only be overcome by a collaboration of the stakeholders in sustainability initiatives (Lozano-García et al. 2009).

SMS Beyond Campus Operations

It is easy to be swept up in the stream of corporate SMS initiatives with well-developed metrics and reporting standards, but lose sight of the fact that managing campus operations is the low-hanging fruit for an SMS in higher education. As mentioned in section "The Role of EMS in Higher Education," the challenge is developing SMS approaches for the most meaningful core activities of higher education – education, research, and community outreach.

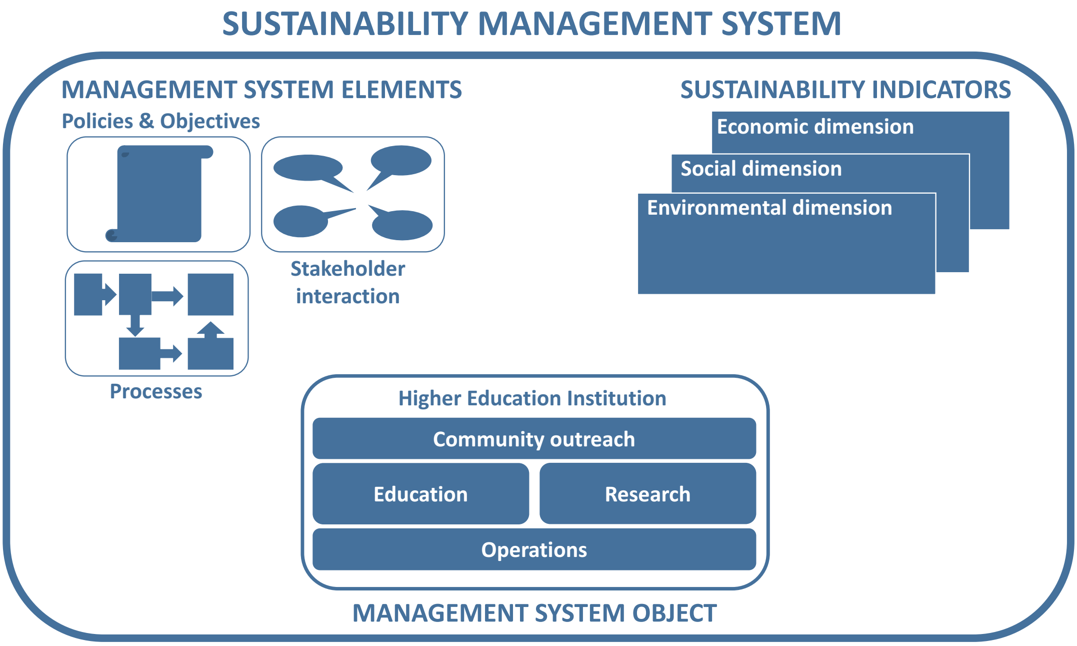
The number of institutions using a formal SMS or EMS is comparatively low. The number of institutions that link their formal EMS – based on ISO 14001 or EMAS – to curriculum aspects is even lower (Clarke and Kouri 2009). Disterheft et al. (2012) found that in a survey uncovering only 35 universities using EMS, less than 1/3 of these (11) included educational aspects.

Campus EMS can be the foundation on which a more comprehensive SMS is built. This would allow higher education to expand its sustainability concerns from own campus operations to researching those new approaches and methods needed to make society sustainable (Alshuwaikhat and Abubakar 2008; Disterheft et al. 2012).

Sustainability management, to the extent it is established, has been the almost exclusive concern of corporations, which rightly focus on minimizing the negative impact of their activities on the environment. However, for educational leaders to limit themselves to this concept of sustainability management would be short sighted. Sustainability management is an area of practice, but it is also an area meriting serious research and an important topic in education for sustainability. Conceived of in an academic context, a comprehensive SMS has 12 dimensions, as Fig. 1 demonstrates: environmental, economic, and social sustainability objectives pursued across the activities of education, research, operations, and outreach.

SMS in Higher Education 2018

The common systems for sustainability management in educational institutions are largely the same as those used in corporations, typically the formal management system standards ISO 14001 and EMAS, often limited to the environmental dimension. SMS approaches tailored to the needs of higher education have not yet gained



Sustainability Management System, Fig. 1 Sustainability management systems in higher education institutions

traction outside the individual institutions where they were spawned. Yet the need exists for an SMS approach that goes beyond campus operations to include the core educational activities of teaching, research, and community outreach. Faculty, students, and community working together to meet the emerging sustainability management challenges will open opportunities for new ways of learning, enabling those changes in attitude and behavior the world needs to find its way to a sustainable future.

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Sustainability Mindset

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Definition

The sustainability mindset is a way of thinking and being that results from a broad understanding of the ecosystem's manifestations as well as an introspective focus on one's personal values and higher self and finds its expression in actions for the greater good of the whole (Kassel et al. 2015).

Origins of the Concept

When analyzing the global unsustainability, a trend of increasing awareness is observed at the individual, corporate, and political levels across the globe. While the environmental movement was launched in the 1960s, it has taken several decades to expand into public awareness. The rate of understanding accelerated since the early 2000, triggered by literacy about global warming and its impact on climate (IPCC (Intergovernmental Panel on Climate Change) 2007; Hansen 2010; Di Caprio 2016; Gore 2006, 2017), which reached the public. This has been accompanied by a progressive understanding of the social and economic effects of climate-related events, at the individual, business, and nation level. In the corporate arena, initiatives like the World Business Council for Sustainable Development, the Principles for Responsible Investment, or the Global Compact have influenced the sense of corporate social and environmental responsibility. Mandated or voluntary reporting also has led to the development of new business practices that went beyond climate action, further supported by the frame of the Sustainable Development Goals launched in September 2015 at the UN Headquarters and signed by 193 member states. Public environmental literacy combined with increased transparency through social media has developed new customer expectations around products and corporate or government behaviors. Education stepped in with initiatives promoting sustainability in a broad sense, from K-12, to higher education and business schools (PRME; Unitar).

The expanding scope of all these sustainability initiatives is revolving around the visible and external planetary challenges. The common aim is to address the social and environmental issues, minimizing or transforming them into new opportunities, through research, technological innovation, and regulations.

Several scholars note that the visible aspects of our collective and planetary unsustainability actually originate in the less visible aspects of our behaviors (Orr 2004; Sterling 2003, 2011; Rimanoczy 2017; Ulluwishewa 2016, 2017). Some visionaries early on pointed to the role that values and beliefs play as the root of our globally problematic behaviors (Carson 1962, 2002; Meadows et al. 1972; Laszlo 1989; Evernden 1993). This perspective has later been picked up by scholars researching sustainability behaviors, who explored the links between unsustainable behaviors, socially accepted values and habits of mind, and social or environmental problems resulting from those behaviors (Post and Altman 1994; Speth 2008; Korten 2015; Raskin 2016). One of the first studies seeking to understand the information and motivations behind behaviors that are not "business as usual" is dated 2010 and concentrated on business leaders championing sustainability initiatives in their organizations without being asked to do so (Rimanoczy 2010). The research started with the observable "sustainability in action" and traced back the thoughts and values that were at the foundation of the behaviors. The aim of Rimanoczy's exploratory research was pragmatic: to identify aspects that could be developed intentionally, in order to shape a new generation of more responsible leaders. The findings of the study fell into the categories of *thinking* and *being* and included specific contents (i.e., ecoliteracy, values, and shared assumptions of our culture) and specific processes (i.e., systems thinking, creative processes, and introspective practices for self-awareness). The compound of elements that characterized a different way of analyzing data, making meaning, and making decisions was thereafter called the "sustainability mindset."

Precursors of the Sustainability Mindset

As a precursor of the sustainability mindset, Adams (2004, 2008) studied the values and behavioral patterns of leaders in organizational settings and created a table of polarities on a continuum that covered ways of thinking within six dimensions: time orientation (short term to long term), focus of response (reactive to creative), scope of attention (local to global), prevailing logic (either/or to both/and), problem consideration (accountability and blame to learning), and life orientation (doing and having, to being). These "ways of thinking" correspond to the mental models that shape behaviors and highlight key aspects of a sustainability mindset. While the classification of aspects into dimensions is novel, the literature shows numerous scholars referring in a way to these different aspects in their studies. So for time orientation (short- and long-term thinking), see, for example, Rogers (1994), Capra (1997), Senge et al. (2005), and Wirtenberg et al. (2008); for focus of response (reactive learning), see Dewey (1938), Kurt (1951), Kolb (1984), Deakins Freel (1998), and Mezirow (2000); for creative thinking, see Antonites (2004) but also vast literature on innovation and design thinking; for scope of attention, see literature on systems thinking; for prevailing logic, see Rogers (1994) and Daloz et al. (1996); for problem consideration, see literature related to self-awareness and emotional intelligence; for life orientation (dichotomy of having/doing versus being), see vast literature related to transformational learning, spiritual intelligence, emotional intelligence, and presencing. The idea of organizing the dimensions that form a mental model can be linked to the literature on paradigms (introduced by Kuhn 1962, 2012) and mind maps/mental models (Freire 1973; Johnson-Laird 1980; Wilson and Rutherford 1989; Senge 1992).

Time orientation: When decisions are made following the short-term value and without attending to the long-term impacts, we have resource depletion, inequity, pollution, greenhouse gases contributing to climate change, health implications, social unrest, crime increase, etc. The mindset for sustainability calls for attending to the short-term (urgency, immediate needs) and to the long-term impacts of a decision.

Focus of response: When we respond to situations in an automated way, following rules because "it has always been done like this," or reacting quickly without pausing to think what could be done differently or better, we stagnate in the current problems accepting the status quo, and we remain victims without agency. Scharmer referred to this process as "downloading" (2009). We give away our power to shape the world we want. When developing a mindset for sustainability, educators seek to foster awareness of the automated, reactive behaviors and promote the exploration of creative and innovative alternatives.

Scope of attention: When we confine our attention to our innermost circle, we protect ourselves but miss the interconnections that are linking us to wider circles. We are blind to the multiple stakeholders that are impacted by our decisions and who in turn are already impacting us. Freeman drew the attention to the importance of recognizing the stakeholders (1994), and this has been expanded since to include stakeholders like nature or the next generations (Zsolnai 2006). Thus, the sustainability mindset calls for an expansion of our scope of attention and care, by identifying the various stakeholders that may be impacted by our actions. This awareness exercise can develop a new lens through which individuals can analyze new situations and pay attention to the (unintended) consequences of their decisions.

Prevailing logic: The "either/or" logic fragments the natural complexity of a challenge and leads to simplistic solutions that create a zero-sum, with some stakeholders winning and others losing. This is never without consequences. For example, "either planet or profit" has proven to be a fallacy, because we depend on the services of nature (air, water, energy, soil, natural resources) for any human activity, including profit-delivering activities (Wirtenberg

2014). When our actions compromise the health of the ecosystem, i.e., pollution of water, loss of soil, contamination of air, and use of fertilizers and pesticides impacting the food chain and human health, it becomes clear that without a (healthy) planet, there is no profit. The “both-and” logic fosters creativity and innovation to develop solutions that can accommodate all stakeholders’ needs (Rimanoczy 2010, 2014).

Problem consideration: Blaming others is an expression of poor self-awareness and makes us miss the understanding of how we are contributing to the problems (Senge 1990; Gray and Williams 2011; Scharmer 2009). As a result, we do not learn from what happened and are deemed to repeat the unfit responses, and we do not evolve to higher levels of understanding.

Life orientation: Our consumer society is designed toward having and doing, with neglect of the spiritual dimensions, through the promotion of a consumer culture, defined as the “interconnected system of commercially produced images, texts, and objects that groups use [. . .] to make collective sense of their environments and to orient their members’ experiences and lives” (Kozinets 2001). Stress (Baker et al. 2013; Ruvio et al. 2014), anxiety, health problems (Burroughs and Rindfleisch 2002), and depression (Mueller et al. 2011) are some of the aspects linked to consumption and to life orientation that prioritizes materialistic goals and achievement. The impacts of materialistic goals are furthermore seen in the environmental and social consequences of globalized consumerism (Nair 2011).

Becoming aware of the unconscious drivers of our actions begins with the exercise of identifying the thoughts and values that are being manifested in our behaviors and decisions, something that is a cornerstone of self-awareness and psychotherapy. Likewise, the sustainability mindset calls for an introspective look at the reasons of our choices and draws attention to the gap between our espoused values and the values in action (Argyris 1987).

All these aspects are included in the definition of the sustainability mindset: a way of thinking and being that results from a broad understanding of the ecosystem’s manifestations as well as an introspective focus on one’s personal values and higher self, which finds its expression in actions for the greater good of the whole (Kassel et al. 2015). “Broad understanding of the ecosystem’s manifestations” refers to recognizing how all parts of our ecosystem are connected and the impact of human behaviors as we are contributing to the problems we experience. “Introspective focus on the personal values” refers to developing self-awareness of our values, beliefs, and assumptions and how the values are reflected in our behaviors. The “higher self” refers to questions like what is my purpose, why am I doing, and what I am doing, which create moments of profound authenticity and consciousness that become transformational. “Actions for the greater good of the whole” refers to the manifestation of the mindset through decisions or initiatives that are for the collective benefit (Mackey and Sisodia 2014; Porter and Kramer 2011).

Elements and Content Areas of a Sustainability Mindset

Adams’ classification has been partially validated, adapted, and expanded in further research. Rimanoczy (2010) adapted the classification for her exploratory study on motivations and thinking patterns of leaders championing sustainability initiatives. In this study she identified the following elements for a sustainability mindset (Table 1):

In order to identify learning objectives and exercises/activities to meet those goals, the elements of the sustainability mindset were organized into four content areas (see Fig. 1). Each content area includes the learning goals that aim to be achieved for a sustainability mindset.

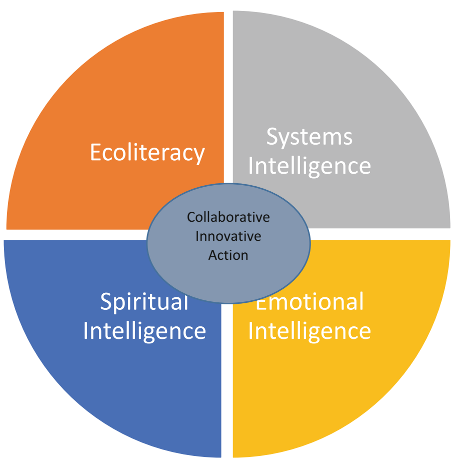
Within the area of systems intelligence, individuals with a sustainability mindset are noted for processing information with an inclusive, both-and logic; solutions have to be created considering the long-term and multi-stakeholders perspectives, understanding the importance of the systemic interconnections.

In the content area of ecoliteracy, understanding the current challenges at the environmental and social level becomes the gateway to exploring the impact of our behaviors and way of life on others and on the world. This content area is closely linked to the emotional intelligence, where

Sustainability Mindset, Table 1 Elements of the sustainability mindset

The thinking	
Systemic	Both-and logic
	Interconnectedness
	Cyclical flow
	Long-term perspective
Innovative	Right brain perspective (holistic, intuitive)
	Creative, imaginative, versatile, flexible
Basic ecoliteracy	Broad understanding of the planetary challenges
The being	
Oneness with nature	
Introspective, self-awareness	
Mindfulness, consciousness	
Reflective	
Larger purpose	
Collaboration	

Adapted from Rimanoczy (2010), Unpublished dissertation, Teachers College



Sustainability Mindset, Fig. 1 Content areas of the sustainability mindset

reflection and introspection help explore what the personal contributions are to the problems. By doing so, individuals are led to identify what values our decisions are depicting and how they match (or diverge from) the values we declare as important. The tacit assumptions and beliefs are uncovered, recognized as socially accepted aspects of our identity, and also awareness is drawn to how certain beliefs or values, such as the value of growth, achievement, competition, speed, etc., become precisely anchors of our collective unsustainability.

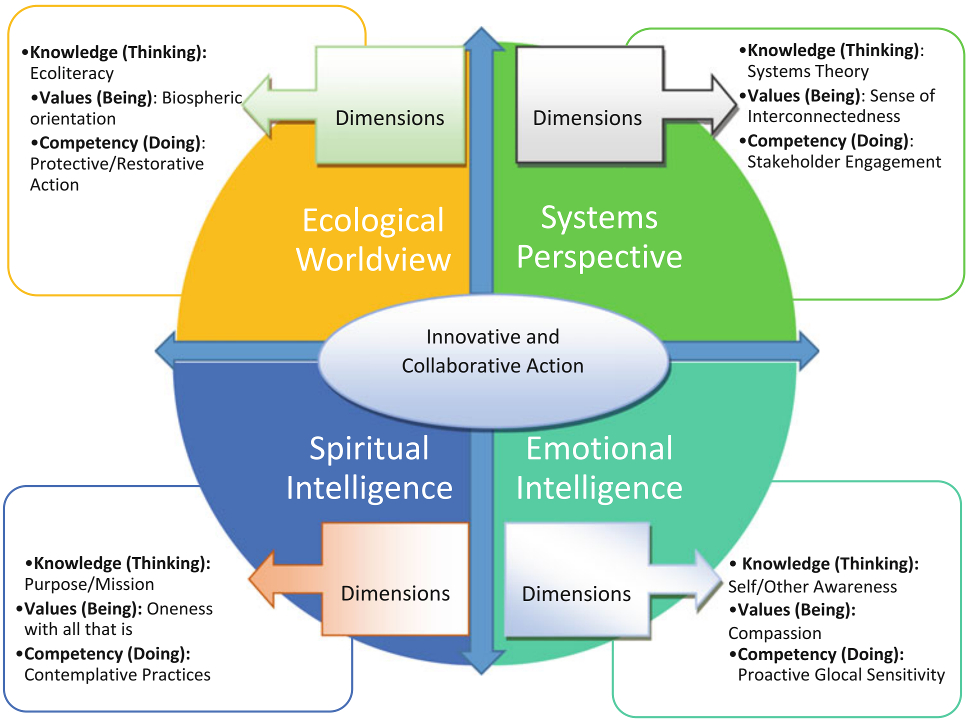
The content area of spiritual intelligence drives questions that explore the purpose, the identification with our higher self, the sense of oneness with all that is, and the difference we want to make in the world. Finally, the four content areas come together in collaborative, innovative projects that are the arena for learning and also become the "sustainability mindset in action."

Later, seeking to develop a sustainability mindset model, Kassel et al. (2016) conducted an extensive literature review, identifying several authors who found behaviors, knowledge, and attitudes related to CSR and sustainability. This pointed at the connection between a particular way of thinking, being, and doing. Fang et al. (2004) call it cognitive, affective, and behavioral aspects; Story et al. (2014) describe the cognitive, metacognitive, and motivational aspects; Sterling (2011) writes about the head, soul, and heart; for Scharmer and Kaufer (2013), it is the head, heart, and hands. These scholars incorporate different contents, also found in Rimanoczy's (2010) study: systems thinking; moral, ethics, and values; collaboration and team projects; self-awareness and introspective practices; and altruism, sense of purpose, and spiritual motivations.

Seeking a model that could act as a guide for creating a syllabus to develop the sustainability mindset, Kassel, Rimanoczy, and Mitchell linked Adam's framework of mental models for sustainability with the literature review and the findings of a 2010 study (Rimanoczy 2010, 2014) (Fig. 2).

Interrelations of the Content Areas

The content areas are not related in linear ways, but rather connected via circular and cyclical paths. The cycle of developing a sustainability mindset can start at any place within these areas. Receiving information about a social or environmental event can trigger an emotional reaction, which can trigger the desire to act. It may be fueled by the realization that we are indirectly or unknowingly contributing



Sustainability Mindset, Fig. 2 Sustainability mindset model (Kassel et al. 2018)

to the problems, which connects with deeper self-awareness, with scrutiny of our values in action and of our socially accepted habits of consumption (Goleman 2009; Ketola 2008). This awareness unleashes feelings of guilt, responsibility, and sadness, all common triggers of engagement in action (Rimanoczy 2014). The lack of ready-made solutions fosters creative thinking and innovation (Mitchell 2012), while the complexity and size of the challenges awaken the desire to share with others, prompting collaborative action (Scharmer and Kaufer 2013; Senge 2008). The dramatic tone of the planetary events moves individuals to review their priorities and "what really matters" to them, connecting with questions of purpose, calling, mission, the difference we want to make, and other aspects related with spirituality and our higher self (Delbecq 2008; Eisenstein 2013; Neal 2008).

For the purpose of development of a sustainability mindset, the elements within the content areas are organized into the categories of thinking/knowledge, being/values, and doing/competencies (Kassel et al. 2018) (see Table 2). This organization, together with connecting the elements with specific and clearly stated learning outcomes, allows professors and leadership development professionals and coaches to design exercises and modules to develop a new mindset that can drive us into a more sustainable planet.

Final Remarks

A mindset is an implicit worldview based on assumptions that are rarely made explicit, but shape our interpretations, decisions, and actions. The sustainability mindset is a new lens through which we can look into the world, analyze and interpret what we see, and make decisions that are considering multiple stakeholders, including nature and the next generations. It includes cognitive aspects, like the knowledge of the ecosystem's functioning and systemic thinking processes; it includes self-awareness by realizing the tacit anchors of our identity, and it includes a spiritual dimension, through the exploration of our deep held values and life purpose.

Sustainability Mindset, Table 2 Dimensions, content areas, and themes

	Dimensions		
Content areas	Knowledge (knowing, thinking)	Values (being)	Competencies (doing)
Ecological worldview	Ecoliteracy	Biospheric	Protective/restorative action
Systemic perspective	Systems theory	Sense of interconnectedness	Stakeholder engagement
Emotional intelligence	Self/other awareness	Compassion	Proactive global sensitivity
Spiritual intelligence	Purpose, mission	Oneness with all that is	Contemplative practices

Kassel et al. Courtesy of Routledge Taylor & Francis Group, 2018

Educators from around the world have joined a PRME (Principles for Responsible Management Education) Working Group on the Sustainability Mindset, to learn how to embed aspects of the mindset for sustainability into their courses, exchange activities and resources, and collaborate (www.unprme.org).

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Sustainability on Campus

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Definition

Sustainability on campus means how universities apply sustainable principles in all their activities and resources management.

Introduction

According to Halac et al. (2015, 2316), promoting sustainable development implies a applying a series of proactive oriented actions. This is especially valid for universities as they are considered institutions where knowledge is cultivated. As a result, critical thinking and social consciousness can impact of the decision making process in the entire society. Based on this premise, the Latin American network UNSUS was created. It formed a University Sustainable Program, directed by the National University of Córdoba, Argentina, whose main goal is creating mutual interest alliances between institutions in Argentina, Brazil, and Mexico. Such alternative initiatives that seek to promote sustainability and education, which have already been implemented in several university settings, include discussing ways to effectively include sustainable construction projects which are based on holistic planning of university facilities.

Lozano García et al. (2006, 760) comment that academic leaderships should be used of systemic approaches, participatory commitment, and preventive principles as part of a long-term vision necessary to reach a transgenerational sustainable development level.

Based on University of Salamanca's proposal for Campus Villamayor in 2005, Campos Calvo-Sotelo (2009, 2010) attempts to apply the concepts of what is called "a didactic campus," and he presents the following ten points to be considered: (1) utopia and integral planning, (2) learning and research community, (3) spatial harmony, (4) effective intellectual envelope, (5) nature and art, (6) imagery and accessibility, (7) adaptation of a sustainable environment, (8) memory and vanguard, (9) university-city partnership, and (10) innovative teaching-learning modalities.

It is relevant to mention that item 7, presented above (2010, 2), deals specifically with the environmental aspects of urban and architectural planning. It proposes that universities should guarantee harmony between geographical environment and climatic conditions. In addition, it should be a role model of biodiversity and sustainability (for sustainable construction, renewable energy use, etc.).

In order to propose guidance for universities of the twenty-first century, Coulson et al. (2011, 235–241) have established guidelines with three major components: landscape, buildings, and circulation. They underline the importance for each university to be shaped by a customized master plan, based on institutional strategy, leadership, and commitment, a plan that reflects their own circumstances and coordinates their own physical structure and institutional strategy.

Hoeger and Christiaanse (2007) state that a perspective for transforming the university in current and future times must, without exception, feed the "dynamic synergy." It is needed to create sustainable centers for knowledge and learning which are innovation incubators. They can respond in a flexible manner to the rapid changes in the demands of the so-called knowledge society (Hoeger 2007, 13), by adding to the university or academic campuses and corporate campuses of science and technology.

Energy is essential for the organization of sustainability efforts in the university campus. For Tomashow (2014, 11–12), the issues related to the use and management of energy activities become part of "the nine elements of a sustainable campus," along with food, material flows, governance, investments, welfare, curricula, interpretation, and aesthetics, provided they are considered more than the building supply, as a direct connection between the campus and the biosphere. According to the author, these elements inform the community decisions and, with their integrated implementation, promote leadership effective results. It encourages campus transformation, its agents, and the community to which the university has the role of supporting the sustainable ethos. In addition, the campus serves as a favorable environment for a new way of thinking about higher education.

Energy consumption can be reduced more efficiently and effectively when supported by changes in the human scale. According to Tomashow (2014, 31), energy consumption behaviors are more likely to change when there is adequate infrastructure that affects and influences user behavior: students, teachers, administrative staff, managers, and the external community.

It is in this way that different universities discuss, propose, and evaluate their effective practices. Three examples showing the application of sustainable universities and their concepts are presented below, based on a concrete experience criterion, constituted by technical visits or doctoral studies at the Polytechnic University of Catalonia – UPC (Frandoloso 2017). These examples, although very specific, still indicate common and previously implemented guidelines that can serve as direction to address future questions.

The Hague University of Applied Sciences: The Netherlands

An example of this new perspective is the experience of Hague University. Such experience has contributed for the planning and development of the new School of Engineering in the Campus of Delft in Holland (Fig. 1). The main challenge has been to obtain favorable and sustainable results, both in education and energy efficiency, so that the building could be considered a concrete example for students, researchers, and all its users. It serves as a model of the different achievable possibilities for high architectural quality and eco-efficiency performance.

These conditions are also applicable to a scientific environment. Both Delft University of Technology (TUDelft) and Delft Technopolis, located on the 910,000 m^2 campus, are examples, considered by Hoeger and Christiaanse (2007, 238–241), as a university for the twenty-first century, where technology, innovation, education, research, and its social applications converge. It is relevant to mention that the campus follows the Mecanoo Master Plan from 2002, whose main objective was to intensify connections and promote cooperation between their different spaces and activities.

The project has been developed by the DWA from a methodology (van Den Dool 2010) structured in three stages: program development (1d), design (2d), and construction (3d) – Fig. 2. At stage 1d, one of the goals has been to choose the essential criteria to determine project priorities, by using metaphors, that is, choosing an image and a symbolic character for the building. The established criteria include educational purposes, sustainability, flexibility, image and identity, charisma, investments, and the building's life cycle. In stage 2d, the priority has been to reflect upon the project and to search for innovation through a solid and integrated design. In the last stage, in order to complete the previous stages, the goal has been to integrate all involved agents and to "experience for the experiment."

The basic criteria in which the project was developed included excellence of educational processes. It also proposed for the building to be a source of inspiration for engineering students in teaching and in research. As one of the main goals of a university, it intends to prepare its users for their professional lives. The university environment, besides being inspiring and attractive, should allow and promote the teaching of educational practices, by transforming spaces into

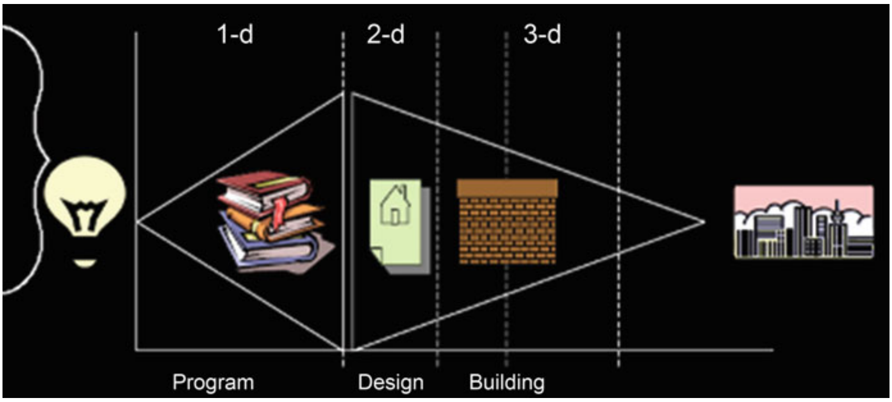
Sustainability on Campus, Fig. 1 Hague University's Engineering School. DWA 2009. (Photograph from author, 2010)

strategies for learning and controlling energy systems and thermal conditioning not to be reactive but predictive. Most importantly, it should maintain its membership in generating knowledge.

Faculty of Health, Psychology, and Social Care: Manchester Metropolitan University, England

Another concrete example is seen at Manchester Metropolitan University's (MMU) new campus. As an extension of its All Saints campus, it hosts the College of Education and the College of Health, Psychology, and Social Care, in addition to the Energy Center (Birley Building) – Fig. 3. "An innovative learning environment with benefits and opportunities for a multi-professional collaboration" was proposed (MMU 2014a). Its design is community oriented in order to provide services to students, technical, and teaching staff and to the surrounding neighborhood as well.

In terms of environmental sustainability, the building integrates general principles of the Environmental Sustainability Policy, approved in February 2014, by the Environmental Strategy Board (MMU 2014b). It aims, specifically and ambitiously, toward a "Zero Carbon, Zero



Sustainability on Campus, Fig. 2 Hague University's Engineering School methodology design. DWA, 2009 (Van Den Dool 2010)

Sustainability on Campus, Fig. 3 Birley Building MMU – Sheppard Robson/Capita Arch. (2012–2014), and sustainability strategies. (Photographs from author, 2014)

Waste, Zero Water" and a maximum biodiversity strategy. As a result, this initiative has receive the BREEAM Excellent certification and Energy Performance Rating "B" (MMU 2014c). It is the result of adopting integrated strategies such as natural cross ventilation and ventilated facades, low-energy LED lighting (adjustable to automatic system needs), CHP systems (combined heat and power), systems for rainwater use, green spaces, landscaping planning, etc.

Polytechnic University of Catalonia: Spain

In order to comply with the European requirements and regulations, the Polytechnic University of Catalonia (UPC) in Spain develops instruments, since 1995, to apply environmental criteria in order to develop sustainable education. Based on this perspective, the Polytechnic University of Catalonia proposed a methodology to define guidelines to manage and qualify its physical structures, both for new campuses and existing buildings (UPC 1995). Their results have been consolidated in the institutions' environmental plans (1996/2001, 2002/2005, 2006/2015).

In its declaration of sustainability (UPC 1997), the UPC was committed to promote professional awareness toward social and environmental responsibility of their activities. It sought to promote specific research venues to generate technical and conceptual tools that could adapt a productive model toward sustainability. In addition, it sought to apply sustainability criteria in their institutional and management activity. It wished "to promote regular follow-up and render accounts, in order to make their commitment explicit and aligned to a coherent and visible action that reinforces and practices a new culture of sustainability."

After the approval of the Sustainable UPC 2015 Plan (UPC 2006), the UPC finds it necessary to adapt its institution based on the Kyoto Protocol. The plan presents actions from 2006 to 2015. Based on previous plans' evaluations, it aims to create a university that participates and commits itself to the challenges of sustainability in its local, regional, and international environment. For this reason, it has been granted a longer period for concrete project changes to be implemented, visualized, and evaluated.

In order to operationalize these objectives, the UPC Sustainable 2015 Plan (UPC 2006) has established five thematic groups:

- Building, energy, and climate change
- Management of integrated water cycle
- Social technology responsibility
- Territory, mobility, and logistics
- Material cycles, eco-design, and waste

These issues were addressed according to four areas of action: (a) commitment and social interaction, (b) investigation, (c) training, and (d) internal management. Each one corresponds to different actions; its objectives and responsibilities are determined by a scale of priorities and associated costs. UPC guidelines sought a transition from a purely environmental approach to a sustainable human development approach, which were open to its community environment and university networks.

This initial framework of UPC's environmental planning has been consolidated through the concrete implementation on Campus Castelldefels or Mediterranean Technological Park. Castelldefels' Campus Environmental Plan (UPC 1999, 2000) was intended to become a protocol when applying environmental criteria in several institutional buildings at Technology Park, inaugurated in May 2001; see Fig. 4.

When developing the methodological benchmarks proposed by the environmental criteria document, the plan simplifies them in a set of eight action areas, distributed in 31 environmental projects, according to the following topics:

1. Soil and vegetation
2. Water
3. Acoustic pollution
4. Mobility
5. Networks and facilities
6. Energy efficiency
7. Materials and waste
8. Global aspects

In 1999, an environmental impact analysis of the Vallès School of Architecture was elaborated, by using the MIES Report – Sustainable Building Research Model (Cuchí Burgos and López Caballero 1999). Its goal was to determine the necessary conditions for the school's expansion based on 2001's entrance examinations, by applying sustainability principles toward construction and teaching. The results obtained values of CO_2 emissions due to building constructions, use, and transport of its users. It

Sustainability on Campus, Fig. 4 (**a**) ESPC, north facade; (**b**) ESPC, south facade. (Photographs from the author, 2014)

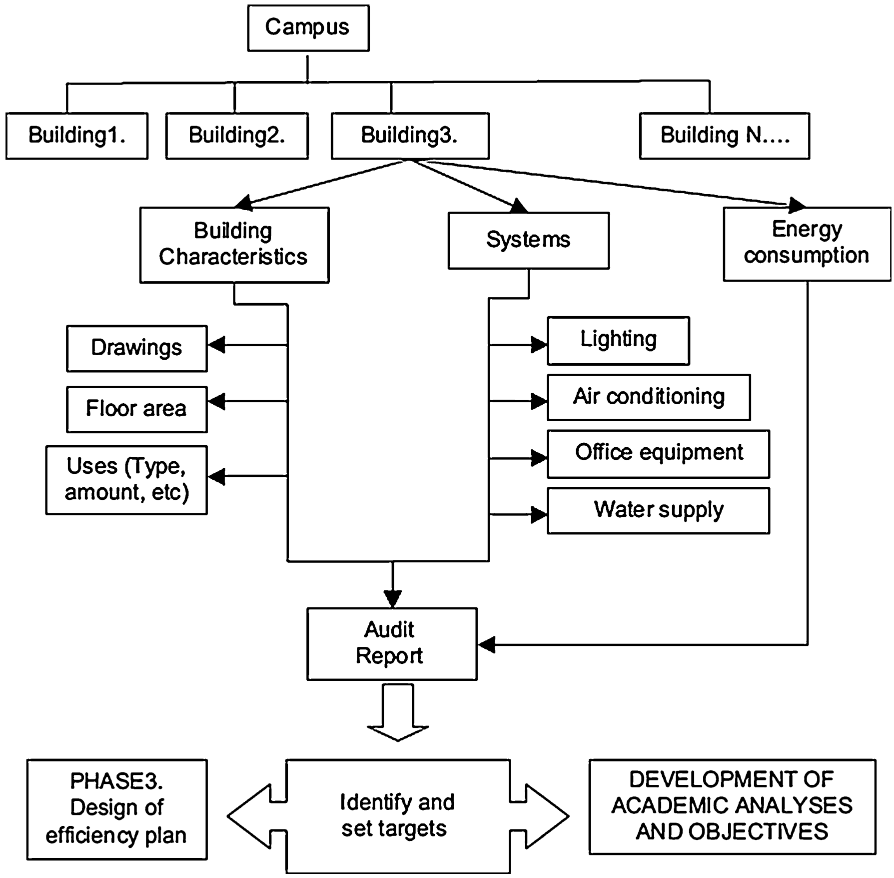
provided an estimate of emissions associated with undergraduate students' future activity. These values were subsequently used as reference of Process ACA2. Within the Environmental Plan's scope/CITIES office, the proposal of the Resource Consumerism Efficiency Plan – PECR (Cuchí Burgos and López Plazas 2004) – moves forward. It evaluates and states that the resulting energy performance indicators can generate UPC's investment and actions programming in order to specify the economy, efficiency, and comfort in terms of a global strategic university planning. As a result, reference values for environmental plans are redirected, for new buildings and existing built park.

All PECR objectives have been based on final projects (PFC) developed by the Building Technical School of Barcelona's (EPSEB) students. All projects were coordinated by professors from different departments and supported by all UPC academic units, in addition to CITIES. The methodology was compiled by Bosch Gonzáles et al. (2006) – Fig. 5. It shows that a great contribution of this process is the applicability and the importance of conducting evaluations as a pedagogical process. As a result, students were able to expand their knowledge and skills in environmental issues and sustainable construction, using both theoretical and practical experiences as motivational and commitment elements, that is, education for sustainability (ES), according to Catalapiedra et al. (2006).

PECR and building evaluations have allowed an initial take/understanding on the architectural and construction conditions, in addition to the building park's air conditioning and lighting installations. The identification of a building's weak points and/or potentialities was also enabled along with building performance improvements and adjustments in their energy demands, resulting in a list of concrete actions of savings and efficiency.

These evaluations have been instrumentalized by controlling in real time a few UPC buildings managed by a *Power Studio* software, an integration of online energy consumption control of UPC's park into the SIRENA Management and Control System. Data available at https://sirenaupc.dexcell.com/dashboard/widgets.htm. Such measurements have allowed the monitoring of energy consumption since 2006. It has also resulted in automated information from demands distributed over time, and consequently, it has identified consumption profiles and schedules. These profiles, when crossed with constructive and typological characteristics of each building and their facilities, activities, and users, create the energy audit indicators.

These energy audits have generated reliable indicators with the development of the SIRENA system – an Energy and Water Information System that included PECR's efficiency plan into all university buildings, as one of the strategic management guidelines of UPC's 2015 Sustainable Plan. It has already reached its initial goal of



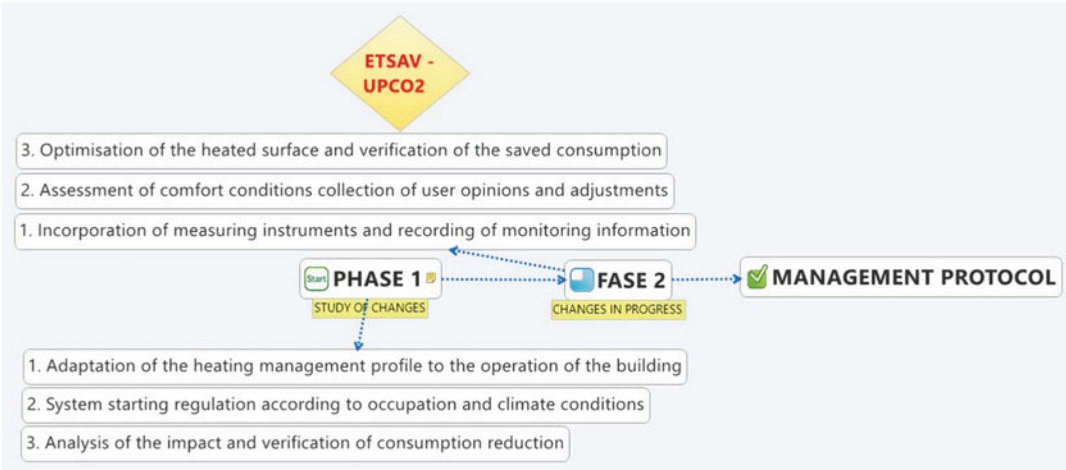
Sustainability on Campus, Fig. 5 Framework for performing energy audits on PECR (Catalapiedra et al. 2006, 960)

specifically contributing to energy saving policies, as well as promoting changes in UPC's institutional processes that can overcome sustainability challenges.

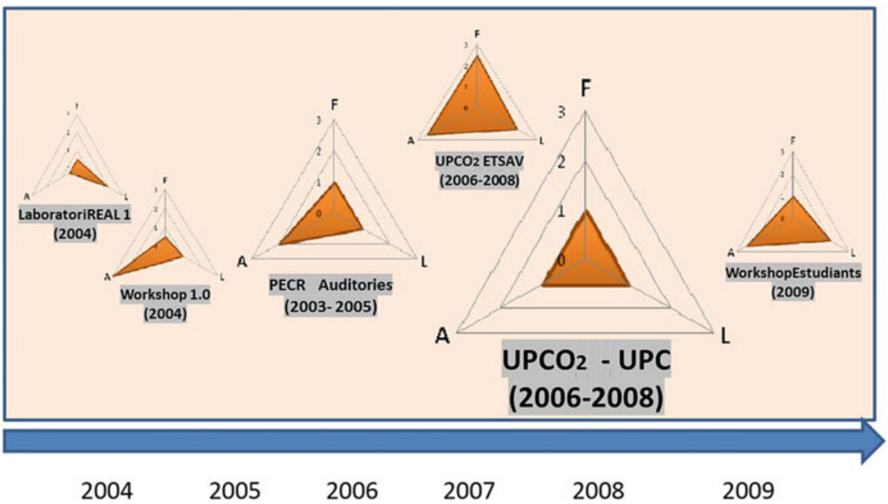
Based on UPC's 2015 Sustainable Plan for buildings and energy, the effects on the building energy consumption and its contributions to global climate change would be analyzed. Another challenge of this plan was to incorporate renewable energies and improve energy efficiency on university buildings. As a result, the UPCO$_2$ program was created to reduce UPC greenhouse gas emissions (GHG). The program identifies the sources of GHG emissions from university activities and the mobility of its more than 40,000 users. It also identifies the consumption of necessary resources to training, research, and administration activities and especially the energy consumption in its 400,000 m^2 park, along with the consumption during new buildings and equipment construction.

Based on the UPCO$_2$ program framework, the Vallès Technical School of Architecture – ETSAV – made the decision to use its buildings for testing. It strategically examined how to reduce the environmental impact associated with energy resources consumption, risking extrapolating most of the other university buildings and their activities.

As a result, a two-phase plan of actions was drawn up (Cuchí i Burgos 2009, 158–167). The first phase included studies and proposals and the second phase included ongoing actions. Its final goal was to establish a management protocol to transfer managing experiences and incorporate them into the new use and occupancy model (Fig. 6). If compared to the previous year, a 38%



Sustainability on Campus, Fig. 6 ESTAV – UPCO2 table of actions summary. (Adapted from Cuchí i Burgos 2009, 164)



Sustainability on Campus, Fig. 7 Chronological diagram of UPC's projects and programs as "a living sustainability laboratory" (Ruiz et al. 2009, 11)

reduction in energy consumption was obtained, which corresponds to 80Tn of CO_2 emissions.

While observing and evaluating all research projects based on UPC's resource management framework, the so-called living sustainability laboratory stands out. It considers university campuses as an ecosystem, which allows knowing and managing their metabolisms (resources consumption and waste generation). Starting with the application of FLA's methodology (Jansen 2003; Ferrer-Balas et al. 2008), the $UPCO_2$ project – ETSAV – has the greatest transformation potential, with a more balanced graphic distribution among all three axes (Fig. 7).

Ruiz et al. (2009, 11) are able to identify all results in terms of progressive improvement and deepening, also represented by Fig. 7. All projects have been represented according to their human and economic resources investment scales. In addition, they have been translated quantitatively by the resulting surface between the all components present on FLA's graph. In this regard, the

$UPCO_2$ project's pilot application in ETSAV was successful as it took into account the dynamics of coordination and dialogue along with UPC's decision-making application as a whole ($UPCO_2$ – UPC). All agents are active part of the process and contribute with "organization's knowledge whose foundation is based on the ability to gain action autonomy." In addition, evaluation reports pointed out that in order "to maintain and consolidate savings, a high and constant involvement from facility managers is required. It also demands equal efforts from academic units as well as from institutional recognition" (UPC 2011a, 42).

SIRENA's implementation (Information System on Consumption of Energy Resources and Water) from UPC uses a computer tool that integrates and manages all the information related to resources consumption from university buildings. As a result, it automatically generates comparisons, graphs, consumption indicators (kWh/m^2, kWh/user, kWh/credit, kWh/usage, etc.), and an associated environmental impact. The data is obtained from supplying companies and also from several UPC campuses consuming locations. It covers 99% on electricity, 32% of water supply, and 65% of gas (Frandoloso 2017).

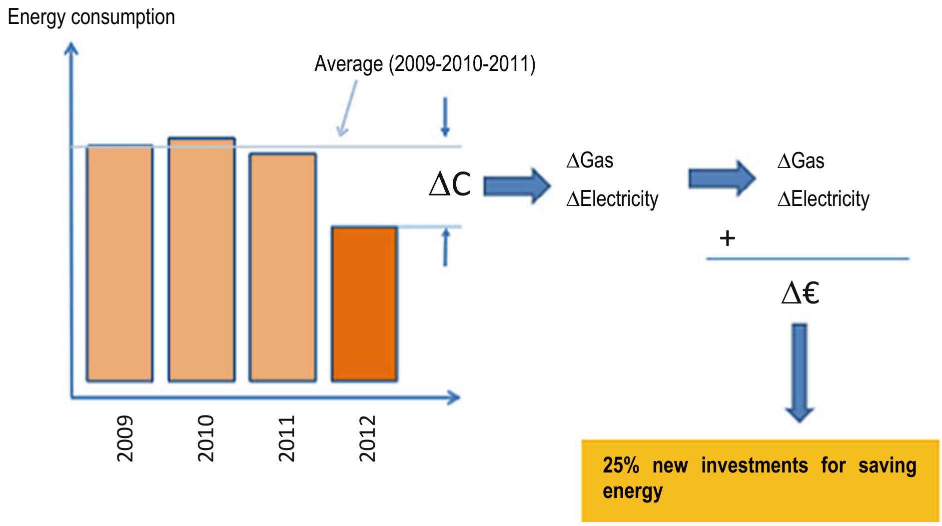
The 2010's annual report (UPC 2011a) recognizes the great potential in savings and decreasing the environmental impacts that research and consumption monitoring bring, especially when involving management. It also recognizes that it is necessary to expand investments to achieve satisfactory results. Seeing that, SIRENA should be expanded and consolidated as a tool, in order to allow greater usability and provide new functions to reduce environmental impacts and corresponding economic costs. Reports from SIRENA 10 recommend strategic directions to implement university energy policies.

Based on these data, UPC approved in 2011 the energy saving plan (UPC 2011b). It included a 4-year action program (2011–2014) for a budget reduction that supplies university natural resources. Such actions were also motivated by economic difficulties UPC had to face in recent years. The plan aims to reduce absolute energy consumption by 25% when compared to 2010. In order to achieve it, it uses principles of sustainability, effectiveness (ensuring university basic services operation), sufficiency (eliminating superfluous consumption), efficiency (optimizing resources), transparency, and information on resource usage, individual and collective responsibility and exemplary, collaboration, and participation (UPC 2013). Among these actions, measures for building energy organization and management were also proposed. They were based on collective commitment and a well-defined consumption tracking system, using previous experiences presented above.

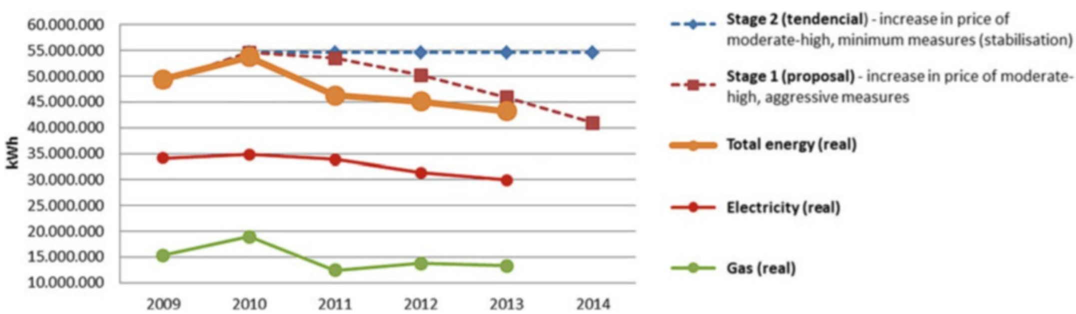
An important element from the program's kickoff involves the energy optimization projects – POE. They form work groups composed of a coordinator and three or four staff members, who are key to each building's organization and operation. An important point to be considered in one of 2012's work sessions is that "energy savings is about political will. Therefore, it is necessary to rely on previously adopted measures" (UPC 2012). The results achieved with energy reduction costs allow new projects' investments (Fig. 8).

Among the actions above, Guide 2.0 is included. It is a space that seeks to hold university-community member accountable. They are involved in each decision level, including rational and efficient facility usage, in order to ensure the minimum energy consumption in their activities. Such space uses the dissemination of experiences and learning, as a channel to expand the program's educational effect. Another key element to obtain environmental quality success is to have specific information on environmental variables' internal conditions (temperature, relative humidity, CO_2 levels, etc.). These data provide feedback on the conditioning systems' requirements and performance by taking into account national regulations.

Both UPC's energy management timeline and data from 2013 (UPC 2014) confirm the plans relevance along with its measuring effect. The presented effective results from 2009 to 2013 are lower than the proposed savings scenarios (Fig. 9). In terms of global energy consumption reduction, it was 20% higher than previously



Sustainability on Campus, Fig. 8 POEs' economic incentive representation (UPC 2012)



Sustainability on Campus, Fig. 9 UPC's gas and electric global results from 2009 to 2013 (UPC 2014, 7)

(16% in 2012 when compared to 2010). Such results represent an estimate of 1.1 million (€) in economic savings. It should be noted, however, that the SIRENA tool has evolved, and it is currently associated with the *DexCell* software.

The main lines of sustainable management work (sustainable management is currently under the coordination of UPC's Sustainable Management and Equality of Opportunities office) according to Ferrer-Balas (2013) should allow advances toward self-sufficiency (less dependent on the economic situation) and sustainable performance:

- Integrate the energy variable in all the decisions made and internalize real costs.
- Evaluate ICT's policy of energy sustainability – Information and Knowledge Technology – along with research and teaching infrastructures.
- Establish mechanisms to attract external investments for campus systems efficiency and renewable energies.
- Perform all actions with social responsibility (climate change mitigation, innovation engine).

Currently, in the university environment, the UPC Energy Plan 2020 (UPC 2017) presents the following challenges, based on previous budgets:

- Integral sustainability
- Considering the campus as a practical laboratory

- Commitment and interaction with the environment
- Transversality, collaboration, and participation
- Consistency, transparency, and exemplariness
- Agile management, simplicity, and efficiency

Its strategic goals entail using 20% of renewable energies, achieving a 20% reduction in management application (in comparison to 2007) and energy demand optimization. It seeks to ensure that 100% of its park is built with energy audits and certifications. Finally, by having the university as *CampusLab*, it hopes to enable 200 students to develop activities in ten pilot buildings.

Final Considerations

Although only a few examples of the application of sustainability on university campuses have been presented, it is important to emphasize the importance of developing methodologies and instruments that allow universities to include their principles effectively in their administrative and pedagogical practices.

Each institution should reflect its own specificities and contexts, based on the examples presented here, with a view to emphasizing its responsibility as a contribution to paradigm shifts that insert sustainability in an integrated, concrete, and permanent way.

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Sustainability Perceptions

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Definition

Sustainability Perception can occur in diverse ways since the environment is perceived by individuals in multiple and differentiated ways and understanding occurs from a subjective perspective based on a concrete reality. Thus, perception is conditioned by factors inherent to the individual himself; by educational and cultural factors imprinted by society, which condition their sensitivity and attitude; and by emotional, affective, and sensory factors, derived from relations obtained with the environment (Hoeffel and Fadini 2007).

Introduction

Given the high rates of natural resources exploitation and in recent years the planet degree of degradation and pollution, recognition of the need for an urgent paradigm shift has intensified. The shift is related with changes in the way progress and growth are perceived to a sustainable development paradigm, which conceives a new ideal of human beings and nature.

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Such a coexistence concept foresees a balance between global economy and sustainable exploitation of the planet's resources, necessary for modern life. However, this transformation is closely related to how each social group perceives the environment and how in each culture it is understood.

Environmental awareness in this context means the construction of environmental "ideas," as being the involvement of "[...] both responses and reactions to impressions, feelings and stimuli mediated by the senses, mental processes related to individual experiences, conceptual associations and cultural conditioning" (Hoeffel and Fadini 2007, p. 225).

In this conception of sustainable living, given the role of human perception in environmental conservation, it has become vital, the creation of environmental programs and policies, that value the environment preservation, in consonance with needs and improvement of local communities quality of life.

This way, it is important to notice the seventeen goals/targets proposed by Agenda 2030, supported by a diagnosis of global scenario, conceiving the interconnection between people and planet. It involves prosperity, peace, and partnership, to ensure possible, concrete, and achievable global planning, which aims to environmental, economic, and human preservation, prioritizing the promotion of equality between people.

In view of the above, the first part of this work highlights the concepts of sustainable development, environmental awareness, and conservation areas, bringing out the principles mentioned by Agenda 2030, deliberated on the seventieth anniversary of the United Nations, and today's social, economic, and environmental demands.

The second part presents the environmental perception analysis of residents and tourists in the vicinity of the Environmental Protected Area Bairro da Usina Dam (EPA Bairro da Usina Dam) located in Atibaia-SP, Brazil. The survey data was conducted in a research project developed in a higher education institution UNIFAAT – University Center and sought to highlight the relationship between conservation proposals present in the study area and the view of the local community and visitors about this reality.

Environmental Awareness and Conservation Units

This entry was developed based firstly on the principles and concepts set out in Agenda 2030 to sustainable development – decided in 2015 by Heads of State and Government and High Representatives, gathered at the 17th anniversary of the United Nations. The document characterizes environmental problems of our time and is an action plan, aimed at the prosperity of people and the planet (United Nations 2015).

The document considers current global scenario, marked by growing inequality, depletion of natural resources, and environmental degradation, and foresees:

> [...] understanding and unprecedented significance. Accepted by all countries and applicable to all, it takes into account the different national circumstances, capacities and levels of development, respecting policies and priorities of each country. It deals with objectives and universal goals that apply to everyone, both developed and developing countries. (United Nations 2015, p. 3)

The 17 stipulated targets consider the importance of the areas: people, planet, prosperity, peace and partnership, in an interconnected way, aiming to ensure completion of this new global planning for environmental, economic, and human protection (United Nations 2015). Such an integrated perception refers to the essentiality of thinking on sustainable development, which integrates a new paradigm of coexistence on the environment and society, deepened subsequently.

On the issue here exposed, the most important goal is number 15, as it comments on the need to "[...] protect, recover and promote the sustainable use of terrestrial ecosystem, sustainably manage forests, fighting against desertification, detain and revers land degradation, and halt loss of biodiversity" (United Nations 2015, p. 29). This relates strictly to the issue of environmental perception, since it foresees, for example, reduction of habitat degradation, end trafficking of fauna and flora species and also conservation and sustainable use of biodiversity and ecosystems, reachable as the relationship of man with the world is strengthened in a new perspective of sustainable development (United Nations 2015).

Thus, before exposing the conceptualization of environmental awareness, essential to the understanding of this entry, it is essential to contextualize the composition of sustainable development mentioned above. Guimarães (2007) exposes a new paradigm, based on a critical environmental diagnosis by admitting the urgency of overcoming the definition of development by a concept of sustainable human development, more comprehensive.

This is due to the central role of the human being in this process, indicating that transformation through a new ethic of growth, covers aspects which enables this new paradigm to be:

> [. . .] environmentally sustainable in access, use and preservation of natural resources and biodiversity; socially sustainable in reducing poverty and social inequalities, and to promote justice and equity; culturally sustainable in preserving the system of values, practices and symbols that define national identity through the ages; and politically sustainable to deepen democracy and ensure access and participation of all in decision-making. (Guimarães 2007, p. 185)

Such understanding ponders the idea that "[. . .] man will only protect nature in as much as he gets protected" (Guimarães 2007, p. 185); in other words, sustainable development will succeed only and/or will be accepted, as it provides improved quality of human life. Thus, there is the recognition of a primordiality in investing in citizen ethics construction because:

> It is never enough to remember that the challenges due to situations of social inequality and environmental degradation cannot be defined as individual problems, becoming, in fact, as social, collective. [. . .] the satisfaction of basic needs required the recovery of collective practices (solidarity) to the achievement of material and spiritual aspirations to ensure human well-being. (Guimarães 2007, p. 191)

Although the subject uniqueness is considered, in the world interpretation, relationships, and life, there is recognition of great cultural influence intrinsically, in the construction of a collective perception of the world. Thus, even if initially the discussion of environmental problems were related essentially to biological issues, it has been widening, encompassing various areas of knowledge and is currently present in all sectors of human life involving biological, socioeconomic, ethical, and philosophical, spreading the concept of environmental sustainability (Stahel 2002).

Thus, with regard to environmental issues and the growing need for changing the concept of development, in a sustainable perspective, we consider the satisfaction of human needs, quantitatively and qualitatively, in harmony and conscious relationship with the environment. In this respect, the concept of perception acquires essential value, as is the investigation of similarities and differences between values and meanings in different contexts, inherent to each social group (Hoeffel et al. 2008).

For Abram (2012) and Ferreira and Coutinho (2000), environmental perception is conditioned by the subject inherent factors, such as educational and cultural transmitted values, and their emotional and sensitive relationship from direct environment observation. Thereby, according to Tuan (2015) and Ogunseitan (2005), something that is essential for the understanding of human perception is the influence of sensory senses, as they enable man to feel, understand, and respond to environmental stimuli in which they are inserted. However, it considers, in the process, the entire sociocultural baggage, lifestyles, and the subject previous experience.

Still for Rodaway (2011), perception is seen as a process, which involves the organism and environment influenced by the senses and mental conceptions. "Thus, ideas about environment involve both responses and reactions to impressions and feelings, mediated by the senses, the mental processes related to individual experiences, conceptual associations and cultural conditioning" (Hoeffel et al. 2008, p. 133).

Thus, it is possible to understand the concept of perception as something broader, as it relates to information and assimilation capacity, overcoming the physical limitation, since it covers the sociocultural instance of this process, the construction of thought and formation of individual and collective ethical values. Therefore, at:

> [. . .] shared environmental management context, the perception of the population becomes an important ally for the government as to the reading of

> social reality, configured as a means of supporting instruments and environmental management system tools. (Rodrigues et al. 2012, p. 99)

As far as environmental awareness is concerned, the study of the relationship between man and nature is focused, involving scientific, social, and political research, which comprises performing analysis, not "[. . .] about what people perceive of spaces, but as the spaces are perceived by the people" (Merleau-Ponty 1999, cited by Rodrigues et al. 2012, p. 100).

Therefore, it is necessary to consider social participation in the identification of environmental problems and planning of actions that start from the perception of man on the environment, to promote a more balanced and effective environmental management (Rodrigues et al. 2012).

In this scenario, when considering Brazil, as one of the countries with the highest biodiversity in the world, which has "[. . .] established a system of protected natural areas, called Conservation Units (CUs), which have been implemented with the main objective of protecting most of the diversity of ecosystems and species" (Torres and Oliveira 2008, p. 228), it is essential to create strategies that promote the conservation of these spaces, both civil and political, as ethical and educationally.

The National System of Conservation Units was established by Law No. 9985, of July 2000, and Conservation Unit is understood, according to Article 2 as:

> I – Conservation Unit: territorial space and its environmental resources, including jurisdictional waters, with relevant natural characteristics, legally instituted by the Government, with conservation and defined limits Goals, under special administration regime, which is subject to appropriate guarantees of protection (Brasil 2000).

Such spaces, besides promoting preservation of natural resources, should encourage learning and awareness on the concept of sustainability, for the subjects who live in it. Thus, it is necessary to research on environmental awareness, as this enables a greater understanding of man's interrelationship with environment, and expectations, judgments, and behaviors, allowing a better foundation in environmental education planning, essential for achievement of better results with respect to participation in conservation processes (Torres and Oliveira 2008).

In this context, the importance of the creation of protected areas management is still considered, in complementing a serious environmental policy, with actions aimed at the prevention of degradation and conservation of natural resources (Silva 2006). Therefore, to be successful, in its implementation the following must be considered:

> [. . .] the possible political interference, on economy, social, cultural and environmental. Planning strategies should respect the interests and growth needs of urban activities, industry, the expansion of the agricultural frontier, as well as the maintenance and conservation of environmental attributes, such as the remaining vegetation, the remarkable landscape components, water resources, archaeological, cultural heritage and other legally provided attributes. (Silva 2006, p. 32)

The Environmental Protected Area, to be exposed, is characterized by art. 15, as:

> [. . .] a generally extensive area with a certain degree of human occupation, equipped with abiotic, biotic, aesthetic or cultural attributes especially important for the quality of life and well-being of human populations. They have as main objectives to protect biological diversity, and order the occupation process and ensure the sustainable use of natural resources.

Corresponds to a Sustainable Use Conservation Unit objective, according to the above by law no. 9985, art. 7, paragraph 2, "[. . .] reconcile nature conservation with sustainable use of part of its natural resources."

The next section will expose considerations about the analysis of data related to the case study, conducted by UNIFAAT – University Center in the EPA Bairro da Usina Dam, located in Atibaia, São Paulo State, Brazil.

Environmental Perception in EPA Bairro da Usina Dam Conservation Unit

The Environmental Protected Area (EPA) Bairro da Usina Dam is characterized as a Sustainable Use Conservation Unit, with possible deployment in public and private areas without the expropriation of property. It aims to reconcile economic activities undertaken at the site, with due protection of natural resources (Silva 2006).

The EPA, corresponds to the Atibaia River dam, which is responsible for the river flow, flood control, and power generation. It covers the entire region surrounding the Bairro da Usina hydroelectric dam, located in the city of Atibaia, São Paulo (Silva 2006).

The EPA Bairro da Usina Dam was established on September 4, 1986, by law number 5280, in which, besides establishing a wildlife protection zone, including flora, fauna and all remaining natural aspects (article 4), with prohibition of degrading activities or potentially degrading (article 5), aims to prevent, according to article 3, second paragraph:

> I – the implementation of potentially polluting activities, that could affect water sources, soil and air;
> II – the execution of earthworks and opening channels implying substantial alteration of local ecological conditions, especially in the wildlife area;
> III – activities capable of causing accelerated soil erosion or siltation sharp in basins;
> IV – the exercise of activities that threaten to extinguish the rare species of flora and fauna (Brasil 1986).

As stated, this conservation unit, a priori, does not show much legal specificity, since, although it relates to the protection of dam waters, the law (number 5280), does not establish clear goals, mentions exact perimeters or describes with details attributes, which must be protected (Silva 2006).

Returning to the theoretical foundation required to perform the analysis, it is necessary to highlight the difference between "the visitor and the native," in relation to environment, since the case study to be presented, discussed the perception of residents and tourists at EPA Bairro da Usina Dam.

According to Tuan (2015), in the context of a highly mobile society, impressions of people passing through should also be considered where in general we can say that only the visitors (especially tourists) has a point of view; their perception often comes down to use their eyes to compose pictures. In contrast, the natives have a complex derived immersion attitude of the totality of their environment. The visitor's point of view, because it is simple, is easily stated. [. . .] On the other hand, the native complex attitude can only be expressed with difficulty and indirectly through the behavior of local tradition, knowledge, and myth.

As stated above, the assessment of space by the tourist is more explicit, aesthetic, and may represent a space new perspective, as it is able to realize the merits and defects in one environment, which are not more visible to the resident (Tuan 2015). But the resident, to live in that environment, has few opportunities to exhibit their perceptions because values are implicit in the economic activities of people, behavior, and lifestyle (Tuan 2015).

The study performed by UNIFAAT interviewed: 50 residents (24 males and 26 females), 18 tourists from second home (11 males and 7 females), and 42 1-day tourists (37 males and 5 females) (Table 1).

Table 2, about age range, helps to identify the predominant profile, which reveals a majority of individuals who live/visit the EPA aged from 31 to

Sustainability Perceptions, Table 1 Gender

Category of answers	Residents	Tourists: Second home	Tourists: One-day tourist
Male	24	11	37
Female	26	7	5
Total	**50**	**18**	**42**

Sustainability Perceptions, Table 2 Age range

Category of answers	Residents	Tourists: Second home	Tourists: One-day tourist
Up to 20 years old or less	2	1	1
From 21 to 30 years old	5	–	10
From 31 to 40 years old	9	4	11
From 41 to 50 years old	11	2	4
From 51 to 60 years old	12	5	8
Above 61 years old	11	6	8
Total	**50**	**18**	**42**

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over 60 years, as the numbers show significant concentration in this age group (there are 43 residents, 17 tourists of first residence, and 31 1-day tourist), which predicts a relative maturity and greater life experience of these subjects.

The difference of education (Table 3), information collected to assess the profile of respondents may help in understanding the way in which each group makes their perception of the location and environment, as well as comprise other environmental problems, and also allows to highlight the demand in each stage of education. According to the data collected, it was characterized eight categories of education.

For the period related to basic education, about five individuals said they had not studied (four residents and 1-day tourist); 37 have not completed primary education (21 residents, 3 tourists from second homes, and 13 tourists 1-day tourist); 13 completed this educational stage (three residents, three second homes tourists, and seven 1-day tourists); 17 have incomplete high school (five residents, two second residence tourists, and ten 1-day tourists) and 22 concluded (12 residents, 3 second homes tourists, and 7 1-day tourists).

The concentration of individuals in the period related to basic education demonstrates the need to strengthen environmental education in schools, "[...] because we only learn to preserve or to make the Environment sustainable and biodiverse when we learn to create between us and for us, an egalitarian, differentiated, supportive and free world" (Brandão 2007, p. 7).

With regard to higher education, the numbers are even more restricted; only 12 of 110 have a higher education degree (three residents, six second homes, and three 1-day visits); three did not complete (two residents and one 1-day tourist), and only one (second home Tourist) has post-graduation degree. It is noticeable, based on absolute numbers, that there is a concentration of locals and 1-day tourists between elementary school and high school education, while the second residence tourists hold a larger share in the level of higher education.

Among the residents (Table 4), four of them have lived in the area for less than 1 year; 12 between 1 and 5; 5 between 6 and 10 years; 3 between 11 and 16 years; 9 between 17 and 25 years and 17 have lived for more than 25 years.

In addition to residents (Table 5), among tourists from second home, five have visited the area from 1 to 5 years; one from 6 to 10 years; five from 11 to 16 years; and seven for over 25 years. Considering 1-day tourist group, of these 15 visit the area less than a year; six from 1 to 5 years; three from 6 to 10 years; five from 11 to 16 years; four from 17 to 25 years; and nine over 25 years.

A concentration in the number of individuals who pass/live in the EPA was recorded in two predominant periods, from less than 1 to 5 and

Sustainability Perceptions, Table 3 Degree of education

Category of answers	Residents	Tourists	
		Second home	One-day tourist
Complete primary education	3	3	7
Incomplete primary education	21	3	13
Complete high school	12	3	7
Incomplete high school	5	2	10
Complete higher education	3	6	3
Incomplete higher education	2	–	1
Postgraduate	–	1	–
No study	4	–	1
Total	**50**	**18**	**42**

Sustainability Perceptions, Table 4 How long have you lived in the area?

Residents	
Category of answers	
Less than 1 year	4
From 1 to 5 years	12
From 6 to 10 years	5
From 11 to 16 years	3
From 17 to 25 years	9
Above 25 years	17
Total	**50**

Sustainability Perceptions, Table 5 How long have you been visiting the area?

	Tourists	
Category of answers	Second home	One-day tourist
Less than 1 year	–	15
From 1 to 5 years	5	6
From 6 to 10 years	1	3
From 11 to 16 years	5	5
From 17 to 25 years	–	4
Above 25 years	7	9
Total	**18**	**42**

over 25 years. This data are observable by comparing the approximate percentage of these two periods, with the total of each cluster: from less than 1 to 5 years, there are about 32% of the residents; 27.5% of second residence tourists and 48.3% tourists a day; while in the visitation group over 25 years is approximately 34% of the residents; 38.5% of second residence tourists and 20.7% of 1-day tourists.

Besides the characterization of the profile, five questions were raised (Tables 6, 7, 8, 9, 10, and 11), which will be shown below in a comparative way, with the respective analysis. Data were collected related with the interviewee perception of what they see as "environment," issues related to environmental problems in the area and opinion about accountability to the preservation of the environment and study area.

Regarding environment perception, greater specificity from tourists is clear (both second home and 1-day tourists), considering it primarily as nature and awareness area, preservation, and care. Residents, on the other side, fall into a wide range, where sometimes the environment comes down to nature and awareness, or environmental issues and resources.

Such a conceptualization of environment is associated with the way they relate to space and how they see environmental problems and their causes. Recognizing such perceptions is relevant for providing information in the process of management and public policy since,

> In this context of shared environmental management, the perception of the population becomes an important ally for the government as to the social reality, configured as a means of supporting instruments and environmental management system tools. (Rodrigues et al. 2012, p. 99)

Sustainability Perceptions, Table 6 What is environment?

		Tourists	
Category of answers	Residents	Second home	One-day tourist
All	–	4	
Trees	2	–	
Trees/rivers	–	–	3
Raise awareness/ preserve/care	12	5	4
Cleaning	1	–	4
Water/dam/forest/ animals	–	–	5
Water/dam	2	1	–
Nature	13	5	8
Everything that people do not care	1	–	–
Resources needed for us	2	–	1
All interrelations between the beings on this planet	2	–	1
All that is degrading nature	1	–	–
Our house, our air, our environment	3	–	2
Stage between town and country	1	–	1
Essential, without it there is no life	1	1	3
Everything good in nature/leisure	–	–	4
All that does not destroy	1	–	–
Good things that people look for	1	–	1
Do not know/no answer	7	2	5
Total	**50**	**18**	**42**

According to the concept of environment, based on the answers, in comparison with the others, there was a higher percentage of choice in two options: "Nature" (Residents: 13, Second home tourists: 5, and 1-day tourists: 8) and "Raise awareness/preserve/care" (Residents: 12, second residence tourists: 5, and 1-day tourists: 4).

Sustainability Perceptions, Table 7 Are there any environmental problems in your area?

Category of answers	Residents	Tourists	
		Second home	One-day tourist
Did not answer	4	3	4
There is not	14	4	10
Garbage	6	1	18
Infrastructure (asphalt, barrier)	–	–	2
Lack of water	1	–	1
Lack of sewage treatment network/ sewage in dam	5	4	
Burned	6	–	–
Lack of care from residents and second home tourists	1	–	–
Cutting trees/ deforestation/lack of supervision	2	–	–
Incorrect destination of contaminated packaging used by farmers	1	1	–
Bad smell coming from the dam, river pollution	8	2	4
Silting of plant dam	1	3	–
Illegal fishing	–	–	1
Lack of awareness	–	–	2
Total	**50**	**18**	**42**

Sustainability Perceptions, Table 8 Why do these environmental problems occur?

Category of answers	Residents	Tourists	
		Second home	One-day tourist
Lack of awareness, education and responsibility	11	3	16
Do not have sewer network and sewage treatment	2	2	1
Tourist lack of awareness	1	–	–
People lack of awareness	–	2	–
Ignorance	2	–	1
Lack of people union	2	1	2
Incorrect disposal of waste	–	–	2
No specific collection of waste	3	1	–
Historical heritage of misuse and exploitation of environment	2	–	1
Lack of supervision	7	–	1
Urban growth	1	–	–
Abuse	1	–	–
Lack of municipal assistance	2	3	2
Neglect	–	–	2
Did not answer	16	6	14
Total	**50**	**18**	**42**
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This finding relates to what respondents characterized as the cause of environmental problems, which as set forth in Table 8, it is prevalent in options that allude to lack of human consciousness (14 residents and 22 tourists in total), which shows determined lack of consistency between such associative responses.

If environment is seen as awareness, preservation, and care, as the major cause of the environmental problems of the study area is this precisely the lack of environmental awareness? This question allows the identification of the need to strengthen the reflection on the theme, as well as support public policies to preserve the environment, with emphasis on social-collective aspect, with an appreciation of environmental education, which should prioritize, as provided for in subsection III of Article 5 of law no. 9795/99 “encouragement and strengthening of a critical awareness of social and environmental issues” (Brasil 1999).

The information gathered about the area environmental problems are correlated to “what” the respondents regard as environmental issues and the way they live with the space. The high number of people who did not answer or said they “did not have” any environmental problem, both residents (18), as tourists (21), reveals a lack of “sensitivity” to what happens in the study area, since when environmental problems become daily realities, their perception becomes more fragile.

Sustainability Perceptions, Table 9 Who should care for the environment in the area?

Category of answers	Residents	Tourists	
		Second home	One-day tourist
Major/government/ public agencies	23	7	19
The residents	3	–	3
Major and the residents	3	1	3
Everybody	13	5	8
The tourists	–	–	3
The farmers	1	–	–
Do not know/did not answer	7	5	6
Total	**50**	**18**	**42**

Sustainability Perceptions, Table 10 Do you know EPA Bairro da Usina Dam?

Category of answers	Residents	Tourists	
		Second home	One-day tourist
Yes	26	9	7
No	24	9	35
Total	**50**	**18**	**42**

A considerable amount of respondents (13 residents and 11 second residence tourists) also lists the environmental problems in the area as lack of sewage treatment and the stench from the dam/river, closely linked issues. The issue of waste is also very present in the perception of 1-day tourists, as set out in Table 7, 18 respondents listed it as environmental issues. This reference discloses certain deficit in the municipality infrastructure and urban and environmental planning.

When questioned about why these problems occur, about 36 people could not answer; there is still predominance on options that associate them with lack of awareness, education, unity, and responsibility of individuals, with a total of 41 respondents. Related to lack of urban infrastructure such as lack of sewage treatment, incorrect disposal of waste and lack of municipal and environmental assistance, 18 respondents mentioned this theme. Also mentioned were historical inheritance misuse and exploitation of the environment (three), lack of supervision (eight), urban growth (one), and abuse and neglect (three).

Sustainability Perceptions, Table 11 What is the EPA for?

Category answers	Residents	Tourists	
		Second home	One-day tourist
Park	1	–	–
Energy supply	–	–	1
Leisure park/to protect environment	4	4	2
It is an area for the preservation of fauna, flora, and the aquifer	1	2	–
Park/water recreation	1	–	–
Holding events	1	–	–
To protect the water	5	–	–
Environmental protection	2	1	1
To help with farm problems	–	–	–
Do not know	10	1	3
For nothing	1	–	–
Total	**26**	**8**	**7**

This concentration of answers enables policy guidance and awareness towards caring for the space, the environment and improving the quality of community life. It is evident the need for investment in environmental education, collective collaboration in nature's care and urgency of urban investment, especially on the issue of sanitation and reduction of pollution, since the predominant objective in this EPA is water preservation.

When respondents were asked about the question of who should care for the environment in the area, there is a prevalence between those who give such a commitment to the government or the general population. About 23 residents, 7 second home tourists and 19 1-day tourists said to be the mayor/government/public agencies, a number that represents almost half of the respondents and that demonstrates the approach that transfers to the government the environment responsibility.

Considering the total number of interviewees (residents, second home tourists, and 1-day tourist), six think that the residents themselves should take care of the environment in the area; another seven think it should be the mayor and residents; and 26 think it should be all people. This shows a certain awareness of environmental responsibility as it is the government along with the population.

As stated by Tuan (2015), the tourist has a different perspective on the space, since the short residence time makes them more sensitive to certain characteristics, already common to residents. Therefore, the survey of tourists from second residence collected data on the aspects that could improve the study area.

However, only 26 residents interviewed said they knew the EPA Bairro da Usina Dam, which shows the existence of an information deficit between government and citizens, since even being present in the EPA, they are unaware of it. Only nine second home tourists interviewed know EPA Bairro da Usina Dam. These data demonstrate the lack of knowledge on the EPA and among 1-day visit, the situation is even worse, as 7 out of 42 respondents reported having known something about the conservation area.

These data demonstrate that while some people know the EPA name, some have no idea about what it does; however, the great majority follow a line of reasoning focused on environment preservation through parkland and recreation. The conception of the purpose (is it for) the preservation area thus reveals a lack of awareness of the conservation area, since, although there is the idea of space preservation, most of the participants do not know or understand it as a recreational area, or just as protection of the waters.

In view of the results achieved, it is worth mentioning the adopted methodology limitations, which involve the fact that the research is sampled and in this way does not reach all residents and tourists (second home and 1-day tourist) present in the study area and thus provide a limited volume of information but which express the perceptions and opinions of the participants. In this way, the data obtained can contribute to the elaboration of a scenario for the Bairro da Usina Environmental Protected Area, based on the interviewees' perceptions, which demonstrates the need for the elaboration of environmental education and management programs that collaborate with the study area environmental conservation.

Final Considerations

The entry aims to expose, survey, and analyze the environmental perception of residents and tourists in the vicinity of the Environmental Protected Area Bairro da Usina Dam in Atibaia-SP, establishing a relationship between the conservation proposals present in the study area and the view of the local community and visitors.

These data were exposed and analyzed according to a literature based on the concepts of sustainability, environmental awareness, and conservation units, in line with the 2030 agenda of the goals set by the United Nations, and information related to a qualitative case study, which examined the prospect of residents and tourists about the EPA, through interviews with both groups.

From the diagnosis of a socioenvironmental reality in critical condition, which comprises the urgency for changing the concept of development and economic growth to the idea of sustainable development that balances socioeconomic demands and enable equity among peoples, it becomes necessary the responsible management of natural resources in order to sustain human life for generations to come.

The data allowed us to understand the difference in the perception of residents and visitors, in order to identify how each group perceives, understands and acts on environmental preservation. The data allowed to realize that there is a considerable lack of awareness and information on the local environment and space, especially by the residents, which sometimes exposed a vague or erroneous idea about the purpose and function of the area.

Besides this, the existence of environmental issues in the area made it possible to identify a deficiency in the EPA infrastructure, which was exposed by the interviewees recognizing the problems with lack of basic sanitation and garbage collection.

Cross-References

▶ Behavior Change for Sustainable Development
▶ Education for Responsible Consumption and Sustainable Development
▶ Education for Sustainable Development
▶ Engineering Education for Sustainable Development
▶ Importance of Sustainability Indicators
▶ Incorporation of Sustainability
▶ Social Responsibility and Sustainability
▶ Sustainability Barriers
▶ Sustainability Challenges
▶ Sustainable Development
▶ Transformative Responses to Sustainability

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Sustainability Policies

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S

Definition

Sustainability policies can be characterized as dynamic, complex, and interactive systems through which environmental problems are identified and countered by creating new policies or by reforming existing policies with the objective to improve environmental performance and to collaborate with sustainable development processes. They encompass human and ecological health, social justice, secure livelihoods, and a better world for all generations and can be created both by public and private sectors. In this context, it should be emphasized that higher education institutions play a fundamental role in the formulation, implementation, and discussion of policies aimed at sustainability.

Introduction

The challenge associated with the promotion and implementation of sustainable development (SD) is a global concern. At this scale, the efforts of governments and society are aimed at curbing environmental degradation and its direct and indirect consequences, through public policies and agendas, like the United Nations 2030 Agenda for Sustainable Development, that include various means of awareness and the effective change of environmental standards (United Nations 2015). The pursuit of environmental preservation and sustainability is related to the level of environmental awareness of individuals. Besides perceptions pointing towards an understanding that natural resources are finite, there is the need for harmony with nature that allows an emphasis on the importance of fairness and equality capable of shaping the way society treats the environment humans live in (Tavares 2005).

This situation illustrates the necessity of sustainability policies, which among diverse aspects involve environmental education, in a broad perspective, to enable awareness of societies so that sustainability can be achieved. According to Sauvé (2002), environmental education aims to induce social dynamics that promote collaborative and critical approaches to environmental realities and an autonomous and creative understanding of problems encountered and possible solutions and adequate policies to solve them. "More than an education 'about the, for the, in the, by the or on behalf of the' environment, the object of environmental education is indeed fundamental to our relationship with the environment" (Sauvé 2002, p. 1).

In this context, it is important to highlight the role of higher education institutions (HEIs) in the analysis, reflection, and elaboration of public policies aimed at environmental sustainability. For Santos et al. (2011), HEIs are plural institutions, and among many functions, they should be concerned with the training of professionals for the labor market, by means of research and extension activities guided by relevant policies, besides the goal of knowledge cultivation through scientific production. These institutions should address issues that are prominent and stimulate interest in aspects that are not yet considered relevant. Thus, a space conducive to discussions involving human development, prospects for improving the quality of life, as well as sustainable development policies that facilitate attention to these as well as similar issues.

Tauchen and Brandli (2006) emphasize the outstanding role played by HEIs in the process of technological development, in the preparation of students, and in the provision of information and knowledge and that these institutions can and should be used to support the development of a sustainable and just society. It is imperative that HEIs incorporate the principles and practices of sustainability, through the formulation and use of adequate policies, to make fundamental decisions about planning, training, operations, and activities common in their different areas of specialization, as well as in their premises, and to initiate a process of awareness at all levels, including academics/lecturers, employees, and students.

According to Salvioni et al. (2017), HEIs have a fundamental role in exploring, testing, developing, and communicating necessary conditions in the quest for sustainability. Ralph and Wendy (2014) mention that HEIs should provide information, training, and skills to leaders, advocates of environmental sustainability, and staff to improve their understanding of environmental sustainability principles, direction, and policies.

HEIs play a fundamental role in enhancing the creation and diffusion of sustainable thinking by being thought and opinion makers. For this process to be possible, it is necessary that people involved in the development of university activities serve as the basis for dissemination of knowledge and strengthening of sustainable policies and practices. There are still many challenges that need to be overcome in higher education regarding sustainable development, even with the advances already made (Leal Filho et al. 2015). Leal Filho et al. (2018) also emphasize that initiatives to evaluate and encourage the engagement of HEIs in sustainable development is a complex and extensive process. So, sustainability policies at HEIs are important, since they provide a basis for systematic initiatives across the institution.

HEIs and Sustainability Policies

The concept of sustainable development in higher education around the world is widely implemented, analyzed, and studied (Amaral et al. 2015; Lukman and Glavic 2007; Holm and Martinsen 2015). Different policies, perspectives, and lines of action regarding the role of HEIs in building a more sustainable society can be distinguished.

Lozano et al. (2013) propose that the elements to be considered and embraced within sustainable policies of HEIs are: curricula, research, campus operations, community outreach, university collaboration, assessment and reporting, transdisciplinarity, embedding sustainable development into the institutional framework and in the daily campus experience, and educating the educators. Potentially, each of these areas could be covered in an overarching sustainable development strategy and policy. However, according to Leal Filho et al. (2018), some will require focused initiatives, subpolicies, and integrative approaches, so that policies must ensure that broader concerns are fully addressed.

The increase in policy development aiming to address SD is a cause and a consequence of the growing number of HEIs incorporating SD practices. However, such policies often do not reflect the broader concerns of SD; instead, they are more likely to address specific environmental issues (e.g., carbon reduction, conserving energy). This reveals that a more holistic approach may be missing in the policy development process.

Tauchen and Brandli (2006), for example, conducted a study on sustainable practices developed by HEIs, through an extensive bibliographical review on the subject, in 42 institutions located in the UK, the USA, Canada, Portugal, Germany, Spain, France, and New Zealand and in four institutions located in Brazil. In a general analysis, the authors found that environmental management has been implemented using diverse and appropriate policies at most HEIs, with growing concern observed by institutions to adapt to sustainable development policies not only in terms of education but also in environmentally sound practices and campus operation.

Examples of incorporating sustainability policies and principles into higher education mentioned by Lukman and Glavic (2007) indicate that the HEIs analyzed have focused their attention on incorporating sustainability principles into everyday activities and structures such as “managerial performance (vision, mission, statement, strategy and council/sustainability coordinator), education and research (programs, curriculum, education, operations, networking and stakeholder reporting (evaluation tools, sustainability indicators)” (Lukman and Glavic 2007, p. 107). However, it is important to emphasize that the creation of well-defined environmental policies must precede the implementation and incorporation of these sustainability practices, since in this way, one can objectively evaluate and determine who will be responsible for each step of the process, what are necessary physical changes, which resources are available for investments, and then to monitor the different steps, correct mistakes, and minimize possible problems.

Gough and Scott (2007) contribute to this analysis by presenting examples (mostly in the UK) that explore the relationship between higher education and sustainable development policies and practices in the light of seven international case studies on sustainability, related to learning processes, higher education teaching, and management practices. The case studies analyzed by Gough and Scott (2007) demonstrate that research and teaching can contribute to creation and implementation of diverse sustainable development policies, even though there are many challenges, and even failures, in this process. For the authors, when thinking about higher education and sustainable development policies, there are different perspectives; however, HEIs play a central role in the development of citizens and their ideas of sustainable development are implicit in this.

Amaral et al. (2015) present examples of the performance of HEIs for sustainability considering operational and management practices (environmental management system), created by the formulation of campus operations policies, which focus on the efficient use of energy resources. Regarding operational practices, the authors cite Green Building Initiatives, focusing on the Green Building Leadership in Energy and Environmental Design (LEED) developed by the US Green Building Council (USGBC). In addition to LEED certification, the authors cite the Building Research Establishment Environmental Assessment Method which is another environmental assessment method and rating system widely used not only in Europe but also all over the world. Several UK university buildings have been certified under this specific method. All these examples of operational and management practices and their use are based on sustainability policies for campus operations developed by these institutions.

For environmental management practices, Amaral et al. (2015) include examples from organizations certified according to ISO 14001, which also depend on institutional sustainability campus operations policies to be implemented. The authors (Amaral et al. 2015) mention as examples the University of Glamorgan, University of Melbourne, Mälardalen University, and University of Gävle. These authors also mention that some institutions prefer not to certify their EMS, despite using ISO 14001 as framework to implement it: examples are Lincoln University in New Zealand and Dalhousie University in Canada.

The implementation of green building and/or management initiatives often tends to address only the operational dimension of the university system. In this sense, it is necessary to develop improvements regarding approaches to environmental practices and policies in HEIs including in this process, not only the operational question but also the research, education, and community engagement aspects that are fundamental to enable sustainable development policies (Amaral et al. 2015).

According to Leal Filho et al. (2018), these diverse examples make it clear that SD at universities is here to stay. Yet they also emphasize that there is a need for refurbishment and adjustments, and that SD policies need to be incorporated to improve the management of all resources, community relations and the dissemination of new practices and innovations.

It is worth noting that in addition to the examples presented so far (Tauchen and Brandli 2006; Lukman and Glavic 2007; Gough and Scott 2007; Amaral et al. 2015), there are still many other examples of initiatives of HEIs regarding the contribution to sustainable development policies and actions. However, even in the face of so many examples and diversity, to better incorporate sustainability in all levels of university activity and to guarantee its continuity, the continuous development, incorporation, and evaluation of policies for sustainable development are necessary, as well as adequate analysis on problems and failures related to them.

For Bizerril et al. (2018), sustainability policies in HEIs can be strategic in the transition towards sustainable societies, since they include, among other aspects, critical thinking about the organizational models of society and participation in decision-making as a method of teaching and learning about democracy.

In this sense, it is important to mention Lukman and Glavic (2007) who present an organizational tool, based on a continuous feedback loop (Deming spiral), to incorporate the idea of sustainability policies and principles into university activities. These authors (Lukman and Glavic 2007) proposed four steps in approaching towards a sustainable university: policy, operations, evaluation, and optimization and mention that one significant challenge to integrate sustainability policies into universities is to achieve a coherent institutional approach, where operations, teaching, research, and outreach are synergized.

Policy-making is the first significant step towards facilitating institutional change to achieve sustainable development and education objectives.

Sustainable policies should contain key elements, such as the university's statement on its mission, vision, and goals, its organizational structure, and its strategy. The policies represent a framework to support education for sustainable development and the essence of how a university can foster sustainability (Lukman and Glavic 2007).

In this context and in view of the importance of sustainability policies for HEIs to collaborate in sustainable development, it is worth presenting the results of the research developed by Leal Filho et al. (2018), which sought to verify which universities that work in the field of sustainable development have policies for sustainable development and whether such policies are a precondition for successful sustainability efforts.

This research was carried out from a mixed-methods approach, ranging from document analysis, website analysis, questionnaires, and interviewing. The sample involved 35 universities from 7 countries: Brazil, Germany, Greece, Portugal, South Africa, the UK, and the USA. The results were presented through an individual analysis by country and a comparison between countries (Leal Filho et al. 2018).

In a general analysis, it was observed that 57% of the sample universities present a policy that specifically addresses sustainable development. However, this result cannot be considered as an indicator that the remaining 43% are not engaged in actions and policies that address sustainable development (Leal Filho et al. 2018). For the authors, all the universities in the sample have shown involvement with environmental sustainability policies or procedures in some form or another, regardless of the existence of specific sustainable development policy.

Leal Filho et al. (2018) also highlight that the existence of concrete and active SD policy and principles in some university areas may suggest that other areas are equally developed, but the authors observe that this conclusion is not always true. This illustrates the fact that SD policies are valuable tools in showing the commitment of HEIs to sustainability and assist in the implementation of sustainability training efforts. However, the absence of a SD policy at a given university does not necessarily mean that it would perform poorly in dealing with environmental or social issues. As the findings of Leal Filho et al. (2018) have shown, even in universities with no formal SD policies, there can be successful sustainability initiatives but that are not necessarily integrated into broader policies.

On the other hand, statistical analysis has shown that universities with sustainable development policies "have more probability to have initiatives as green campus procedures, SD in the curriculum and joint local/regional SD activities, when compared with those who do not" (Leal Filho et al. 2018, p. 33).

In view of the above, it is possible to note the relevance of policies for sustainable development and its contribution so that HEIs can effectively collaborate in the promotion of sustainability, as well as in the training of citizens committed to this theme both on and off campus. For Cortese (2003), higher education institutions have a deep moral responsibility to increase the awareness, knowledge, skills, and values needed to create a just and sustainable future. Most professionals who develop, lead, administer, teach, work, and influence the institutions of society are prepared by higher education. As students learn from everything around them, the activities developed in higher education form a complex network of experience and learning. Thus, all parts of the university system are fundamental to achieving transformative change.

According to Velazquez et al. (2005), policies to support sustainability initiatives were rarely found in HEIs, and when they existed, they lacked implementation and were not effective in guiding the daily activities of campuses. The effect of this scenario, among other issues, was to significantly limit access to funds and opportunities for support. However, many of those responsible for sustainability initiatives at HEIs have created their own objectives without adequate sustainability policies, which have led to a struggle for policy-making in these institutions.

Ralph and Wendy (2014) mention that the barriers and failures to integrating sustainability policies into universities are predominantly internal and that financial constraints can limit the implementation of sustainability policies and initiatives at universities due to competing priorities for limited resources and because the long-term savings of these projects are not accounted for in budget modeling. Ralph and Wendy (2014) also emphasize that within university communities, there is often a lack of understanding and awareness of sustainability issues and policies, resulting in confusion, resistance to change, and a lack of staff commitment to implementing sustainability policies and programs. Leal Filho et al. (2018) emphasize that policy development and implementation of initiatives will only be possible with the support of the HEIs senior team.

According to Lozano (2006), the concepts of SD should be integrated into the policies, approaches, and learning of all members of university stakeholder groups (administrators, faculty, and students). In cases where SD is still not part of the culture, it is possible "to force" it from the top to the bottom through power-coercive strategies; however, this approach creates conflicts, which can weaken the implementation.

Contributing to this analysis, Amaral et al. (2015) suggest that in general terms, a sustainable university should teach the concept and philosophy of sustainable development to its students, but it is also fundamental to be able to conceive the concept within day-to-day of organizational management, through the development and adequate incorporation of sustainable policies.

Stephens et al. (2008) describe specific issues related to failures to integrate sustainability policies into HEIs that include factors internal and external to the higher education system and are related to the dominant sustainability challenges of each region, the financing structure and independence, the institutional organization, the extent of democratic processes, and communication and interaction with society.

According to these authors (Stephens et al. 2008), these five critical questions can help assess the potential and limitations of higher education as a change agent for sustainability policies and actions and can be explored in the context of any higher education institution or system around the world. In this context, identifying specific characteristics of the region in which the HEI is located can facilitate the design and implementation of new initiatives and adequate policies, maximizing and accelerating potential of higher education in social change towards sustainability.

Final Considerations

According to Tavares (2005, p. 4), a sustainable society should be aspired to, since sustainable societies may exist in balance with the environment. Therefore, to build a sustainable society where there are no diverse and continuous environmental problems, the development of policies aimed at sustainability is fundamental, as well as broad processes related to environmental education.

Mader et al. (2013) analyze the important role that higher education must play in addressing the social, cultural, economic, and environmental challenges facing the world and how this can reflect both in multiple university functions, including internal campus operations, education, research, community outreach, and may also reflect in public policies that affect society and sustainability. According to Leal Filho et al. (2018), it is evident that, over the years, incentives for establishing sustainable development policies in higher education institutions including sustainability-oriented curricula, research, social initiatives, and other related actions have increased.

In this context, it is worth mentioning Stephens et al. (2008), for whom HEIs hold a unique position in society since they are important places of production, perpetuation, and dissemination of knowledge. According to the authors, HEIs have the unique potential to stimulate the synthesis and integration of different types of knowledge and to improve their application, thus enabling social changes that seek sustainability. And these results need the previous development and implementation of diverse sustainability policies in HEIs.

Thus, to enable HEIs to engage even more with sustainable development, the policies for sustainability, as seen in this work, are fundamental. Such policies enable the structuring and implementation of actions that promote research, teaching and learning practices, management, and actions aimed at communities working towards a more just and sustainable society. To achieve this transformation, higher education institutions must identify not only what to give increased focus to in their curriculum, research, and community and business engagement activities but also how to ensure that desired changes are effectively and sustainably implemented through the whole institution (Mader et al. 2013), and this approach needs to be embedded across every aspect of institutional operations in a synergistic way.

However, as mentioned by Bizerril et al. (2018), there are factors that hinder the implementation and institutionalization of sustainability policies in higher education institutions, and the following stand out: personal resistance to change and innovation, institutional and systemic barriers to change, limited perception of the concept of sustainability on the part of the managers, and problems in the conduction of participative process in the institutionalization of the sustainability.

In this sense, it should be noted that HEIs are important references for diverse societies, remain centers of production of knowledge and possibilities for solutions to the problems they experience, and important agents in the implementation and development of policies and actions that aim at sustainability.

Cross-References

- ▶ Dimensions of Sustainability in Higher Education
- ▶ Higher Education and Sustainability Initiatives
- ▶ Institutional Change and Sustainable Development
- ▶ Sustainability Domains in Higher Education
- ▶ Sustainability on Campus

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Sustainability Principles

► Sustainable Education Methods

Sustainability Rankings

► League Tables and Sustainability

Sustainability Transitions

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Sustainability transitions are fundamental shifts in systems that are designed to fulfill societal needs (e.g., the transport system, the food system, the health care system, etc.) caused by profound changes in our dominant – often unsustainable – ways of thinking and doing. It usually takes from 25 to 50 years for such transitions to occur in a given system (Rotmans 2005), and they often unfold through the coevolution of two or more societal subsystems (e.g., economic, cultural, institutional, etc.). In what follows, some of the essential characteristics of sustainability transitions are first explored. The second part examines in more detail the question of when and how a sustainability transition may occur. Finally, in the third and final part of this contribution, the potential of transition narratives is explored.

General Characteristics

Sustainability transition studies have highlighted the hybrid nature of sustainability challenges. Transitions to sustainable development require the ecological modernization of products' life-cycles as well as the "greening" of our lifestyles. Moreover, transitions require political courage to facilitate and implement more sustainable policies. Transition researchers also argue that persistent and complex – sometimes called "wicked" – problems demand a combined set of solutions. Regular policy-making and existing market mechanisms are needed and yet should also be considered part of the problem. In addition, besides individuals, civil society organizations, markets, and states, transitions may be triggered and enacted by various knowledge institutions like universities (Weber and Duderstadt 2012).

In the scientific debate on sustainability transitions, a governance approach has been put forward in which networks are created. This is perhaps most explicit in the literature on transition management (Rotmans 2003; Loorbach 2007), where a transition arena is one of the first elements to be formed (see also Rotmans and Loorbach 2010). A transition is a long-term process that takes place at various levels and through different actors and domains. Accordingly, the changes that are needed can be situated at the systemic level. The concept of sustainability transitions is therefore often linked to the concept of system innovation, a more horizontal policy approach that stresses the need for more sustainable alternatives on different scales. In order to innovate at the systemic level, a broad range of actors must be mobilized and a long-term vision must be developed. In transition management, such visions are explored further and tested in transition experiments.

Transitions often evolve cyclically (Rotmans et al. 2001; Rotmans 2005). The first step is the predevelopment phase, in which a small number of people become aware of the problems of the current system. As more actors lend their support to the idea that change is needed, transitions enter the take-off phase. In the acceleration phase, structural changes become increasingly visible. Finally, in the fourth and final phase, the system stabilizes and a new equilibrium is established. This stabilization phase may then serve as a predevelopment phase for the next transition (see van der Brugge 2009).

The idiom of socio-technical transitions has proven to be a fruitful means of studying the entanglement of technologies, knowledge systems, institutions, market structures, and everyday practices and lifestyles. In little more than two decades, this emerging – largely European – field seems to have become institutionalized quite rapidly (Markard et al. 2012). Several international conferences have been organized, specific courses on transitions studies are beginning to appear on curriculums, a Sustainable Transitions Research Network (STRN) has been established, and a specialist journal titled *Environmental Innovation and Societal Transitions* was recently launched. The findings published in journals such as this reveal that transitions research essentially revolves around two questions. First, how do long-term changes in socio-technical systems happen and how can they be analyzed? Second, can such transitions be influenced, and if so, how? While the first question asks how we can come to a better understanding of transitions, the second question alludes to how we can actually shape them.

Understanding and/or Accelerating Sustainability Transitions

Sustainability transitions result from an interplay of factors. In the multilevel perspective, these factors are situated at three levels: regime, niche, and landscape (see Geels 2002, 2005; Geels and Schot 2010). Regimes are understood to be the dominant structure, culture, and practices. As these often consist of both social and material actors (or "actants"), they are sometimes referred to as socio-technical networks. For example, the socio-technical network of the energy regime consists of actors such as the oil industry, lobby groups, states, policies and legislation, but also nuclear power plants, pipelines, and renewable resources such as solar energy.

Regimes are also characterized by inertia. This can be partially explained by the interdependencies that exist in a socio-technical network and by path dependencies when it comes to the choices made about material aspects and infrastructures. An illustrative example is the steady but slow transition to a low-carbon energy system, which can be partly explained by the persistence of material factors such as pipelines, cables, and coal-carrying canals (see Jones 2014). Furthermore, dominant regime actors (e.g., oil and gas companies) are adept at adapting to crises and in maintaining the status quo (Haxeltine and Seyfang 2009). Hence, even when so-called radical transitions unfold, they most often occur in incremental steps (Grin et al. 2010). In this context, reference is made to the notion of "radical incremental change" (Rotmans and Loorbach 2010) and the general idea that managing transitions is more about "evolution" than "revolution" (see Rotmans et al. 2001).

The landscape level refers to the broader environment in which regime and niche players are active (Geels 2002). Landscape developments are highly structured in the sense that they occur beyond the direct influence of niche and regime players (e.g., the evolution of worldviews, economic conditions, the geopolitical situation, demographic trends, etc.). Niches are "novelties" than can be conceived as alternative means of fulfilling societal needs. These niches may include technological developments (e.g., efficient batteries for alternative and cleaner vehicles) as well as social and grassroots innovations, such as local, community-owned projects on renewable energy (see Seyfang and Smith 2007; Li et al. 2013).

Since the 1990s, advocates of strategic niche management (SNM) have been exploring the use of socio-technical experiments to test the potential of niches (see Kemp et al. 1998; Rip and Kemp 1998). The success and strengths of strategically managing niches are believed to lie in: (i) the articulation of expectations and visions, (ii) the building of social networks, and (iii) learning opportunities (see also: Schot and Geels 2008). Specifically, one of the merits of SNM is that it provides an instrument with which to transform unsustainable regimes through the creation and management of niches for promising technologies in fields such as wind energy, organic food production, and electric vehicles (Caniëls and Romijn 2008; Raven et al. 2010). In addition, it has been shown that failed niche developments can often be attributed to "either minimal involvement of outsiders in the experiments and a lack of second order learning, or to minimal involvement of regime actors which resulted in lack of resources and institutional embedding." (Schot and Geels 2008: 541).

In SNM, regime shifts to sustainability are largely created through processes of niche formation and the diffusion of clean technologies. Transitions, however, do not take place in a vacuum; nor can the up-scaling of niches be understood as a linear process (i.e., from technological niches to market niches to regime shifts). Instead, different transition pathways can be distinguished (Geels and Schot 2010). For example, when niches are not sufficiently mature, moderate landscape pressure may cause regime actors to adapt development paths to suit the changing conditions of the environment. This was the case, for example, in the Netherlands during the late nineteenth century, when a hygienic transition took place from cesspools to sewer systems (see Geels 2006a). Niche innovations may also be adopted when they are sufficiently mature and when they have symbiotic relationships with the regime. A historic example of this alternative pathway is the shift that occurred in American factory production, when traditional factories switched over to mass production (see Geels 2006b).

Looking Ahead: The Potential of Transition Narratives

The multilevel perspective on sustainability transitions has been applauded for taking into account the interaction of different contextual factors at multiple levels. It has also proven useful and necessary to understand past transitions, since the industrial revolution, for example. However, it could be argued that persistent sustainability issues, normative by nature, also require new forms of social learning as well as an in-depth analysis of what could be termed "sustainability transitions in the making." In other words, while the multilevel perspective and others such as the social practice approach (Shove 2003; Spaargaren et al. 2002) have certainly shown their relevance in describing sustainability transitions in a less one-sided (i.e., nonlinear) and more historically sensitive manner, the more sustainable management of transitions (as in SNM or transition management) remains an important yet contested issue (see e.g., Shove and Walker 2007, 2008).

Part of the reason it is difficult to steer society in a more sustainable direction is that disagreement often exists with regard to what a sustainable society should look like in the first place. Criticisms of the concepts of sustainability and sustainable development have been widely reported in the literature (see e.g., Gibson 1991; Daly 1993; Rees 1995). Some of the most recurring criticisms are that the concepts are too vague, that they distract us from real-world problems such as poverty and global inequality, and that they may exacerbate the problem of "greenwashing." Although these and other criticisms must be taken seriously, it is generally agreed that, however ambiguous and contested the term may be, we need to mainstream sustainability. Indeed, construct ambiguity can also be viewed as a positive, in the sense that "the lack of definitional precision of the term sustainable development may represent an important political opportunity" (Robinson 2004: 374). In addition to their role in teaching and research, higher education institutions can also lead by example by implementing a range of sustainability initiatives (see e.g., Thomashow 2014).

Recent research on "sustainability transition pathway narratives" has responded to the general idea of constructive ambiguity by providing an overview of alternative sustainability solutions. Transition narratives can be described as "idealized approaches for navigating societies toward sustainability" (Luederitz et al. 2017: 394). Various sustainability interventions and their associated narratives can be distinguished. For example, the narrative of the green economy puts forward the idea that it is possible to reconcile economic development with environmental policy (Pataki 2009). Thus, economic growth can be decoupled from environmental degradation through the development of greener and more efficient technologies. The narrative of the low-carbon transformation, on the other hand, focuses on a specific problem (i.e., climate change) and the role of cities and local governments. Other narratives, such as those of transition movements or ecotopian solutions (see Luederitz et al. 2017), may include interventions that aim for greater systemic changes but are more difficult to achieve. Examples here include the potential (but also up-scaling problems) of urban farming initiatives and the introduction of alternative currencies.

Future research may reveal the existence of other transition narratives and identify synergies that exist across them. For example, recent discourse on "smart cities" contains elements from both the green economy and low-carbon transformation narratives. Another, related example is the rapid growth of "urban living labs" (ULL), which often combine a diverse set of sustainability interventions. As noted by Luederitz et al. (2017), sustainability transition studies should also consider how different narratives provide learning opportunities to help foster sustainability transitions. Thus, we can attempt to move beyond the apparently hopeless clash of conflicting voices in sustainable development.

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Sustainability Weeks and Sustainable Development

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Definition

A type of event (usually annual) organized by higher education institutions with the goal of raising environmental awareness while engaging university members with local communities. Along these meetings, a great variety of activities directly related to environmental issues are carried out in order to disseminate institutional actions associated with research, teaching, extension, and management in sustainability on its multiple dimensions (social, environmental, economic).

Introduction

Higher education institutions (HEIs) have intensified their environmental sustainability by developing many activities in this direction and at the same time making the educational processes and facilities more sustainable.

From the institutional environmental management's perspective, the engagement of the university community (students, teachers, and employees) is essential in order to reach success, either as a direct action for the operators within their professional activities or for the users of academic spaces. Therefore, the HEIs have developed different engagement strategies, ranging from short-term campaigns and events to training programs for their administrative and operational staff.

In a broad sense these actions are related to environmental education (EE), which, according to the Charter of Belgrade (1975), has the goal of developing a population awareness about the environmental problems while establishing "the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions for current problems and the prevention of new ones" (UNESCO 1975).

In this context, the sustainability weeks (SWs) are an opportunity to develop EE activities, publicize the environmental actions developed by the institutional management, engage the university community on its programs, and provide educational opportunities that broaden the curricular approaches. They work as a starting point for more in-depth educational activities, having an important role in sensitizing the university community and its surroundings (city and region) while engaging them in the sustainability program that the HEI is tracking or has already been able to implement.

This paper presents a compilation of some activities developed by different HEIs. They are collected from sustainability's reports produced by the HEIs and then categorized according to their themes. In each of these themes, reference points and environmental management structures are identified as indicators, aiming to establish a framework for those wanting to organize a sustainability week (SW) in any university.

The survey was carried out at the institutions websites using the keywords "sustainability week" and "higher education institution." The SWs programs available on the HEIs websites were considered for the activities compilation.

Many websites were analyzed, but only SWs activities of 18 HEIs from 11 countries were categorized (Asia, Europe, Oceania, and USA). (Universidad Miguel Hernández-UMH (Elche, Spain); Universitat Autònoma de Barcelona-UAB (Catalunya, Spain); Universidad de Sevilla (Spain); University of Brighton (England); University of Southampton (England); Wageningen University (Netherland); Purdue University (West Lafayette, USA); the University of Mississippi (Oxford, USA); College of Charleston (South Carolina, USA); San Diego Mesa College (California, USA); Queen's University (Canada); the University of Auckland (New Zealand); Hokkaido University (Japan); Universidade de São Paulo (Brasil); Instituto Federal de Educação, Ciência e Tecnologia de São Paulo (Araraquara, Brasil); Pontificia Universidad Católica del Perú (Lima, Perú); Universidad Costa Rica; and Institución Universitaria Salazar y Herrera-IUSH (Medellín, Colombia).) The investigation makes sense when the activities found during the web search are considered representative for what was expected in terms of themes and methods frequently occurring in a SW. Due to the large number of HEIs organizing SWs, this can't be considered a statistical sampling but the result of a data saturation strategy.

Sustainability Weeks in Higher Education Institutions' Sustainability Indicators

In order to understand the importance given to the SWs in the context of the HEIs' sustainability actions, we've tried to identify their presence in different tools of global university classification and self-reporting frameworks.

The figure of the SW was not found as an indicator or an evaluation question accounting points. However, in three of the analyzed tools, indications that SWs can contribute to the HEI's sustainability index were found. These are the "Universitas Indonesia GreenMetric World University Ranking," the "Network of Sustainability Indicators in Universities" (RISU in Spanish), and "Sustainability, Tracking, Assessment, and Rating System (STARS)," described below.

UI GreenMetric World University Ranking

Universitas Indonesia (UI) has created a worldwide ranking of universities, known as UI GreenMetric World University Ranking (http://greenmetric.ui.ac.id/). One of the six categories used in this ranking is *education* (ED), with a weight of 18%, which evaluates, among other things, the number of events related to environment and sustainability (e.g., conferences, workshops, awareness raising, practical training, etc.) hosted or organized by the university (average per annum over the last 3 years).

First place in the 2017 ranking was the Wageningen University and Research, which organizes the "Seriously Sustainable Week" to celebrate, since 2015, the National Sustainability Day in the Netherlands. In their fifth birthday the program was intense and diversified, ranging from themes related to individual health and well-being (short yoga/stress relief session) to issues of collective and global interest (modern slavery and food production, sustainable fashion, secondhand book sale and clothes swap, Dabke workshop: a traditional Arab dance).

Network of Sustainability Indicators in Universities (RISU in Spanish)

The Network of Sustainability Indicators in Universities (Red de Indicadores de Sustentabilidad en las Universidades – RISU in Spanish) was organized by Alliance of Iberoamerican University Network for Sustainability and the Environment (Alianza de Redes Iberoamericanas de Universidades por la Sustentabilidad y el Ambiente – ARIUSA in Spanish) (http://web.unep.org/training/alianza-de-redes-iberoamericanas-de-universidades-por-la-sustentabilidad-y-el-ambiente-ariusa. http://ariusa.net/es/informe-sobre-resultados-del-proyecto-risu). The RISU Project enrolls 65 universities in 10 countries and focuses on the development of indicators to assess

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the implementation of sustainability policies in Latin American universities (Benayas 2014).

Eleven areas of indicators were studied. Among these areas, *sustainability awareness* and *participation* were considered the most directly related to SWs. Their 12 indicators aim at assessing the extension of universities support to public awareness initiatives and learning opportunities in sustainability outside the formal curriculum (Benayas 2014). Among the indicators with high scores, it is highlighted that 86% of the universities organize these actions for university-community members. However, the average scores obtained for all the indicators in management areas are much lower and may indicate that there is a lack of real effectiveness on environmental awareness measures, as these are not translated into behavioral changes that would improve institutional performance. The conclusion is that "it is usually easier and more cost-effective to promote awareness programs than management measures" (Benayas 2014).

Sustainability, Tracking, Assessment, and Rating System (STARS)

The Sustainability, Tracking, Assessment, and Rating System™ (STARS) framework was voluntarily developed by the Association for the Advancement of Sustainability in Higher Education (AASHE 2017a) (www.stars.aashe.org) and consists on a self-reporting framework for helping colleges and universities tracking and measuring their sustainability progress (AASHE 2017a).

The STAR's score is based on the percentage of points across four categories. (The categories are academics (AC), engagement (EN), operations (OP), and planning and administration (PA). In addition, institutions may pursue innovation and leadership (IN) credits.) Among these categories, *engagement* (EN) is the closest one related to activities performed in SWs. Its subcategory *campus engagement* seeks to recognize sustainability learning experiences outside the formal curriculum (cocurricular activities) that allow students to deepen and apply their understandings of sustainability principles (AASHE 2017b). An important credit in this subcategory is the *outreach campaign*, which recognizes activities that produce measurable and positive results in the institution's sustainability performance (e.g., energy reduction or water consumption). According to AASHE (2017b), these types of campaigns engage the campus community and can help raising student and employee awareness on the sustainability's principles.

The highlights in "2017 Sustainable Campus Index – SCI" regarding *campus engagement* are a custom-designed online engagement platform and incentive program (Stanford University), the sustainability pillar in a cocurricular program (Niagara College Canada), a green labs program (University of Victoria), a multi-institution initiative (hosted by James Madison University) to transformative teaching and learning in research and practice, and an initiative to make the paper industry more sustainable (University of Illinois). These types of examples reflect the diversity of activities that should encompass the engagement initiatives at public universities.

Considering the three evaluation tools here analyzed, it should be emphasized that the first case stands out the role of individual approaches as well as the collective actions for common goals, which promotes a sense of belonging to the place and society as a whole; in the second one, the awareness actions should be accompanied by structural and operational changes; and, in the last, the importance of a diversity of strategies for promoting the university-community involvement.

Guidelines for a Sustainability Week (SW)

A sustainability week can be taken as an opportunity to raise environmental awareness in the university's community while developing its engagement in better management practices (Guidelines. UI Green Metric World University Rankings 2017).

A process overview to initiate transformation in an HEI comprises a range of activities related to (a) engaging the university stakeholders (academic and operational staff and students) as well as the wider community; b) awareness and training in every sustainability action plan;

(c) communications and documentation to facilitate engagement of the university's community and maximize the chances of success; and (d) closing the loop, monitoring, evaluating and communicating progress, including annual sustainability reporting, and marketing promotion and celebration of successes (UNEP 2013, 2014).

All these activities, part of an environmental management system (EMS), are related to stakeholders' engagement, in which SWs can play an important role as information disseminators, performing from a "general awareness" to an effective engagement in action plans, leading to a broad participatory process in which the parties involved can contribute in a qualified way. According to Partridge et al. (2005), engagement describes the "organization's efforts to understand and involve stakeholders and their concerns in its activities and decision-making processes."

According to UNEP (2013, 2014), *awareness-raising* and *training opportunities* (all level of staff and new students) should be part of regular induction procedures, explaining the university's sustainability policy and action plans, the impacts of their activities, and the importance of compliance with relevant legislation and regulations. Besides that, it is important that "personnel are exposed to the most recent technology and knowledge base relevant to the organization's significant environmental impacts" (UNEP 2013, 2014).

Similarly, each sustainability action plan will need to incorporate a *communication strategy* to facilitate engagement and maximize the chances of success United Nations Global Compact Office (2012). Approaches and tools may include minuting meetings, newsletters, social media, focal groups and workshops, displays, and exhibitions. In this context, sustainability reports inform the university and wider community on what has been achieved and what remains to be achieved (UNEP 2013, 2014).

Sustainability Weeks and Levels of Engagement

In order to identify how SWs can contribute in this process, it is necessary to map the potentialities and comprehensiveness degree on the promoted activities, investigating their role in planning the transition from HEI to sustainability. To attend this task, the levels of engagement indicated by UNEP (2013, 2014) were highlighted through the participation of stakeholders in EMS with various strategies, depending on their steps and the stakeholder's profile involved.

UNEP (2013, 2014) presents a spectrum of situations for actor's engagement in the context of HEIs, which we relate to SW activities. This spectrum ranges from less complex activities with a low interaction between the actors to disclose information and actions (*inform*) and/or gain information and feedback from stakeholders about decisions made by management (*consult*), through activities that have greater interaction (*involve*), to those comprising joint actions (*collaborate*) and delegated decision-making (*empower*).

In terms of supporting HEI's environmental management, actions at all levels of engagement – *inform*, *consult*, *involve*, *collaborate*, *empower* – are important, once the information and activities developed will include different audiences from university's community (and surroundings), with different objectives (from informing to empowering for transformative actions). Due to their limitation in time, the SWs have some constraints carrying out more extensive capacity building activities (to reach *collaborate* and *empower* levels). Despite this, it is possible to develop training activities (such as short-term technical courses) in which the necessary skills, knowledge, and attitudes for the development of EMS action plans are built.

On the other hand, the SWs are great opportunities to reach the first levels (*inform*, *consult*, *involve*), which might be reachable with short-term activities covering different methods and subjects that will attract the interest of distinct audiences (students, teachers, employees, and general public) that have different levels of knowledge and interest in sustainability issues.

The research carried out on the activities developed in SWs demonstrated this variety of methods (Table 1) and topics covered (Tables 2, 3, 4, and 5).

Sustainability Weeks and Sustainable Development, Table 1 Typical methods applied by the activities of the sustainability weeks in an individual and collective scope

Individual (I) / Collective (C)	Methods of SW activities	Acronym	Description
I	Lecture (hear)	L	Lecture without talks and discussions
I/C	Lecture (hear/ be heard)	LHH	Lecture plus talks and discussions
C	Panel discussion	PD	Assembles a diverse panel of specialists to discuss sustainability themes (campus and surroundings)
C	Multi-stakeholder forums	MSF	Assembles a diverse panel of individuals to discuss sustainability themes (campus and surroundings)
C	Cross-disciplinary dialogues	CDD	Brings together different classes into an interdisciplinary discussion on sustainability topics
C	Workshop	WS	A meeting to discuss and/or perform practical work in a subject or activity. Hands-on experience. Do it yourself (DIY) workshops
C	Eco-walk	EW	Guided tour in natural areas (campus/around)
C	Technical visit/ field trip	TV/FT	Guided tour in places that demonstrate good practices in EMS (campus/around)
C	Sustainability competitions	SC	Competitions between classes/groups on subjects such as water and energy saving
I/C	Experience	EXPE	Sensorial experiences
I/C	Event	EVE	Activities in general
I/C	Exposition	EXPO	Demonstration, through various activities, of new technologies, research results, and action plans
I/C	Film/ documentary screening	FD	+ talks and discussions

Examples of Methods Developed in Sustainability Weeks

The survey on SWs programs indicates a wide variety of methods applied, ranging from activities with individual focus to others prioritizing collective interactions; activities that encourage competition between the classes or groups to those emphasizing cooperative and solidarity practices; activities that include more fun, recreation, and sensorial experiences to others with more technical-operational contents; activities developed indoor and/or outdoor; activities with a more passive feature to others “do it yourself”; and activities that demonstrate actions developed by the HEI to external actors (companies, enterprises, public administrations, etc.).

Table 1 shows the main methods that were found, classified according to its individual and collective focus. The description was based on UNEP (2013, 2014) and Partridge et al. (2005).

Examples of Activities Developed in Sustainability Weeks

Concerning the methods, the surveys in the SWs programs indicated a wide variety of topics addressed in their activities. These topics represent many dimensions of sustainability and are appropriate to enroll people no matter what their current knowledge in the field is.

In order to facilitate the results perception, the activities were grouped into four categories also reflecting the activities usually developed in the HEIs’ action plans.

The categories (and their respective subcategories) are:

1. **Environment**
   – Climate change
   – Water, land use, and wildlife
2. **Operations**
   – Renewable energy

Sustainability Weeks and Sustainable Development, Table 2 Activities comprising the environment category on sustainability weeks and the methods and levels of engagement identified

Category: environment		Levels and methods of engagement				
Subcategories	Activities	Inform	Consult	Involve	Collaborate	Empower
Water, land use, and wildlife	Green areas. Forest fragments. Ecological corridors	L/PD	Possible to apply in all activities			
	Planting of tree seedlings			WS	WS	
	What is a worm farm, how it works, and how to do it			WS	WS	
	Exposure of environmental adjustments on campus	Various				
	Eco-walk/wild walk – with a talk, photograph, and identification of local wildlife			EW		
	Find and identify a range of natural campus elements			EW		
	Composting and agroecology workshop			WS	WS	
Climate change	Carbon calculator. Calculation of the individual carbon footprint			WS		
	Use of skype for business to avoid trips				WS	
	Climate change	L/PD				

Legend: *L* lecture, *LHH* lecture (hear/be heard), *PD* panel discussion, *MSF* multi-stakeholder forums, *CDD* cross-disciplinary dialogues, *WS* workshop, *EW* eco-walk, *TV/FT* technical visit/field trip, *SC* sustainability competitions, *EXPE* experience, *EVE* event, *EXPO* exposition, *F/D* film/documentary screening

Sustainability Weeks and Sustainable Development, Table 3 Activities comprising the operation category on sustainability weeks and the methods and levels of engagement identified

Category: operations		Levels and methods of engagement				
Subcategories	Activities	Inform	Consult	Involve	Collaborate	Empower
Waste – recycling	Zero waste campus events		Possible to apply in all activities	Various	Various	
	Campus waste audit			WS	WS	
	Beach clean and litter pick			WS	WS	
	Making decorative objects with non-returnable glass bottles			WS	WS	
	Workshops on materials reuse: confecting pots out of tetra-pack milk boxes, seats from PET bottles, portraits and exhibition on recycled and recyclable materials			WS	WS	
	Composting and agroecology workshop				WS	
	The market for recyclable solid waste and its importance for the economy, society, and the environment			WS	WS	
	Donation campaign for used books and clothes			WS	WS	
	Collection of electrical and electronic devices (cell phones, chargers, keyboards, video game consoles, etc.) at authorized points available on all campuses			WS	WS	

(*continued*)

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Sustainability Weeks and Sustainable Development, Table 3 (continued)

Category: operations		Levels and methods of engagement				
Subcategories	Activities	Inform	Consult	Involve	Collaborate	Empower
Renewable energy	Wind farm tour			TV/FT	TV/FT	
	Career networking session for students with interests in the renewable energy industry				PD	PD
	Energy and renewable energy	L				
	Solar farm tour (a community-owned solar farm). Super home energy-efficient home tour			TV/FT	TV/FT	TV/FT
Sustainable transport	Sustainable transportation day					
	Campus transportations Expo			Various	Various	
	Basic workshop on mechanics for bicycles			WS		
	Free bike maintenance support			WS		
	Cargo and trailer bike meetings – a chance to meet up with people who carry large loads on their bicycle or trailer			WS		
	Electric boat trip – new technology in water transportation, which is being developed by the HEI	TV/ FT				
	Sustainable shipping – an academic and industry event exploring the challenges faced by the maritime industry in becoming more sustainable	EVE/ EXPO		WS/ EXPO		
	Alternative transportation. Open to the public, with a variety of alternative modes of transportation, such as electric vehicles, bicycles, and hybrids	EXPO		EXPO		
	Alternative transportation hub – event with sustainability-related topics	EVE/ EXPO		EVE/ WS		
Green infrastructure	Green construction. Green building. Green sustainable city pattern	EVE/ EXPO		EVE/ EXPO		
Local and sustainable food	Agroecology	L/PD				
	Urban garden workday (seed saving, planting)			WS	WS/FT	
	Risk communication in food and agriculture and agroecosystem	L/PD				
	Sustainability lunch – guest speakers delving into food waste, energy storage, and personal carbon footprints			WS		
	Food co-ops/buying groups (cost savings and environmental benefits)	PD		PD	PD	
	Local food and recipes. Alternative foods. Local food cook-off competition			WS/ PD/ EVE	EXPE	
	Market with agricultural products of the season			EXPE		

Legend: *L* lecture, *LHH* lecture (hear/be heard, *PD* panel discussion, *MSF* multi-stakeholder forums, *CDD* cross-disciplinary dialogues, *WS* workshop, *EW* eco-walk, *TV/FT* technical visit/field trip, *SC* sustainability competitions, *EXPE* experience, *EVE* event, *EXPO* exposition, *F/D* film/documentary screening

Sustainability Weeks and Sustainable Development, Table 4 Activities comprising the sociocultural category on sustainability weeks and the methods and levels of engagement identified

Category: sociocultural		Levels and methods of engagement				
Subcategories	Activities	Inform	Consult	Involve	Collaborate	Empower
Equity, justice, and local economy	Encouraging participation in local voluntary projects		Possible to apply in all activities	Various	Various	Various
	Collaborative economics and collaborative funding projects			Various	Various	Various
	Talk about family farming and fair trade	PD		PD		
	Donate to your favorite sustainable organization			EXPE	EXPE	EXPE
	Socialization of eco-ideas: sustainable business projects	PD		PD/WS		
	The market for recyclable solid waste and its importance for the economy, society, and the environment	PD/ CDD		WS	WS	WS
	Exchanging fairs – solidary economy enterprises that people and groups meet to exchange products, services, or knowledge			EVE	EVE	EVE
	Solidary economy – production, consumption, and environment	PD/ CDD		EVE	EVE	EVE
	Visit solidary economy co-ops			TV/FT	TV/FT	
	Social business contest			EVE	EVE	EVE
	Sustainable market/solidary market			EVE	EVE	EVE
	Earth democracy and ecofeminism	PD				
Health, happiness, and spirituality	Sensory circuit with plant species. Explanations and benefits of Hortotherapy			EXPE		
	Workshop with performance exercises for children who will explore their ideal world			EXPE		
	Garden party – a tour of the garden with live music and spoken word poetry readings			FT/ EXPE		
	Guided tour of the medicinal plant garden (focus on soothing and tranquilizing plants)			GT/ WS		
	Yoga practice			EXPE		
	Field class			EVE		
	Group cleaning in order to extinguish mosquito (*Aedes*) breeding sites on campus/surroundings			EVE	EVE	
	Green run – sport and sustainability, inclusion of people at risk of exclusion, tree planting			EVE	EVE	EVE
Culture and tradition	Traditional peoples and environment	L/PD				
	Talks from local people using permaculture techniques	PD		PD	PD	

Legend: *L* lecture, *LHH* lecture (hear/be heard, *PD* panel discussion, *MSF* multi-stakeholder forums, *CDD* cross-disciplinary dialogues, *WS* workshop, *EW* eco-walk, *TV/FT* technical visit/field trip, *SC* sustainability competitions, *EXPE* experience, *EVE* event, *EXPO* exposition, *F/D* film/documentary screening

Sustainability Weeks and Sustainable Development, Table 5 Activities comprising the transversal category on sustainability weeks and the methods and levels of engagement identified

Category: transversal	Levels and methods of engagement				
Activities	Inform	Consult	Involve	Collaborate	Empower
Contributions of researchers and teachers to the United Nations Sustainable Development Goals (SDGs)	EVE/ EXPO		EVE/ EXPO		
Know your goals – how everyone can contribute toward SDG in their personal and professional lives			WS	WS	WS
Sustainability careers – how to incorporate sustainability into careers			PD		PD
Sustainable involvement: the vision of women in science			PD		
Environmental licensing	L/PD				
Sustainability and entrepreneurship	L/PD				
Cleaner technologies and production	L/PD				
Water management in the urban environment	L/PD				
Sustainable urban planning	L/PD				
Sustainability summit – explore innovative solutions to issues such as climate change, food security, and water resources	L/PD		WS	WS	WS
Film festival/exhibition of photos – topics: nutrition, environmental sustainability, fashion industry, sustainable architecture, history of cycling, permaculture, climate change	EVE		EVE		
Postcard-writing. Students can send legislators what sustainability issues interest they care about	EVE		EVE/ WS	EVE/WS	EVE/WS

Legend: *L* lecture, *LHH* lecture (hear/be heard), *PD* panel discussion, *MSF* multi-stakeholder forums, *CDD* cross-disciplinary dialogues, *WS* workshop, *EW* eco-walk, *TV/FT* technical visit/field trip, *SC* sustainability competitions, *EXPE* experience, *EVE* event, *EXPO* exposition, *F/D* film/documentary screening

- Waste, recycling
- Sustainable transport
- Local and sustainable food

3. **Sociocultural**
   - Culture and tradition
   - Equity, justice, and local economy
   - Health, happiness, and spirituality
4. **Transversal**
   - Activities that cover different topics, which are related to the other categories

Tables 2, 3, 4, and 5 demonstrate these categories (and subcategories) of activities classified according to engagement levels and methods. These classifications are not definitive, being the result of an exercise carried out from the activities found in the HEI's programming, and what has been identified as potentialities for each method, according to its reality (in terms of environmental, social, economic dimensions) and its environmental management's stage.

As there are few details about the activities and their results on the HEI's websites, it was not possible to identify the levels of engagement reached. That way, the classification was performed according to the potentiality of the chosen method, considering, for example, a lecture has a low transformative potential (but is good to *inform*), while an event or experience will offer better conditions for integration and solution's collective construction (*collaborate*, *empower*).

The research did not identify activities that have directed the consultations opinion (at the *consult* level) with the participating SW audience. However, it should be emphasized that this is a good opportunity to obtain information on what the community thinks about sustainability issues, generating subsidies for teaching and research and also for better planning environmental management actions and get a feedback on plans already implemented. In this way, consultations (such as opinion surveys, interviews) can be applied in all activities, taking advantage of the fact that many people in the community are gathered together.

With these examples of activities developed in SWs, it is possible to visualize the potentialities and organize a SW that integrates a greater diversity of subjects and strategies (methods) for involving the public.

Each of the thematic categories can have a variety of goals and strategies, depending on how they were structured. The reason is that the activities commonly developed in SWs are linked to different levels of engagement within the parties involved, varying their objectives from simply disseminating information to those focused on building actor's empowerment, according to UNEP (2013, 2014).

All levels of engagement are important in the education process for sustainability. Therefore, this classification does not intend to restrict the possibilities of each method to one or two levels but aims to highlight the level at which the method has the greatest potential or for which is the most appropriate.

Final Remarks

The analyses of the SWs in different HEIs identified a great variety of activities developed through different methods and topics, but mainly, promoting people's commitment and satisfaction, either as organizers or as general public involved and engaged in the necessary ways to transform their institutions into more sustainable spaces.

This is important because, according to Morin (2002), there is an impasse, in which "one cannot reform the institution without a prior reform in his mind and one cannot reform his mind without a previous reform of the institutions." The way to overcome this double bind would be to start anyway, even in a deviant and marginal way, but when the idea is disseminated, that becomes an acting force (Morin 2002).

In this sense, the SWs are great opportunities, in which the actions of involving people in the university community (and surrounding areas) can be initiated, what is closely related to environmental education (EE). Finally, these efforts must be continued and expanded to disseminate the institutional actions of teaching, research, extension, and management and effectively contribute to people's transformation and at the same time enhance the role of the institution that shall educate by the example.

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Sustainability Worldviews

► How Worldview Development Influences Knowledge and Beliefs About Sustainability

Sustainable Campus

► University Operations for Sustainable Development

Sustainable Community

► Sustainability Barriers

Sustainable Development

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Introduction

Many scholars discuss the emergence of "Sustainable Development" (SD), and associated discourses, from "World War 2" onwards. Indeed, it was from the 1980s that discourse solidified at the international scale and became significantly embedded in policy, research, and practice. Driven by nongovernment organizations (NGOs), associated SD praxis was galvanized under the United Nations (UN), diffused deeper into the Third Sector, colonized government policy, and even the discourses and practices of private enterprise (Macekura 2016, p. 66).

SD is of course most famously defined by the UN's World Commission on Environment and Development (WCED 1987, p. 43), as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This work was the culmination of international efforts to reconcile increasing international concern for environmental impact with the continuing demands of the less economically development world for economic and material improvements. Indeed, the formal idea of SD is often associated with the simultaneous consideration of economic, social, and environmental factors in the development process. SD is therefore perhaps best interpreted as an anthropocentric concept focused on the promotion of intra- and intergenerational social justice of life opportunity, therefore offering a coherent approach to contemporary material development that considers future as well as current generations (Langhelle 2000).

Broad interpretations aside, the specific meanings of SD have always been highly contested and quickly developed a cacophony of interpretations and more specific concretization: as reconciling the protection of the natural environment with material welfare improvements has remained more straightforward in abstract principle than lived reality. Moreover, even the unitary definition of "sustainability" is dogged by questions of what is to be sustained, over what period, for whom etc. Despite the numerous interpretations, the UN has continued to provide a central international point of reference and most recently embodied the foundational idea in the Sustainable Development Goals (SDGs); although, wider discourses remain fluid and deeply contested.

In addition to formal contemporary praxis, it is identified that discourses and practices arguably antecedent of, and synonymous with SD, can be identified for much of human history. Indeed, there is currently a sustained effort in both popular and academic literature to counter the idea that humans are only just starting to understand the negative environmental and social impacts of economic activities.

In the light of these definitional and interpretative contests, the remainder of this entry provides an intellectual archaeology of the primary tenants and discourses of SD. It will show that intellectual and practical antecedents are significant, but that any conclusive and unitary operationalization of the concept remains highly allusive. Indeed, there are many criticisms of the contemporary SD Development Goals: not least that they fail to sufficiently recognize deepening environmental crisis while taking a backward step in valuing democracy and freedom as aspirational principles.

Sustainable Development: An Archaeology of Praxis

Homo sapiens as a species, like all other life on earth, are fundamentally dependent on naturally occurring living and nonliving resources, and have evolved to live within certain ecological conditions, for example, a given temperature range (Marten 2010). Most fundamentally, they survive within food webs grounded in the conversion of energy from solar and geological sources, and the consumption of nutrients that originate with the planets primary producer organisms.

Despite these fundamental ecological realities, humans have excelled at the active management of their ecological niche on earth, through the creation of technical and social "tools," including those for communication, social organization, and cooperation (Pezzey 1992; Steiner 2016). Through this conscious process of ecological adaptation, humans have constantly changed their lives in material and nonmaterial ways for the perceived advantage of themselves as individuals, for their "kin," and wider identity and politico-economic groupings. The history of modern humans is therefore, very often, broadly interpreted as a story of "improvement" or "development." Moreover, this rate of collective structural change has arguably intensified over time, and significantly increased with the move from migratory to settled lives, and following subsequent agricultural and industrial revolutions.

There are of course retrospective interpretations of these processes which question the validity of a broadly positive narrative. Sahlins (1998) heavily critiqued the framing of transition from hunter gather livelihoods to settlement as socially progressive. Moreover, while some argue that one fundamental social innovation in early humans might have been a conceptualization and associated culture of justice – including "resource distribution norms pertaining to equity and fairness" (Buckholtz and Marois 2012, p. 655) – the inequalities in human lived experience are of course a matter of historical fact (p. 329; Pezzey 1992). Others have also questioned positive narratives on a wider set of criteria, including outcomes in terms of "happiness" and fulfilment (Steiner 2016). However, setting aside the retrospective evaluation of outcomes, a long-standing desire for "better lives" or development, including clear themes of distributive justice, can be broadly accepted as a fundamental aspect of human history.

What is often less recognized is that there are long-standing traditions of conscious human concern for the impact of their activities on the wider environment, including both immediate ecosystems and the broader biosphere. Indeed, the emergence of formal discourses of environmental sustainability can be usefully conceptualized as arising from a number of long-standing intellectual considerations (Adapted from Kidd 1992), including the recognition of:

1. **Resource constraints** – The availability of natural resources and quality of ecosystem services.
2. **Ecological/carrying capacity** – Recognition that human population can overstretch available ecological resources, or degrade other carrying capacities, as where a rainforest no longer sustains itself through rainfall generation, the introduction of novel entities (e.g., species or waste) overwhelms other resources and processes.

3. **Systems connectivity** – That human activity impacts not just local but also biophysical processes at regional and global scales.
4. **Negative impacts from socio-physical technology** – Human adaption using social and physical technologies have fundamentally compromised social and ecological sustainability.

Naturally, it is difficult to determine if preliterate cultures consciously thought, discussed, or planned with reference to any of the above themes. However, inferences do emerge from other empirical histories, and direct analysis of the sustainable practices usually begins some 8,000 years previously (Meadows et al. 1992; Mebratu 1998). Here it is hypothesized that the global human population, of around 10 million, was often fundamentally ecologically sustainable, and arguably, although by no means universally, socially just (Corning 2011). It is thought that low population-to-resource ratios allowed for a sustained existence and nonsettled livelihoods ensured that resource use and waste production were unconcentrated (Pezzey 1992, p. 327). Indeed, the principle of using rotation in food production can be seen throughout human history (Federico 2005).

Significant changes in the scale and concentration of human impact followed the development of language and technology, such as tools, clothes, and the management of fire (Steiner 2016). Humans adapted past natural constrains on their population densities in two important ways. Firstly, they overcame physical barriers and inhospitable conditions to move into new areas (Mebratu 1998, pp. 494-495). While some migrations were sustained, others were correlated with extinctions of large animals (Sandom et al. 2014; Surovell et al. 2015) and sometimes the collapse of human communities (Diamond 1991). The second opportunity to adapt was through a slow transition to fixed agriculture and its associated technology (North and Thomas 1977). There were many long-lasting communities in Greece, Mesoamerica and Mesopotamia Persia and Rome, as fixed settlement sustained greater populations (Wilkinson 1973). However, these settled communities often disappeared or were greatly degraded due to localized problems with a combination of resource constraints and carrying capacities: a material process often decisively accompanied by socioeconomic discord (Niragu 1994; Ponting 1991). With fixed agriculture, control over territory became even more important, and the development of property emerged; alongside, modern notions of accumulated wealth, intensifying networks of trade, the creation of financial capital, and increasingly complex divisions of labor (Mebratu 1998, pp. 494-495). In summary, settlement and population expansion structurally altered the relationship between humans and their natural environment and this laid the foundation of sustainability concerns of the future generations (Meadows et al. 1992).

As socioeconomic systems developed through feudal arrangements into industrial organization, growing levels of resource exploitation was shadowed by concurrent recognition of environmental impacts (See for numerous examples: Wall 1994). Although major world religious traditions often legitimized and further promoted ecological exploitation (Ponting 1991), they also contained some of the earliest evidence for conscious environmental and social justice sustainability concerns (Gottlieb 1996). Subsequent texts originating in ancient Greco-Roman times further debated the merits of human slavery and later became the foundation of more sustained critique and the eventual dismantling of such formally accepted practices (Hall et al. 2011).

As the written historical record thickens, we find proto-sustainability discourse emerging in discussions of primary economic activities, such as mining, agricultural, and particularly forestry. In sixteenth century Europe, for example, agricultural handbooks advised on maintaining wealth through thrift, although farmers were evidently also aware of the need for rotational grazing, and some writers espoused maintenance of certain soil components to avoid declining yields (Warde 2011). Concurrently, it was noticed in England that woodland was becoming scarce, and by the seventeenth century, it was observed that there were “too many destroyers, but few or none at all doth plant or reserve” (Warde 2011, p. 160). Given the importance of timber, not least as an input in ship building and war, and then later of coal, national resource management strategies were developed (Warde 2011, p. 160). Further European manifestation of environmental sustainability came in the eighteenth century, with the invention of the sustained yield concept, which became the foundation of modern forestry, and there was the proposal that governments should aim to balance supply and demand in order to prevent over exploitation. There was also increasing recognition that continued productivity of soil required active nutritional management, as opposed to the favorable view of "providence" (Warde 2011, p. 161). At the wider scale, the ideas of Thomas Robert Malthus' (1798) on the principle of human population were starting to establish the idea that, despite technological progress, the human population might be fundamentally limited at an external carrying capacity.

Moving to wider geographies, European colonialism – emerging from around the fourteenth century, when Spanish and Portuguese settlement and plantation agriculture arrived in the Azores, Canneries, and Madeira (Richard 2002) – was fundamentally embedded with concern for the socio-economic prosperity and sustainability of imperial countries. Growing European populations, and their expanding material wants and needs, offered a ready market for resource extracted from peripheral colonies and drove the associated environmental degradation in these peripheral places. As we know from more subsequent scholarship, this impact stood in stark contrast to the often highly complex and conscious approaches of local indigenous populations in balancing materials needs with ecological sustainability (Gammage 2011; Watts 1990).

In response to the significant environmental detriment and social horrors of colonial activity, there was of course much socially progressive resistance. While this is well documented in terms of more socially sustainable discourses, less well known are the growing environmental concerns of this period. For example, observations of reduced rainfall following deforestation led the power of colonial administration to protect certain woodlands, explicitly to promote sustainable harvesting (Richard 2002, p. 52). Colonial globalization also paved the way for European knowledge creation, and at the turn of the nineteenth century, Alexander von Humboldt highlighted the scarcity of environmental resources and the negative impacts being created by human development in the New World (Zimmerer 2006, p. 457). Indeed, von Humboldt continued the work of others in advocating the state as protector of environmental resources against commercial interests, and large areas of forest reserve were created, expressly to preserve their natural processes and therefore benefits (Richard 2002, p. 53). Meanwhile in Europe, a greater understanding of soil science was emerging, including the recognition of interactions between soil and air to establish the principles of more technologically sustainable farming (Warde 2011, p. 169).

Clearly then, concerns for the sustainability of local ecosystems are old as human impacts upon them (Wall 1994). However, while resource and carrying capacity constraints were usually seen as local or national issues, there are also long-standing examples of wider thinking. In 1864, some felt that "the scale of [environmental] change initiated by man is no longer local, but global. [That] the climatic and hydrological effects of deforestation provide an example" (Cited by: Kidd 1992, p. 77). Ten years later, Antonio Stoppani proposed humankind as a new force "which in power and universality may be compared to the greater forces of earth," and coined the concept of the "anthropozoic era" to describe this (Cited by: Crutzen 2002). There was also internationalized reflections on the social justice of human experience, in which the horrors of globalized slavery stimulated internationalized demands for greater equality (Schmidt-Nowara 2011); this included an end of more paternalistic concern for colonial populations and culminated in formal decolonization.

The long-run context of colonial rule, and its dissolution, also arguably helped to incubate the emergence of formal internationally codified discourses of SD. As the concept of development crept into the discourse of European material change (Arndt 1981), the shadow of the Great

European War (1914–18) incubated the League of Nations. While its creation was deeply embedded in paternalism of colonial administration, it is seen as part of the intellectual history of SD. The League created more legitimate and genuine *de jure* multilateral support not only for "backward and undeveloped colonies, territories and peoples" (Davis 1919, p. 18) but also for separately protecting the natural world: both for its intrinsic value and more instrumental role in promoting human welfare (Redekop 2010, p. 175).

Later, however, towards the end of the Second World War (1939–45), contemporary international development discourse stabilized further, and associated institutions – the United Nations (1945), the International Bank for Reconstruction and Development (later the World Bank), and International Monetary Fund (1944), and Word Health Organisation (1948) – were established. Influenced by the 1948 Universal Declaration of Human Rights, the focus here was postwar recovery and "international development," whereby Western countries would support developing world governments to improve the material conditions of life (Uvin 2007). Although the focus was largely on the promotion of economic development (See: Adelman and Morris 1997), increasingly recognition of national inequalities led to other discourses: such as a concentration on the concept of "basic needs" (Streeten 1984), which that would be directly absorbed in SD discourse later in the century.

There were other important conceptual stabilizations in the postwar period. Firstly, in contrast to development as a nationally determined and linear process (as conceived by Marx and later manifest in Rostow's (1959) "The Stages of Economic Development"), trajectories of more and less developed nations were argued to be causally related (Frank 1966). Moreover, it was increasingly questioned that the policy tools and technologies of economically richer nations were appropriate, or easily transferred, to the developing world, especially given the limitations of technologically driven development more generally (Schumacher 1973).

Simultaneously, decolonization created a specific concern for ecological sustainability. In this context, Western environmentalists became concerned that intensified economic activity in the developing countries would result in accelerated local ecological deterioration (Macekura 2015). These actors opposed such prospects, not because they viewed ecological resources as the new property of independent peoples, but because they were now understood as belonging "to all the world" (Macekura 2015, p. 33). It was this concern for global environmental resources that motivated the first international environmental NGOs – the African Wildlife Leadership Foundation (AWLF), the International Union for the Conservation of Nature (IUCN), and the World Wildlife Fund (WWF) –to work across national boundaries on transnational issues (Macekura 2015).

This new wave of NGOs was important in the SD story as Western governments were initially focused on stimulating economic development as a tool of Cold War international relations, and were little concerned with the natural environment. However, fuelled by growing commitment, NGOs continued to work for protections and persuade governments and other actors about the importance of environmental concerns. Indeed, by the mid-twentieth century, air and water pollution, excessive resource exploitation, rapid population growth, and many more issues had become too obviously and well publicized to be ignored. In the late 1960s and during the 1970s, emphasis shifted from concern over the adequacy of resources for economic activity to the maintenance of environmental quality (Kidd 1992). For example, Rachel Carlson's Silent Spring (1962) is widely regarded as prompting much better developed environmentalism among the American Public, though there are of course much longer and complex influences (Gottlieb 1993). More broadly, ecologists highlighted that national and international development needed to consider its impacts on natural ecosystems: a celebrated example being Farrar and Milton's 1977 warning of declining ecosystem productivity (See: Hulse 2007, p. 25).

The Formal Creation of Sustainable Development Discourse

In 1971, a new perspective on the sustainability of human development was introduced. Nicholas Georgescu-Roegen publish *The Entropy Law and the Economic Process*, in which he argued that the foundational laws of thermodynamics fundamentally limited global economic potential and therefore made a steady-state economy inevitable (Cited by: Kidd 1992, p. 10). More concretely, a group of eminent European scientists and concerned citizens, the Club of Rome, published a comprehensive analysis of environmental impact: concluding that if current rates of economic activity continued, most ecological limits would be transgressed within decades (Meadows et al. 1972).

At this point, concern for the natural environment incubated discourses of "sustainability," "development without destruction," and "environmentally sound development" (Kidd 1992; Mebratu 1998, p. 501). Most relevantly, the Polish-born French economist Ignacy Sachs codified the concept of "eco-development," which laid firm intellectual foundations for SD as "an approach to development aimed at: harmonizing social and economic objectives with ecologically sound management, in a spirit of solidarity with future generations" (Cited by: Kidd 1992, p. 12).

According to Tryzna (1995), the further major breakthrough in conceptual insight came from the IUCN. Together with the WWF and The United Nations Environment Programme, they published the *World Conservation Strategy* (1980), with the subtitle of "Living Resource Conservation for *Sustainable Development.*" The term Sustainable Development instantly broke into the mainstream development discourse as the new President of the World Bank, A.W. Clausen, delivered a speech on, "Sustainable Development: The Global Imperative" (Cited by: Kidd 1992, p. 22). Interestingly, the UN Declaration on the Right to Development (UN 1981) granted material development and national sovereignty of resources with no mention of sustainability; although, equality and participatory governance were reiterated. The more disruptive development came in 1983, when the UN World Commission on Environment and Development (WCED) was convened to address interrelated concern "about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development" (Gentile 2009, p. 197). Returning their findings in *Our Common Future* (the *Brundtland Report*) in 1987, the Commission prominently established the concept of Sustainable Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, p. 43).

Despite the subsequent and widespread focus on the WECD's succinct definition, the report offered much more complexity. Although an emphasis on "basic needs" was taken forward (see above), SD was also to be about improvement of human lived experience, as it "requires. . .*extending to all the opportunity to fulfil their aspirations for a better life*" (WCED 1987, p. 24 My emphasis). Likewise, SD was fundamentally concerned with deepening and participatory decision-making (WCED 1987, p. 25). The report also offered a rather ambiguous conclusion on discourses of resource constraint and ecological carrying capacity, by summarizing that: "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" (WCED 1987). Although, this actively promoted a continued drive for economic growth, it also explicitly highlighted social justice concerns as requiring "those who are more affluent adopt life-styles within the planet's ecological means - in their use of energy, for example" (WCED 1987, p. 25).

Following the formal coining of SD for international policy making and practice (Kirkby et al. 1995), the UN immediately followed up with the 1992 UN Conference on *Environment and Development* (UNCED – the Rio Earth Summit). This event established: a broad framework for action in the agreement of Agenda 21 (United Nations 1993); a Declaration of 27 principles fundamental to SD; legally binding agreements on Biological Diversity, Desertification, and Climate Change; and the establishment of the UN Commission on Sustainable Development, which institutionalized the agenda as part of the UN's core activities and foster 18 new global environmental agreements and 21 new protocols or amendments to existing global treaties by 2012 (Chasek et al. 2016, p. 66). Moreover, national signatories to Agenda 21 returned home to operationalize the perceived principles of SD in government policy and state regulation. This galvanized concurrent and growing national protection of the environment: such as the UK's Environmental Protection Act (1990). More widely, SD discourse created the troika graphic of integrated social, economic, and environmental spheres; although this is much criticized and redeveloped (Larcher and Tarascon 2015).

Many stakeholders understandably interpreted these events as hugely positive and environmentalists celebrated the embedding of ecological science into public policy: greatly bolstered by the perceived successes of the participatory multilateral governance created by the 1987 Montreal Protocol on substances that deplete the Ozone layer (Chasek et al. 2016, p. 66). However, material improvement and reducing environmental impact have often remained contradictory bedfellow (Wackernagel and Rees 1996). SD instantly became "a contested concept, with theories shaped by people's and organizations' different worldviews, which in turn influence how issues are formulated and actions proposed" (2002, p. 187). From the 1990s onwards, discourses and practices have manifest "major debates as to the nature of sustainable development, the changes necessary and the tools and actors for these changes" (Hopwood et al. 2005, p. 47). Given the extent to which the meaning of SD has been stretched, in the view of some to the point rendering the term meaningless, the concept has been subject to considerable criticism from all perspectives.

In an attempt to salvage meaning in this context, and analyze SD's interpretation and practice, academics developed classifications of different approaches. Most early efforts concentrated on identifying "weak" and "strong" environmental perspectives (for example, Daly and Cobb 1989). At the so-called weak end of the spectrum, mainly economic interpretations call for the preservation of aggregate levels of capital, therefore justifying the conversation of natural to human-made capital (physical, financial, etc.) (p. 13 cited in Anand and Sen 2000, p. 2035). It is this approach to SD which was most widely adopted by mainstream development institutions, such as the World Bank and national governments (Jacobs 1999; Tisdell 1999), and is often associated with the advocacy of market governance (Hopwood et al. 2005). At the other end of the spectrum is the view that "man-made and natural capital are fundamentally complementary and only marginal substitutes" (Daly 1996, p. 76). In this interpretation, the global economy should not quantitatively expand but qualitatively adapt to reduce the through-put of environmental resources, shifting from nonrenewable to renewable sources of materials and energy (Daly 1996).

Beyond these and many other typologies (Connelly 2007; Hopwood et al. 2005; Palmer et al. 1997), others argued that debates "have often missed the critical political point that this concept was not formulated as part of the technical vocabulary of social science, or as an operational rule that would allow policy outputs to be automatically read off from a list of situational inputs" (Meadowcroft 2007, p. 300). Instead, SD is compared to "liberty," "democracy," and "justice", as a normative point of reference for environment and development policy making, and not as a concept that can, or should, be concretized for specific definitions (Jacobs 1999; Lafferty 1996; Meadowcroft 2007).

In this sense, Amartya Sen's (1999) seminal proposition, that "development" was about the expansion of an individual's "freedom" to live a life they themselves have reason to value, offered a tremendous compliment to the SD agenda. Although Sen always resisted the objective weighting of capabilities, into prioritized basic and otherwise, others writing in this tradition echoed the WCED's differentiation (see: Nussbaum 2003). Unfortunately, however, despite the hugely influential impact of conceiving development as freedom – including as a theory of education for sustainable development (Sullivan 2017; Wilson-Strydom and Walker 2017) – and some marginal consideration (McDonald 2006), it has remained true that "If there is one noticeable gap in Sen's analysis [of development], it is a lack of concern with the environment and ecological changes" (Sneddon et al. 2006, p. 262).

Reformulating Sustainable Development: Contemporary Interpretations

Despite the power of the SD agenda in the early 1990s, the UN's flagship Millennium Development Goals (MDGs) and the Millennium Declaration (UN 2000) mirrored more traditional international development discourses. This framework subcategorized the promotion of SD for governments, NGOs, civil society, and students (and its associated aspirations to increase access to drinking water, whiling reversing deforestation, CO_2 production, and ozone and biodiversity losses), within Goal 7, "to ensure environmental sustainability." The MDGs therefore declined to explicitly highlight that the promotion of "basic needs" might operate within fixed ecological or biospherical thresholds.

Despite this backgrounding of environmental issues in Western development discourse, evidence regarding to extent and gravity of these has continued to mount. Perhaps the most influential summary of this situation was incubated by the Stockholm Resilience Institute, in the proposal that the earth might be subject to nine distinct, yet highly interconnected, planetary thresholds: operating in the areas of stratospheric ozone, biosphere integrity (biodiversity loss), novel entities (e.g., chemical pollution), climate change, ocean acidification, the global hydrological cycle, land system change, biogeochemical cycles (e.g., nitrogen and phosphorus), and atmospheric aerosol loading (Rockstrom et al. 2009; Steffen et al. 2015). If the impact of human activity transgresses these thresholds, it is predicted that significant structural changes in the planet's ecosystem will threaten the "safe operating space" of human development. This conceptualization has indeed been rapidly absorbed into SD discourse (See for example: Sachs 2015, p. 214), alongside other emerging concepts, such as "Cleaner Production" and the Circulate Economy (Larcher and Tarascon 2015).

The most contemporary international policy framework of SD discourse is, of course, the UN's 2030 Agenda for Sustainable Development (UN 2015) and its associated 17 Sustainable Development Goals (SDGs – see Table 1), first conceived in 2012 at the Rio+20 summit in Brazil (Chasek et al. 2016). Agenda 2030 affirms the UN's policy history, including the principle of common but differentiated responsibilities established in Rio, and commits to finish the work of the MDGs. However, the 17 SDGs, with their 169 subtargets, are the most comprehensive global agenda ever developed. Poverty reduction and other conditions of vulnerability remain "non-negotiable priorities,"

Sustainable Development, Table 1 Sustainable Development Goals (UN 2015)

1	End poverty in all its forms everywhere
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3	Ensure healthy lives and promote well-being for all at all ages
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Achieve gender equality and empower all women and girls
6	Ensure availability and sustainable management of water and sanitation for all
7	Ensure access to affordable, reliable, sustainable, and modern energy for all
8	Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all
9	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10	Reduce inequality within and among countries
11	Make cities and human settlements inclusive, safe, resilient, and sustainable
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts
14	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
15	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

but the UN (2015) argues that other "integrated and indivisible" goals promote a shift away from "unsustainable consumption and production patterns."

The UN post-2015 development agenda differs from the MDGs as it applies to all UN countries and aims to completed the reconciliation of material development and environmental concerns in one framework (Griggs et al. 2013, p. 305). In this sense, the SDGs bring together the social, economic, and environmental spheres, as well as a further prominent theme that appropriate governance will be required. However, while there is recognition that socioeconomic development needs to happen within some critical ecological and biophysical limits, SD continues to construct material improvement as compatible with ecological sustainability. There is no sense of thermodynamics as a constraint on development and a more accurate title might be the "*more* sustainable development" agenda. The SDGs are also not legally binding, and instead, governments are expected to take ownership and establish national frameworks for their realization. Although, it should be considered that legally binding international agreement is neither sufficient nor necessary for successful outcomes (Rosen 2015): a conclusion well supported by the subnational actions following the Presidential announcement of US withdrawal from the Paris Climate Accords (Bordoff 2017, p. 22).

One of the most significant critiques of the SDGs is that they fail in their attempt to meaningfully reconcile economic, environmental, and social agendas. The ambition "to end poverty and hunger" might be compatible with that "to protect the planet from degradation. . .sustainably managing its natural resources and taking urgent action on climate change." However, these ecological objectives are seen by many as less compatible, and potentially entirely contradictory with the objective "that all human beings can enjoy prosperous and fulfilling lives," if prosperity is defined as high consumption (UN 2015). Indeed, while there has been some important progress towards more circular economies, many celebrated environmental technologies remain production driven, rather than truly "cradle to cradle developments," as they require new resource exploitation and generate new waste streams that are far from internalized: foundational examples of which might be silicon photo-voltaic cells, electric cars, and the so-called alternative systems of energy storage (Contreras-Lisperguer et al. 2017; Larcher and Tarascon 2015).

A further critique of the UNSDGs might be that they abandon the previous Agenda 21 focus on grassroots democracy as part of the definition of development. While Goal 17 is to "revitalize the global partnership for sustainable development" – and this does reference the need to encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships – there is no mention of participatory decision-making or democracy in the new framework. This does not feature either as a reference to procedural participation or more holistic demands such as freedom of speech and genuine freedom for well-resourced and independent journalism. Indeed, the failure to carry forward the principles of democracy and participatory decision-making from Rio's Agenda 21 might well be significant; state power structures continue to oppress and murder their own citizens (Burns 2018), and rates of political disenfranchisement, even in countries such as the USA, remain of significant concern (Cottrell et al. 2018).

Cross-References

- ▶ Anthropocene and Sustainable Development
- ▶ Conservation and Sustainable Development
- ▶ Cradle-to-Grave and Sustainable Development
- ▶ Curricular Innovation for Sustainability
- ▶ Environmental Resources and Sustainable Development
- ▶ Feedback Procedures on Sustainable Development
- ▶ Indigenous Perspectives of Sustainable Development
- ▶ Quality of Life and Sustainable Development
- ▶ Social Justice in Sustainable Development
- ▶ Sustainability Challenges
- ▶ Waste Management Strategies for Sustainable Development

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Sustainable Development Goals

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Introduction

The Sustainable Development Goals (SDGs), considered a universal set of goals, targets, and indicators, primarily aim at ending poverty in all its forms by 2030 (UN 2015). According to Sachs (2012), these SDGs are based on the eight

Millennium Development Goals (MDGs), already launched in 2001 and that expired in 2015. These were (1) eradicating extreme poverty and hunger; (2) achieving universal primary education; (3) promoting gender equality and empowering women; (4) reducing child mortality rates; (5) improving maternal health; (6) combating HIV/AIDS, malaria, and other diseases; (7) ensuring environmental sustainability; and (8) developing a global partnership for development (UN 2000). The deadline for achieving these goals was set out in the declaration as the year 2015, but, in June 2012 at the UN Conference in Rio de Janeiro (Rio+20), additional targets and tasks related were specified for each goal (Wysokińska 2017).

These MDGs have encountered several constraints over time, such as the following:

(i) They did not arise from any comprehensive analysis and prioritization of development needs and were consequently sometimes only very vaguely focused.
(ii) The loose-leaf nature of many goals impacted on the fostering of synergies between education, health, poverty, and gender.
(iii) Not enough attention was put into the potential impacts across the environmental, social, and economic dimensions; hence, most goals focused on the social dimension to development even if also interrelated with environmental and economic factors.
(iv) There was a lack of clear leadership at both the international and national levels that might partially have affected the achievement of the MDGs.
(v) The general level of government and donor engagement with the MDGs was severely hit by the global financial crisis and economic recession from 2007 onward. (vi) The issue of gender equality received only poor representation, clearly stated only in MDGs 3 and 5 (Lomazzi et al. 2014).

However, in the end, analysis of the MDG implementation results, as described in the "The Millennium Development Goals Report 2015," allows for a positive, even though still not entirely satisfactory, assessment of the progress made thus far (Wysokińska 2017). At this point, the way lay open for the next step – SDG implementation.

SDG Description and Context

In comparison with the previous MDGs, the new propositions enclosed in the SDGs add several additional dimensions to the core aspects of the sustainable development strategy, considered in its economic, environmental, and social aspects. These additional facets include the following:

- Sustainable development based on stable economic growth
- Making appropriate usage of human capital
- Reduction of inequalities within and between countries
- Constructing an economic infrastructure and promoting industrialisation based on innovation and sustainable production and consumption models
- Promoting the sustainable development of cities
- Developing a system for sustainable water resource management (as well as oceans and marine environments)
- Developing a system for the sustainable management of forests, lands, and biodiversity
- Encouraging inclusive social development based on international partnerships
- Ensuring all people have access to the institutions responsible for protecting their human and social rights

In order to meet the UN recommendations, countries were requested to incorporate the new goals into their agendas and policies, working toward achieving the SDGs. While the MDGs focused primarily on poverty and health, the 17 SDGs include 169 targets spanning new areas such as sustainable production and consumption, climate change, economic inequality, innovation, and peace and justice, among other issues. Each goal incorporates specific targets due to be achieved by the year 2030 (Wysokińska 2017).

According to the UN Assembly (2015, p. 14), the 17 goals are as follows:

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improve nutrition, and promote sustainable agriculture.
3. Ensure healthy lives, and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education, and promote lifelong learning opportunities for all.
5. Achieve gender equality, and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable, and modern energy for all.
8. Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts*.
14. Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.
17. Strengthen the means of implementation, and revitalize the global partnership for sustainable development.

According to Wysokińska (2017), the SGD approach stems from the conviction that eradicating poverty and sustainable development deeply interconnect and are mutually reinforcing. Hence, the SDGs correspondingly focus on three dimensions: social, economic, and ecological with the resulting set of approved goals striving to end poverty, protect the planet, and ensure the collective well-being.

The Gupta and Vegelin (2016) perspective on the UN document, "Transforming our World: The 2030 Agenda for Sustainable Development," including the 17 SDGs and their respective targets, contains a rhetorical commitment to sustainable development but fails to mention inclusive development, emphasizing instead the term "growth." In theory, sustainable growth implies growth that takes social, economic, and ecological aspects into account, but the term applied in the document holds a different meaning that rather reflects the idea that growth is needed to reduce inequality.

The selection of these goals took place following a very complete consultation process, contrary to the MDGs, which were settled by a working group at the UN headquarters in New York. In the SDGs case, an open working group with representatives from 70 countries had been established previously in 2013. In parallel, the UN staged several global meetings, national-level consultation processes, and personal/online surveys which asked their respondents to highlight the topics they would like to see approached. The final drafting of the SDG program considered all of these results.

According to the UN Sustainable Development Solutions Network (SDSN) (2015), all SDG indicators need jointly considering as an integrated package as many of them are interdependent and require pursuing in conjunction as progress in one area often depends on progress in other areas. Additionally, measuring the full range of the SDGs and their targets through a compact indicator framework and associated monitoring systems represents a key prerequisite to achieving these goals. The mechanics of monitoring the SDGs need working on extensively in order to appropriately adapt them to the national and regional levels.

The UN Conference on Trade and Development (UNCTAD) (2016) estimated that annual investment requirements amount to USD 3.9 trillion to achieve the goals globally. One instrument for encouraging foreign direct investment involves signing investment treaties and reaching free trade agreements with investment parties. At this point, the Investment Policy Framework for Sustainable Development plays a relevant role in reinforcing efforts in this area. Furthermore, according to the International Institute for Sustainable Development (IISD) (2016), the best financing solution seems to incorporate a platform representing several SDG funding stakeholders. Additionally, the World Bank Group presented a 2030 vision document in which its contribution significantly features open trade promotion and sustainable concessional financing for supporting the SDGs (IISD 2016). Instead of the previous division into financial donors and recipients, the new agreement on SDGs nurtures global partnerships based on the joint responsibility and obligations of all partners. The structure of financing also proved different because it has been noted in recent years that the official development assistance (ODA) fund lacked the flexibility to guarantee permanent economic growth to developing countries in the South.

As regards the EU's role, the community actively participated in drafting the SDGs and has since been fully engaged in implementing the 17 goals of Agenda 2030. Further, the Agenda 2030 was introduced to all EU policies, both internal and external, and with the subsequent adaptation of various activities in order to achieve the SDGs. The EU, contributing €58 billion, is the world's largest development aid donor, mainly directed at developing countries in support of all their efforts to implement the SDGs, especially in those countries most in need. The majority of EU members have committed themselves to raising their ODA contributions to about 0.7% of their gross national product by 2030 (Wysokińska 2017).

The EU has set a good example regarding the fulfillment of certain principles, such as gender equality, while also supporting all the efforts to reinforce the position of women both in society and in employment. Within the context of climate change policies, the EU has largely contributed financial assistance as well as donated to a special fund aimed at protecting the environment (e.g., protection of forests, clean water projects, management of chemical and other wastes, etc.) (Wysokińska 2017).

Universities and the SDGs

Universities and scientific research play relevant roles in both the knowledge society and the economy, generating a significant impact on decision-making processes as is the case of SDG implementation. According to Vilalta (2017), universities and research centers are perceived as neutral and truthful agents, and this presents them with the opportunity to engage in dialogue and open up spaces for collaboration between multiple actors. Thus, some institutions have already established networks to promote the SDGs, while others undertake research about certain specific goals, with some (a minority) having also identified the potential benefits of strategically aligning their study programs with the SDGs, given the educative role they have in societal engagement with the goals.

When universities incorporate the SDGs into their programs, the benefits to society soon become evident: students get better equipped for the global context, and graduates gain the knowledge and skills to contribute to the SDGs, thereby securing a sustainable future. As such, universities need to "support a shared understanding with their students of the great challenges of the 21st century through transversal, pluralistic, inter- and trans-disciplinary teaching" (Neubauer and Calame 2017).

There are certain aspects which universities particularly need to take into account when considering SDGs in their agenda, including (i) aligning curricula and research to the SDG commitments; (ii) developing and adding new contents, learning methods, and transformative approaches; (iii) attempting to develop more applied research around the SDGs; (iv) engaging with students to commit and act in support of the SDGs; and (v) acting as public opinion leaders in support of the SDGs. This approach may result in a paradigm shift in the teaching, learning, and understanding of sustainability (PRME 2015). Embedding these global goals within and across university study programs not only contributes to enhancing and deepening human capital but also brings about an increase in the number of effective actions and policies aimed at living sustainably.

University-level research and teaching is necessary for all of the 17 goals, but, in the opinion of some authors (e.g., Mader and Rammel 2015), the SDGs most closely related with their activity are SDG 04 (ensure inclusive and equitable quality education, and promote lifelong learning opportunities for all), SDG 09 (build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation), SDG 12 (ensure sustainable consumption and production systems), SDG 16 (promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels), and SDG 17 (strengthen the means of implementation and revitalize the global partnership for sustainable development). Despite these authors highlighting only these goals, it is important to stress that all students need to understand the implications of the entire set.

Within the scope of universities, the transformation necessary to achieving the SDGs might be enhanced by actions such as instituting transdisciplinary settings for research and education; capacity building and training to enable leadership for sustainability; establishing sustainability as the baseline for higher education policies at the national, regional, and global levels; applying a transversal institutional approach that reflects people's needs and competences; inspiring transformations at the interface of education, research, policy, and practice; and supporting transformative education including new means of teaching and learning (Mader and Rammel 2015). In this field of Higher Education Institutions (HEIs), the UN Global Action Programme on Education for Sustainable Development was set up to encourage university engagement (Aichi-Nagoya Declaration 2014).

As described above, the benefits of universities engaging with the SDGs which stem not only from the impact that these will have on global society but also from how universities play a leading educative role in the sustainability agenda mean the SDGs are themselves more likely to be attained. The opportunity the SDGs present for transforming education, even if such a transformation may challenge the existing ways of thinking and organizing, may produce further benefits in terms of enhancing learning quality and student experiences. Thus, the conclusion points to universities being closely involved with the social, cultural, and economic development of their countries while also needing to foster alliances for international cooperation in the fields of training, scientific research, and knowledge transfers.

Conclusion

The MDGs represented the first and essential step in the fight against hunger, poverty, disease, and environmental destruction even if the fact remains that through to the 2015 deadline, the effects, which mainly interrelate with the negative impacts of climate change, global hunger, and the consequences of the economic and financial crisis, meant the goals had still not been fully achieved. Compared to the MDGs, this new SGD developmental agenda is more universal in nature and therefore requires all of international society to take responsibility, including the private sectors and NGOs of both developed and developing countries.

The SDG text however does demonstrate that the commitment to addressing ecological issues is significantly lower even though 11 goals deal directly with environmental issues. The focus on technology transfers and scientific solutions is obvious, contrary to the need to redefine the growth concept based on the availability of physical space and enhancing human welfare. Moreover, there are few goals that focus either only on social issues or only on ecological or related issues (Gupta and Vegelin 2016). As such, this is an aspect prone to criticism that should be taken into account when, in the future, the UN evaluates the 17 SDG program. The SDG agenda also runs the risk of meeting the same fate as the sustainable development discourse, that is, the priority goes firstly to economic growth and only then to social and economic goals.

Nevertheless, the SDGs do also represent a useful tool and a worldwide commitment to sustainability able to contribute to securing a legacy for future generations. Furthermore, there is a great potential for the SDGs to mobilize academic communities and social movements to demand the appropriate changes. Deep commitment to the principles of inclusive development by all stakeholders would boost these efforts and improve the quality of life of billions of persons around the world. However, successfully reaching the SDGs above all depends on their correct planning and effective financing.

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Sustainable Development Goals and Networks as a Collaboration Model

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Definition

A dictionary definition of a "network" is any system of interconnected things. However, this basic definition could also be applied to a multilateral agreement or any partnership with enough actors to be considered a system. For the purposes of this paper, the authors define networks as having several key attributes that differentiate them from multilateral agreements or partnerships. The intent of networks is one attribute; actors in networks come together to leverage each other's strengths and pursue a common objective of mutual benefit to all participants. Another characteristic is their horizontal or lateral organizational structure, which allows members to come together as equals. Additional elements are the number of organizations involved, with a network placing no

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limit on the number of members, and an inclusive rather than exclusive membership structure. Clear guidelines for membership are another key attribute, including organized mechanisms for institutions or individuals to join or leave a network.

Networks exist to serve a common goal, which could be as concrete as providing safe drinking water to a particular community or as vague as advancing the cause of democracy globally. Given this diversity of objectives, the form they can take is equally vast. Groups including industry associations, professional associations, unions, social clubs, alumni networks, volunteer organizations, university consortia, political associations, and alliances of NGOs can all be considered networks. In some cases, such as a professional association, participants may be very similar in both interests and skills and emphasize the sharing of good practices and lessons learned. In other cases, members of a network could be extremely diverse, bringing together different skills, perspectives, and objectives. The UN Global Compact is a network of private sector firms, but it includes major multinationals as well as small- and medium-sized enterprises, from all countries, and in all sectors.

Introduction

The Brundtland Commission defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (1987). It is a complex and multifaceted challenge facing present and future generations across the globe. To tackle this issue, in 2015 all 193 Member States of the United Nations (UN) adopted the 17 Sustainable Development Goals (SDGs) to be achieved by all countries by 2030. The Goals encompass environmental stewardship, social equity, and economic development, with specific targets on poverty, hunger, health, education, gender equality, water, sanitation, energy, economic growth, urbanization, climate change, ecosystem preservation, and social inequality.

Achieving these ambitious goals by the tight deadline of 2030 will require collaboration and interdisciplinary action from all sectors of development (public, private, academic, international organizations, and civil society). Networks play a key role in mobilizing these stakeholders into action, as well as coordinating action both within and between sectors. By identifying synergies across sectors, networks embody SDG 17 (partnerships for the goals), forging pathways for partnerships and optimizing the efforts being made to achieve the SDGs.

The Key Role of Networks

Networks are a key tool for successful implementation of the SDGs. Agenda 2030 will be difficult to achieve because of the scale of ambition but also because of the interlinkages between the different goals. Because of this complexity, no one actor or sector will have all the knowledge and expertise needed to achieve the SDGs. Networks have several key advantages which allow them to more efficiently develop solutions to complex problems:

- Rapid and efficient exchange of information
- Bringing together stakeholders with diverse perspectives, expertise, and knowledge
- Coordination of action, reducing redundancies, and balancing trade-offs
- Greater resilience to change

Exchange of Information

Many researchers have demonstrated that networks offer advantages in the dissemination of information. Powell (1990) describes how non-network structures of organization limit the flow of information. In a hierarchical structure, information flow is limited in direction; it can only flow up and down a decision ladder. Alternatively, in most partnerships, legal agreements limit the kind of information that can flow between participants. In a network model, Powell argues that the flow of information is both freer and richer, as the flow of information is neither limited directionally nor in substance. The emphasis is on learning by doing, and any information that is considered useful can flow between diverse actors unfettered.

In the context of the SDGs, this suggests that promising implementation projects or best practices can be disseminated faster by networks than by partnerships or hierarchical arrangements.

Diverse Perspectives and Expertise

Given the interrelated nature of the SDGs, it is critical to bring together diverse expertise to foster innovation, ensure a sustainable solution, and reduce negative spillovers. Take as an example an irrigation scheme in Central Ethiopia that raised yields on farms and improved food security but had the negative consequence of increasing monthly malaria incidence by a factor of 6 (Kibret et al. 2014). The inclusion of a larger set of actors from the public health sector could have supported irrigation system engineers in developing a solution without this consequence. This theory is also supported by Hong and Page (2004), who found that diversity was a stronger factor in solving problems than ability.

Effective Coordination

Networks allow diverse actors to work together toward a common goal, capitalizing on the strengths of different partners to improve efficiency while minimizing redundancy or overlap. Büchel and Raub (2002) found that knowledge networks in particular offered increased efficiency through the compilation and dissemination of knowledge, reducing the need for actors to learn the same lessons independently. A study in Bolivia (Galway et al. 2012) found that poorly coordinated NGOs in the health sector were providing duplicative services in some areas, while other regions completely lacked service provision. A network coordination structure could reduce redundancy in such a scenario, in addition to facilitating the exchange of information and best practices.

Increased Resilience

We define resilience as the ability to adapt and change in the face of a shock or challenge, so that key functions and processes are carried out. In the context of the SDGs, this encompasses a number of challenges, such as maintaining health services during a natural disaster or civil unrest, seeing a project through to completion despite the loss of a key partner, or the provision of modern energy services in an area with an unreliable power grid. Networks can increase resilience to many kinds of shocks. Barasa et al. (2018) demonstrated that social networks and collaboration increased resiliency of health systems, as providers with larger networks had greater access to resources in times of natural, economic, and social crises. An analysis of organizational networks in Canterbury, New Zealand, by Stevenson et al. (2014) yielded similar results, finding that institutions with strong networks were more resilient following a series of earthquakes in 2010.

It is important to note that not all networks are created equally. There are many attributes of a successful network, and should any of these be lacking, there is a chance that the endeavor could fail. Three interrelated challenges are especially relevant in the context of the SDGs:

- Trust between actors
- Effective engagement of all stakeholders and prevention of free riders
- Clear and equitable added value for all participants

Trust Between Actors

Both Powell (1990) and Büchel and Raub (2002) highlight the importance of trust between actors to foster successful collaboration, finding (perhaps unsurprisingly) that the strongest partnerships are those where trust is highest. Büchel and Raub (2002) argue that “trust in networks is built through repeated rounds of interaction that allow network members to make judgments about the trustworthiness of others.” In the context of the SDGs, this finding indicates that trust may be more difficult to generate; history yields many examples where trust between civil society organizations and both government and private sector partners has eroded over time based on past interactions. To achieve the SDGs, partners may need to come to terms with the past and begin a new history of collaboration and trust. Further, Sloan and Oliver (2013) examine the strong role that emotionality plays in building or losing trust. Fortunately, in the case of the SDGs, most organizations and their staff are passionate about their mission in such a way that emotionality could play a role in deepening trust over time. There is no shortcut to building trust, but ensuring that all partners accept trust as a condition for success and developing solid communication tools can lay the right groundwork.

Effective Engagement and Prevention of Free Riders

Bowen et al. (2010) describe three different levels of community-corporate engagement, but their findings can also be applied to broader network engagement. Transactional engagement aims to passively engage participants in a one-way exchange, such as informing a community, while transitional engagement is more participative and includes activities such as stakeholder consultations. To achieve the SDGs will require the third class of engagement, called transformational, which aims to generate collective action while empowering all participants to lead. This kind of deep and thorough engagement can be difficult to achieve. It requires a foundation of trust, as discussed above. All partners must be motivated to contribute, although motivation can take many forms, including the exchange of information, sharing of financial resources, contribution to achieving an organization's core mission, or access to education and capacity building. At the same time, networks have to reduce the opportunities for free riders to benefit without having to provide input or share risk. Transformational engagement also requires participants to share a language of practice and be in consistent and relatively frequent contact, making it relatively more costly from a human resource perspective.

Clear and Equitable Added Value

Closely related to effective engagement is the clear articulation of roles and responsibilities and the equitable sharing of both risks and benefits (Bowen et al. 2010). When participants are candid about what they are willing and able to contribute, as well as what they hope to gain in return, each participant is better able to see the added value to their organization (Stibbe et al. 2018). Further, the costs of participation (staff time, financial resources, social capital, etc.) and the gains (additional staff, new funding, social capital) must be allocated equitably between partners. This is critical in the context of the SDGs, given their global commitment to both reduce inequality and leave no one behind, but also because unequal distribution of risk and benefit can rapidly erode trust, reduce the value of participation by certain partners, and make meaningful engagement of all participants more difficult.

Case-Study Examples from Different Sectors

Academia

Achieving progress on the SDGs will undoubtedly require the involvement of governments to work across policy areas. However, these commitments alone are futile without the mechanisms to steer their implementation. Decision-makers will need to be informed by policy-relevant evidence that is designed and produced by pertinent stakeholders, taking the local context into consideration (El Jardali et al. 2018). In order to fill this gap, global knowledge generating networks such as the Sustainable Development Solutions Network (SDSN) and Future Earth are essential stakeholders in achieving Agenda 2030.

Sustainable Development Solutions Network

One of the leading networks in the academic field is the Sustainable Development Solutions Network (SDSN). Launched in 2012, SDSN aims to accelerate joint learning and promote integrated approaches that address the interconnected economic, social, and environmental challenges confronting the world. As the organization title states, SDSN's purpose is to promote practical solutions for sustainable development and does so by mobilizing global scientific and technological expertise to implement the SDGs and the Paris Climate Agreement (SDSN 2018a). The SDSN was established by and works under the auspices of the UN Secretary-General and supports the implementation of the SDGs at local, national, and global scales through their network of over 800 universities, research institutions, nonprofits, foundations, and civil society organizations. SDSN members span all 6 continents and belong to one of the 16 national (Brazil, Canada, Germany, Greece, Hong Kong SAR, Indonesia, Italia, Japan, Malaysia, Nigeria, Philippines, Russia, South Korea, Spain, Switzerland, Turkey) or 10 regional networks (Amazonia, Andes, Australia/New Zealand/ Pacific, Caribbean, Great Lakes, Mediterranean, Northern Europe, Sahel, South Asia, Southeast Asia). New networks are launched when the membership base in an area is sufficient to support them. According to the 2018 SDSN Networks in Action Report, upcoming new networks include Bolivia, Colombia, Mexico, France, Kenya, South Africa, Uganda, and the United States. Institutions looking to join may do so at any time (SDSN 2018c).

In a field where data, knowledge, and resources can be locked up due to bureaucratic nuances, an academic network is arguably one of the most important. SDSN's ability to create a resource-sharing space available to over 800 knowledge-generating institutions adds immense value to the members involved and to their shared interest: sustainable development. Research suggests that engagement with external organizations strengthens the two core missions of academics, research, and teaching (Abreu et al. 2009). SDSN excels in their ability to engage with external organizations through their events, practical analytical tools, reports, and thematic groups. For example, the SDG Index and Dashboards report (SDSN 2018b) applies analytical tools from academia to data that is predominantly from government sources and disseminates results in a format that is easily digestible by policymakers and civil society. This takes data out of an academic setting and makes it useful for governments to set priorities and track progress, civil society groups to hold government accountable, and a diverse set of actors to identify and share good practice. The highest level of engagement from people-based activities comes from attending conferences and participating in networks (Abreu et al. 2009). In 2017 alone, SDSN and its national, regional, and thematic networks hosted 85 different events to disseminate the results of and discuss the findings of 15 separate reports. Not only does SDSN provide a space for collaboration and coordination, it provides a platform for its members to engage externally, effectively bringing the academics to those who need it most. Internally, SDSN uses the online communication tool Mobilize between national and regional network members to exchange methodologies and approaches while also hosting biannual capacity building workshops for their network managers.

Future Earth

Holding the title of the largest sustainability science consortium in the world, Future Earth is a global platform for international scientific collaboration, providing the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability (Future Earth 2018b). Future Earth boasts 18 national networks with 6 in development, as well as 4 regional networks which cover Asia, South Asia, the Middle East and North Africa, and South Africa, all with the purpose of drawing on its collective knowledge. Interested researchers can join the open network or can reach out individually to Future Earth's global hubs, regional centers, or national and regional networks for involvement. The organization displays adaptability by recognizing that various models for national networks might be preferred and welcomes innovative structures to the national model.

Future Earth's greatest strength as a network is their ability to engage with a variety of perspectives and specializations. Their knowledge-action networks specifically aim to build on the broad range and diversity of expertise represented in the large community of researchers and practitioners associated with the projects of Future Earth (Future Earth 2018a). One specific network, the Water-Energy-Food Nexus Knowledge-Action Network, began with a scoping process designed by a development team. That development team was composed of members from seven global research programs, one regional center, two external partners, two representatives of the early career community, and the Future Earth Secretariat. A steering committee was then established to initiate and stimulate activities within the network; and while the steering committee may oversee the activities, individuals, organizations, and/or initiatives from research and other sectors may propose and lead activities to the benefit of the larger community. Their open-access approach welcomes collaboration, and their diverse actors create a solid foundation that increases resilience and ensures efficiency.

The Private Sector

The private sector has a major role to play in sustainability, although the SDGs are one of the first global agreements that define their role as going far beyond traditional contributions to development (i.e., jobs, tax income, and technological innovation), to include contributions such as building infrastructure and financing (Gneiting 2015). The SDGs demand a level of responsibility from businesses for their decisions. Networks developed to mobilize the private sector are helping businesses navigate these responsibilities, turn them into opportunities, and hold the sector accountable for their actions.

UN Global Compact

As the world's largest corporate sustainability initiative, the UN Global Compact is the leading private sector network. The UN Global Compact aims to mobilize a global movement of sustainability companies and stakeholders to create a better world. With over 12,000 signatories in over 160 countries, both developing and developed, they represent nearly every sector and size firm for a wide-reaching impact. The network is open to any firm and works through the sharing of good practice, capacity building for executives, and voluntary adoption of ambitious targets, including the ten principles. Their membership grows as they demonstrate value for participants; by supporting the private sector, companies are able to take strategic actions to advance broader societal goals, such as the SDGs, with an emphasis on collaboration and innovation.

According to a survey conducted by Corporate Citizenship, creating new business models and partnerships is the best way that business activities can contribute to achieving the SDGs (Guar and Rajewska 2016). The UN Global Compact has developed more than 600 guides, case studies, and reports to support their members. Through tools, resources, and trainings, companies learn to do business responsibly and align their strategies and operations with Global Compact's ten principles on human rights, labor, environment, and anti-corruption. This not only adds value to Agenda 2030, but a company's commitment to sustainability increases consumer trust. Participation in the UN Global Compact is a win-win situation.

World Business Council for Sustainable Development

WBCSD is a global, CEO-led organization of over 200 leading businesses from 6 continents working together to accelerate the transition to a sustainable world, with an objective of ensuring 9 billion people are living within planetary boundaries by 2050. With their members representing a combined revenue of more than US$8.5 trillion and over 19 million employees, the network maintains an unparalleled reach across the globe (WBCSD 2018a). WBCSD differs from the UN Global Compact with its inclusive policy that allows all companies to join for free regardless of their legacy.

WBCSD has a strategic focus to tackle the private sector from the top down. Their CEO-focused approach creates effective engagement among stakeholders and employees. Walls and Berrone (2017) discuss how CEO power based on environmental expertise and formal influence over executives and directors spurs firms toward greener strategies. WBCSD regularly publishes CEO Guides to bring a high-level perspective to issues. Their guides cover topics such as water, climate-related financial disclosures, and the SDGs (WBCSD 2018b). WBCSD also embraces the key function of a network to provide diversity through a content stream, dubbed Panorama, which is designed for looking at sustainability from different perspectives. Through articles and podcasts that members can contribute to, companies are given an unobstructed view of the challenges facing our world and the ways in which they can make an impact (WBCSD 2018c). This both applauds companies for particularly successful programs or innovation, while also supporting the ability of other firms to adopt similar practices.

Government

Governments are perhaps the most obvious stakeholders in implementing the SDGs, as it is national governments who adopted Agenda 2030 in 2015, are responsible for monitoring progress toward achieving the SDGs, and report their progress through Voluntary National Reviews (VNRs) in the halls of the United Nations. However, even governments often find a network model useful for implementation, to better coordination across ministries and with other stakeholders, or to foster collaboration between parliamentarians of different parties. Below the authors present two well-developed municipal networks as case studies; these examples were selected as they have been effective at sharing good practice between cities and in particular on implementing sustainable development policy. Further, both networks have a positive reputation globally and are recognized for their legitimacy. Several examples of government networks from other contexts, such as the Czech Republic, Mexico, the Netherlands, and Sweden, can be found in a 2017 report from the OECD (OECD 2017).

C40 Cities

C40 Cities is a network of the world's largest cities, formed with the objective of addressing climate change (SDG 13), adopting an overall goal to limit warming to 1.5°C. As of the writing of this article, the network includes over 90 cities on 6 continents, representing more than 650 million people and about 25% of global GDP (C40 Cities 2018a). They add value to their members by coordinating the exchange of good practices and expertise around specific topics including energy efficiency, solid waste management, transportation, and urban flooding (C40 Cities 2018b).

C40's network approach has many advantages and allows them to drive deeper action on climate change than a partnership model would. They place an emphasis on the sharing of good practice, allowing cities with successful projects to share their experiences and advise cities in need of solutions. This motivates members to contribute both by recognizing and raising awareness of cities that are doing well in certain areas and providing useful resources to cities aiming to build their own capacity. Further, this kind of exchange fosters transformational engagement as described above; cities approach each other as equals and engage in a two-way exchange. Given the diversity of city experiences, the network members are stronger together. Any given city can show leadership and act as a teacher on topics they are strong in while taking a learning perspective on areas where they are weaker. These exchanges generate a return for all parties involved. The focus on urban planners and civil servants at the municipal level aids this exchange, as it is easier to build trust between participants when so many of their concerns are the same and they share a language of practice. One indicator of their success is the 14,000 actions to combat climate change they have registered (C40 2018a). Lee and Koski (2014) demonstrated that C40 members take "more arduous steps of implementation and monitoring in comparison with non--members" and that the increased level of ambition from C40 Cities has spillover effects encouraging nonmembers to act.

United States Conference of Mayors

The United States Conference of Mayors (USCM) is a nonpartisan organization for cities with populations of 30,000 people or more, which captures about 1,400 cities in the United States. Additional cities meeting the eligibility requirements can join at any time. Similar to C40 Cities, their objectives include developing tools and trainings to build the capacity of mayors to be more effective and to share good practices between mayors and cities. In addition, they work to provide a unified voice on national urban policy through the adoption of resolutions and policy positions, which are presented to the federal government. USCM covers a diversity of topics, most of which are linked to the SDGs, including education (SDG 3), health (SDG 4), housing (SDG 11), jobs and workforce (SDG 8), environment (SDGs 13, 14, and 15), and transportation (SDG 11) (USCM 2018).

USCM's network model shares many benefits with that of C40, discussed above, including fostering greater coordination of action among cities and effectively sharing information between mayors, especially on good practices and successful programs. There are indications that working together on policy objectives has further offered benefits. The nonpartisan nature of USCM and their political diversity increases their legitimacy and ability to lobby the federal government, likely contributing to the passing of federal legislation in line with USCM recommendations on issues including infrastructure (Wogan 2014; USCM 2008) and LGBTQ rights (Freedom to Marry 2016). In addition to increasing policy effectiveness, their greater political diversity also contributes to resilience, allowing them to engage with different administrations and making their efforts less vulnerable to political change.

Multi-sectoral Examples

Often the challenges that networks aim to solve are so complex that a multi-sectoral approach is required. This offers several diversity-related advantages, particularly the ability to bring together different areas of expertise, perspectives, and approaches and the ability to exploit different levers of influence. Further, it allows information to be exchanged between sectoral silos and ensures actors are working together rather than at cross-purposes.

Scaling Up Nutrition (SUN)

Although they characterize themselves as a movement, SUN has many of the key characteristics of a multi-sectoral network. Led by governments working in partnership with civil society, the private sector, academia, UN agencies, and donors, SUN's overall objective is to end malnutrition in all its forms. They track their progress through indicators on stunting, wasting, low birth weight, anemia, breastfeeding, and obesity. Given the interdisciplinary nature of this objective, they call upon stakeholders with a diverse range of expertise, including health, agriculture, education, social protection, and gender equality. SUN currently operates in 57 countries, mostly in Africa and Asia but also covering Latin America and the Middle East (SUN 2016). Any country may join SUN by agreeing to ensure nutrition-sensitive policymaking across all sectors of government and committing to invest in nutrition interventions, working with SUN to adapt their evidence-based projects in diverse contexts (SUN 2018b). Other stakeholders can join SUN's supporter networks for civil society, business, donors, and UN agencies (SUN 2018a). SUN currently works with over 2,000 civil society organizations in 39 countries, 5 UN agencies, and 164 companies.

The SUN Movement works with its members in several ways to spur action to end malnutrition. A major part of their work is brokering technical assistance to countries, including from the SUN support networks. Given the complex linkages between agriculture, gender equality, and poverty with hunger, technical assistance that can help countries integrate policies across these often-siloed areas is a key advantage of SUN's network model. To further support advances in nutrition-sensitive policies, they also host several meetings and workshops, at the local to global scale, to facilitate knowledge exchange and the sharing of good practice. They also work directly to document and disseminate experience across their networks in publications, reports, and training materials which they distribute through their website, emails, and online discussion forums (SUN 2016).

International Network to Promote Household Water Treatment and Safe Storage

Operating since 2003, the International Network to Promote Household Water Treatment and Safe Storage (HWTS Network) aims to improve water safety through household water treatment and safe storage (HWTS), thereby protecting human health. This is a complex challenge, which requires action from urban planners, architects, providers of water and sewage services, individual residents, neighborhood associations, healthcare providers, and educators at all grade levels, among other stakeholders. HWTS Network brings together over 150 organizations, and membership is open to any organization that agrees to the Network's mission and principles (HWTS Network 2018).

The Network's activities include conducting research to evaluate the success of different policies, packaging the results of that research in easily understood formats, and ensuring the results reach relevant stakeholders and decision-makers (HWTS Network 2018). This is accomplished through conferences, networking events, and distance learning programs. A significant advantage of their approach is the unification of a diverse set of technical backgrounds and the development of a shared knowledge to foster interdisciplinary communication between microbiologists, public health specialists, water and sewer system engineers, and community groups.

The Global Partnership on Sustainable Development Data

The Global Partnership on Sustainable Development Data (GPSDD) aims to strengthen data systems and infrastructure to support monitoring and review of SDG progress and in turn SDG achievement. As of this writing, they count 300 members from academia, civil society, the private sector, government, and international organizations (GPSDD 2016a) worldwide, and additional organizations may still join. Their diverse membership supports a broad mission, as well as multiple actions to spur advancement, including publication of policy briefs and research reports, hosting regional workshops, and implementing field projects (GPSDD 2016a).

One flagship project of the GPSDD is the Data 4SDGs Toolbox, a set of methods and resources to support countries in developing data roadmaps for the SDGs, developed through a participatory, multi-stakeholder approach (GPSDD 2016b). By working as a multi-sectoral network, the GPSDD was able to improve this resource, bringing in feedback from a large set of global stakeholders and including the different roles each type of organization can play in the data roadmap. The long-term objective would be for every country to develop their own participatory data road map for monitoring and review of the SDGs. This collaborative process increased trust between collaborators, allowing each to feel ownership of the document, leading to improved dissemination and uptake of the Toolbox.

Conclusion

Achieving the SDGs is the biggest challenge of our time. These goals present a "supremely ambitious and transformational vision" (United Nations 2015) of a future that will require high-level knowledge sharing and coordination of action. The SDGs should not be pursued in silos or sequentially but through integrated strategies designed with the participation of actors from different sectors. Given the relatively short time frame for implementation of the SDGs by all countries by 2030, it will be essential to move forward quickly on multiple fronts simultaneously. Among other activities, this will require pushing forward scientific research in a wide range of fields, facilitating innovation in the uptake of key technologies, mobilizing investment from multiple sources, building social and political support for sustainable development, and experimenting with and implementing appropriate regulations that facilitate concrete action.

Networks can play a key role in all of these fields by helping to quickly disseminate good practices and lessons learned, by bringing together diverse groups to work on common projects, by coordinating activities by a wide range of actors, and by ensuring the resilience of these activities. They offer a unique interface for diverse stakeholders to work together. Networks can adapt to changing needs in a more rapid and often more innovative way than more rigid structures, such as a specific multi-stakeholder partnership set up for the duration of a project. Therefore, networks may hold the key to generating the kind of collective action that the SDGs require while empowering all participants to lead.

Through a variety of examples, this article has shown how networks can amplify impact. Global sustainable development will not be achieved with small-scale projects that result in duplications and allow for gaps in action. In this sense, by providing access to knowledge and results from a range of different experiences, actors engaged in networks can avoid duplications or reinventing the wheel (GIZ 2015). In addition, networks can amplify the impact of projects by connecting successful initiatives to donors, assisting prototype models to surmount barriers of implementation by partnering with more dynamic and experienced allies, or helping to communicate the results of research to policymakers from different regions of the world. Finally, networks can successfully identify gaps in areas of knowledge or technological development and collaboratively work to fill them.

The case studies described here are high-profile examples of successful networks, most of them with global reach, but achieving the SDGs will require engagement far beyond the institutions and fields represented in this small sample. Many networks are being developed at national, subnational, and community levels, often with the involvement of civil society, the nonprofit sector, and regular citizens. Efforts to achieve the SDGs will be more successful if members of the broader public are able to engage with the challenge at a personal level via the vast range of existing networks in our societies, which may not have sustainable development as their central focus but which can still engage in the global discussion on sustainability.

Achieving the SDGs will also require engagement with the industries and fields of human activity that are not easily compatible with long-term sustainable development. Those areas in which transformational change is most required may not be well represented in existing sustainable development networks. Working with the industrial, professional, and personal networks that already exist in these fields may be a useful way to encourage conversation about the SDGs and facilitate efforts toward developing more sustainable technologies and livelihoods for those most invested in these difficult areas.

Finally, a key factor in the use of networks as a tool to achieve the SDGs will be their capacity to evolve over time. As the monitoring framework of the SDGs becomes more established, the results of existing implementation strategies will emerge, pointing at areas that will need to be further developed. Technological advancement may also bring new opportunities that networks will need to capitalize on. The capacity to quickly adapt and develop new alliances will remain essential for networks to maximize their role in achieving the SDGs.

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Sustainable Development Innovation: Education, Research, and Enterprise Activities at Universities

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Introduction

Achievement of the United Nations' Sustainable Development Goals (SDGs) requires progressive action in a number of realms including economic and environmental policy, finance, education, diplomacy, and many others. Technology and innovation are also foundational to success. Innovative technologies can be leveraged to improve the quality and reduce the costs and environmental footprint associated with the provision of basic services such as clean water, energy, healthcare, education, and other critical needs embodied in the 17 SDGs (LIGTT 2014).

The promise of technology in moving the sustainable development needle is exemplified by numerous examples. In the area of access to clean energy (SDG 7), recent advancements in solar photovoltaics, batteries, and information and communications technologies has allowed deep penetration of high-tech, climate-friendly energy technologies in economically disadvantaged and remote communities all over the world. In East Africa, for example, private sector enterprises can now sell solar energy systems to customers living a near-subsistence lifestyle at an affordable cost (Hansen et al. 2014). The penetration of mobile phones and mobile banking services in particular allows highly dispersed populations with low incomes to pay small intermittent fees for clean energy services (Hellström 2010). These technologies deliver the energy to meet basic household needs such as lighting and cell phone charging, as well as to power productive equipment for irrigation, post-harvest food processing, and other uses (Kaygusuz 2011).

Universities play key roles within the sustainable development arena as hubs for educating future innovators and as sites where research and development of new technologies occurs. Increasingly, Universities also act as "incubators" of new enterprises such as those that serve the clean energy sector in East Africa, helping to shepherd sustainable development innovations out of the lab and into the field (Etzkowitz 2002).

When it comes to developing appropriate technologies for sustainable development, a number of unique design challenges permeate the space. Consequently, universities have contributed to the refinement of concepts such as "frugal innovation" (Basu et al. 2013) and "user-centric design," (Wever et al. 2008) and explored their application to the sustainable development sector. A new engineering pedagogy that aims to capture the distinct nature of designing technologies for sustainable development is thus emerging and has an interdisciplinary flavor. This field is most often referred to as "humanitarian engineering" or "development engineering" (Amadei and Sandekian 2010).

A growing trend towards private sector-driven approaches to sustainable development is also emerging in response to the inherent challenges that international aid and charitable organizations face in providing solutions that can be maintained and scaled over the long term (Prahalad 2004). Social enterprises are therefore increasingly relied upon in the sustainable development sector and are promoted by leading development institutions such as USAID (2017). Universities, too, are increasingly turning to entrepreneurship as a viable pathway for elevating solutions developed in the lab to real-world applicability (Kuratko 2005). Entrepreneurship programs, start-up incubators, and other such programs are increasingly in vogue at postsecondary institutions. A confluence of these trends has led a number of universities to pursue social enterprise support activities that marry technology development and entrepreneurship for sustainable development (Göransson 2017).

In this article, the author reviews university-based sustainable development innovation programs across three major thematic areas – education, research, and enterprise – with a specific focus on approaches that relate to technology innovation and social enterprise. Exemplar programs within each theme are highlighted, drawing on secondary research as well as interviews with program managers, faculty members, and administrators at leading universities with well-documented programs. Key challenges, opportunities, and best practices that relate to the development of programs are also explored. Finally, the benefits that such activities may deliver to academic institutions are discussed as are outstanding gaps in understanding and next steps for further analysis.

The goal of this work is to present a typology of activities emerging at leading universities which respond to the technological and enterprise trends that are driving the sustainable development sector. In so doing, the article provides insights of relevance to the creation of new programs and activities aimed at producing innovations that support the achievement of the SDGs.

Education, Research, Enterprise: A Typology of Sustainable Development Innovation Activities at Universities

Universities offer a wide variety of programs and initiatives to train students, conduct research, and develop new ideas and technologies to address sustainable development challenges. The goals of these initiatives is to provide opportunities for faculty and students to better understand complex sustainable development challenges, develop place-based solutions that combine technology innovation and sociocultural-economic awareness of end user communities, and scale these solutions through social enterprise (Fig. 1).

Education

Educational activities train students to equip them with the skills necessary to succeed in the sustainable development sector, with a specific focus on - technology-enabled approaches. Interdisciplinary coursework engages students across disciplines in - project-based learning that blends technological and socioeconomic considerations. Applied training in social entrepreneurship, cultural competency (such as language training and community engagement), and experiential education opportunities that take students beyond the classroom are common elements of educational programming. University-based researchers and practitioners have contributed to the emergence of a new engineering subdiscipline. Most often referred to as "Development Engineering" or "Humanitarian Engineering," it utilizes concepts such as "frugal innovation" and "user-centric design" in the development of an engineering pedagogy that is tailored to the complex nature of design challenges inherent in the sustainable development sector.

Sequential Courses and Certificates

Courses supporting the education of students in sustainable development innovation are often offered sequentially or as part of a certificate program. In many identified cases these courses are administered by engineering colleges and departments but are open to students with a nonengineering background. Social entrepreneurship, cultural competency, and project-based courses wherein students work with partner organizations to develop solutions that respond to specific community needs are common amongst these offerings.

Exemplar The Humanitarian Engineering and Social Entrepreneurship (HESE) program at Penn State University offers a sequence of courses that focus on practical skill development for success in the fields of humanitarian engineering and social enterprise. While administered through the College of Engineering, approximately half of the students who enroll in these courses are nonengineers. A certificate in Entrepreneurship and Community Engagement is awarded to students who complete all five HESE courses in addition to one elective. The program prizes rigorous research and evidence-based approaches. Since 2008, affiliated faculty and students have published over 100 peer-reviewed papers that analyze the effectiveness of HESE-related projects undertaken across the developing world (K. Mehta, August 2017, personal communication).

Sustainable Development Innovation: Education, Research, and Enterprise Activities at Universities, Fig. 1 Sustainable development innovation activities at universities

Minor and Major Programs

Minors and majors at the undergraduate and graduate level generally feature interdisciplinary coursework, project-based research, and often an international travel component. Prominent examples include the Global Technology and Development Master's program at Arizona State University and the Sustainable Global Technology minor offered at Finland's Aalto University, both of which equip students from diverse disciplinary backgrounds to analyze the interplay of technology and sustainable development using social science methods (S. Lindeman and M. Parmentier, August 2017, personal communication). At the PhD level, the world's first "Designated Emphasis" in Development Engineering has been established at UC Berkeley (UC Berkeley 2016a). In collaboration with Elsevier, Berkeley's Development Impact Lab (DIL) has also launched the peer-reviewed "Development Engineering Journal" (Elsevier 2018) which further supports the growth of this emerging area of academic scholarship (H. Lofthouse, August 2017, personal communication).

Exemplar The Global *Masters of Development Practice (MDP)* (Columbia Earth Institute 2017) program operates at 32 universities across North America, Latin America, Europe, Asia, and Africa. A practical focus on integration of natural, health, social, and management sciences, as well as a required 2–3 month internship in the field and global footprint make MDP a significant example of applied sustainable development education available as a major course of study worldwide.

Field Placements and Trips

The applied nature of research and training in this area and the range of communities and regions that are targeted by sustainable development innovators make field experience a critical element of educational programming. In many cases, travel abroad is compulsory for student participation in "hands-on" projects. In some cases, field trips are arranged for large groups of students, whereas in other cases travel grants and fellowship opportunities are administered to individual students according to their particular interests (Brundiers et al. 2010).

Exemplar The Humanitarian Engineering Center within Ohio State University's College of Engineering (Bixler et al. 2014) arranges approximately 10 field trips for 100 students per year in target communities across the developing world, particularly in Central and South America where travel costs from the USA are relatively low. In addition to offering a minor in Humanitarian Engineering, many of the participating students are also part of the OSU Humanitarian Engineering Scholars program which offers a 1-year scholarship for engineering students interested in sustainable development, alongside access to special bi-weekly lectures and a requirement that they complete 10 h of relevant community service (K. Passino, August 2017, personal communication).

Research

Research activities undertaken to support progress on sustainable development through the application of technology are not only interdisciplinary but often transdisciplinary in nature. Transdisciplinary research activities not only bring together different disciplines but also deeply engage with stakeholders from beyond the academic world throughout the research and innovation process. This includes problem framing and elucidation of research questions, co-development of solutions, and identification of pathways for implementing and scaling solutions (Polk 2014). Small-scale transdisciplinary "action research" (McNiff 2013) projects in many cases are supported by project-based seed grants that are distributed by University departments and initiatives themselves (Tendulkar et al. 2011).

Interdisciplinary Research Clusters

Developing technologies that can deliver genuine progress on the SDGs require careful attention to socioeconomic conditions within target communities from the outset of the design process. This characteristic is captured in the organization of programs that cluster experts from different disciplines together around specific technology use cases in order to develop deep knowledge of local context that can guide solutions development. This team-based approach is evident in the "Vertically Integrated Project" model employed in a number of instances including at Georgia Tech's *Engineering for Social Innovation* Center (Coyle et al. 2005; J. Harris, August 2017, personal communication).

Exemplar Aalto University in Finland features a number of interdisciplinary clusters that conduct transdisciplinary research on sustainable development. A relevant example is the *New Global* project, a transdisciplinary action research project that works with stakeholders in target communities in the developing world to codevelop solutions in areas such as housing, energy, clean water, and forestry. The project utilizes frugal innovation and user-centric design concepts to develop and deploy financially scalable technology-enabled solutions. This project and others at Aalto are coordinated through "Aalto Global Impact," an umbrella organization that supports the development of Aalto's various sustainable development innovation programs and projects (S. Lindeman, August 2017, personal communication).

Action Research Partnerships

Partnerships with international aid organizations, foreign governments, and civil society organizations that implement sustainable development solutions on the ground offer additional avenues for universities to gain deeper insights into sustainable development issues and to codevelop solutions. A common tactic is to form long-term relationships within target geography, allowing researchers and their partners' adequate time for mutual learning (Savan 2004).

Exemplar Arizona State University employs a dedicated staff of international development practitioners who actively seek out funding and strategic partnerships with local partners on sustainable development projects (R. Buch, August 2017, personal communication). Staff are housed within the Knowledge Enterprise Development Office at ASU whose mission is to create value for external stakeholders from the research and knowledge that exists at the university, thereby helping to fulfill the University's vision of becoming a "knowledge enterprise" (Crow 2010).

Project Seed Grants

Research clusters and projects generate numerous ideas and prototypes. To support their ongoing development, seed grants can be offered directly through relevant university departments. Examples include MIT D-Lab's Scale-Up Fellows program, Berkeley's Development Impact Lab Pipeline Projects, and Purdue University's Innovation for International Development Lab (I2D) Global Design Team Awards. In each of these cases, researchers and students benefit not only from additional funds to cover travel, R&D, and other expenses but also the support and mentorship of an outward-facing and deeply networked institution that assists in the difficult process of bringing an idea out of the lab and into the field (A. Burniskie and H. Lofthouse, August 2017, personal communication).

Exemplar MIT's Tata Center for Technology and Design funds approximately 30 projects annually which scope an intervention to solve a development challenge in India using technology. Faculty members apply through an open process and are paired with a graduate student that receives full tuition coverage for 2 years plus additional funds to cover travel, equipment, and other project-related expenses. Graduate students travel to India extensively, establishing relationships within communities and conducting fieldwork. Undergraduate student research assistants can also receive funding to participate in each phase of the research process (R. Stoner, September 2017, personal communication).

Enterprise

Enterprise activities aim to disseminate and scale solutions developed by members of the academic community through for-profit or non-profit ventures. A major focus is on encouraging students and faculty-members to pursue social entrepreneurship as a means to bring their solutions to the wider world. This follows a trend in the international development sector where private sector actors and social enterprises play an increasingly prominent role. On-campus, this recognition coincides with a trend toward entrepreneurship education in general (Etzkowitz 2004). The result is a plethora of new programs – incubators, accelerators, social innovation competitions, and more – which support the creation of new social entrepreneurs and enterprises, as well as the social enterprise sector more broadly.

Innovation Competitions

Competitions that engage students at all levels to develop social innovations are often seen as a low-cost method of increasing student awareness of sustainable development challenges and of emerging social entrepreneurship opportunities. Competitions generate new ideas and feed research projects, incubators and other on-campus activities with engaged students. Framing these competitions as a means to "solve" entrenched sustainable development problems can, however, be problematic when students have little or no experience (K. Passino, August 2017, personal communication).

Exemplar Big Ideas @ Berkeley is an annual year-long social innovation competition run by the Blum Center for Developing Economies at UC Berkeley. Interdisciplinary teams of students develop a social innovation idea and business plan that relates to sustainable development. They are supported by a dedicated staff and mentors with social enterprise experience. Nearly 700 students participate annually and financial awards are given to top teams every year across a variety of categories, from social justice to clean energy. Big Ideas publishes a toolkit highlighting key lessons learned in administering the competition (UC Berkeley 2016b).

Incubators

University-based start-up incubators encourage entrepreneurship on campus through provision of workspace and equipment, mentorship, seed funding, and other support services which are offered to entrepreneurs in the initial stages of venture creation (Etzkowitz 2002). Given the trend toward social enterprise as a means to bring sustainable development innovations to market, many universities have established social entrepreneurship programming within existing incubators or established separate programs for social enterprise support. A variety of examples exist, from Aalto's *Impact Iglu*, the University of Waterloo's *Greenhouse* and Duke University's *Design to Impact* incubator, all of which focus on providing mentorship, staff support, and seed funding to students with a demonstrated interested in social enterprise.

Exemplar MIT's Legatum Center for Development and Entrepreneurship supports the development of social enterprise ventures specifically targeting communities in the developing world. Seed grants, a fellowship program for MIT students that provides tuition support and funding for technology prototyping and travel, an annual conference on "Scaling Development Ventures," and a variety of additional incubation services are offered (Quadir 2012).

Accelerators

Accelerators differ from incubators in that they focus on supporting the ongoing success of established enterprises as opposed to fostering the creation of new ones (Casasnovas and Bruno 2013). Social enterprise accelerators often provide courses and intensive workshop-style programming for social entrepreneurs, many of which come from outside the university. In the UK, both the Universities of Oxford and Cambridge have their own variants. By attracting experienced social entrepreneurs to campus these initiatives help to create a direct exchange of knowledge between the academic community and social enterprise practitioners.

Exemplar The Global Social Benefit Incubator at Santa Clara University's Miller Center for Social entrepreneurship is the world's largest university-based social enterprise accelerator (Warner 2016).

Over 700 alumni from various Miller Center programs have gone on to raise over half a billion dollars in investment to support their ventures. Among the programs offered is the GSBI Accelerator, a 10-month program that connects established social entrepreneurs with seasoned Silicon Valley executive mentors and culminates in an investor showcase. Also available is GSBI Boost, a 3-day intensive workshop for local, early-stage social entrepreneurs, and GSBI Online, a 6-month virtual mentorship program. A number of social enterprises that have participated in GSBI programs also hire Santa Clara students as interns through a dedicated fellowship program run by the Center. The Center's proximity to Silicon Valley and ability to connect social entrepreneurs directly with potential funders and a deep pool of seasoned mentors is a major advantage that would be hard to replicate elsewhere (K. Warner, August 2017, personal communication).

Challenges Facing Sustainable Development Innovation Programs

Interdisciplinary Collaboration

Both institutional and epistemic barriers to interdisciplinary collaboration on sustainable development innovation exist. On the institutional side, programs established under, for example, a college or department of engineering often require collaboration with departments and faculty-members from the social sciences. Universities that encourage cross-department collaboration through holding joint-departmental workshops or offering funding and staff support to multi-disciplinary initiatives are better placed to seed successful programs. Epistemic barriers relate to the difficulty of bringing together experts from different disciplines in such a way as to properly utilize theories and techniques from each discipline and ensure that participants from different backgrounds communicate effectively. Lack of experience with these types of collaborations may present a learning curve (K. Passino, August 2017, personal communication).

Interviews have indicated a strong interest amongst junior faculty in pursuing transdisciplinary and applied research on sustainable development. However, incentivizing early career faculty members to collaborate on programs where publication opportunities may be more limited or non-traditional in nature presents a challenge. For non-tenured faculty, the need to publish in disciplinary journals can take precedent over participating in transdisciplinary research projects and enterprise-related activities (A. Burniskie, August 2017, personal communication).

Finding the Right Local Partners

Developing longstanding relationships with trusted and stable partners in the field is a challenge facing all transdisciplinary research programs on sustainable development innovation. A good partner organization has experience working with academic institutions, a track record of successful projects to build upon, and is undertaking work that is of direct relevance and interest to faculty members and students (S. Lindeman, August 2017, personal communication).

Appropriately Scoping Enterprise Initiatives and Student Projects

Program managers commonly referenced the general difficulty and commitment required to successfully launch a successful social enterprise or venture, which can present significant challenges to students and faculty-members. Students are burdened by classroom commitments, and professors have research and teaching duties that may preclude them from putting in the time necessary to establish an enterprise or adequately field test a technology in a developing world country (K. Passino and K. Warner, August 2017, personal communications). Scoping student innovation projects so that they are realistic in terms of expectations is also a perennial issue (J. Harris, August 2017, personal communication).

Next Steps

Opportunities and Best Practices

It should not come as a surprise that many of the Universities highlighted as exemplars are also institutions with long-standing commitments to service learning, applied research, and interdisciplinary collaboration. Those that undertake sustainability and entrepreneurship programs as pan-university enterprises are also more likely to be leaders in the area of sustainable development innovation.

The degree of co-ordination required, both within institutions and with external partners, also creates a need for internal umbrella organizations that support various programs simultaneously and connect on-campus sustainable development innovators. Aalto University's Global Impact Office and Arizona State's Knowledge Enterprise Development Office offer such examples. These offices offer staff support to professors and departmental administrators that is leveraged to further develop and execute programs, and seek out new opportunities.

Initiating long-term strategic partnerships in a specific geographic region is also an emerging best practice. Rather than spread programs out across highly differentiated contexts, programs Like MIT's Tata Center, which focusses all of its field-projects in India, offer an example for other institutions to follow. By limiting programs to a single well-understood region, researchers, students, and program managers can build connections and regional expertise over time, helping new projects to be more quickly and effectively scoped utilizing existing knowledge of local context.

Team-based learning, especially through project-based courses and action research projects is also common within successful programs. Working in teams creates conditions for interdisciplinary collaboration and helps provide students with valuable soft skills that are directly relevant to social entrepreneurship (Cincera et al. 2017).

For the difficult task of preparing students and other members of the campus community to become social entrepreneurs, universities should consider leveraging the accelerator model wherein existing social enterprises participate in university-based programs. These collaborations open up opportunities for the academic community to learn about the social enterprise sector from established practitioners and assist in developing business plans, social impact strategies, and networking.

Finally, utilizing existing institutional structures to build sustainable development innovation programs presents a critical opportunity for Universities to take advantage of. For institutions with a specific focus on social entrepreneurship, for example, existing entrepreneurship support structures such as start-up incubators and accelerators can be extended to encourage social enterprise. The most successful examples will weave sustainable development innovation into the wider innovation ecosystem of the university, engaging business, international development, environmental sustainability, engineering, and other competency areas to create a dynamic interdisciplinary environment where programs reinforce one another and span the education, research, and enterprise space.

Benefits to Universities

As competition amongst universities spreads internationally, the ability to tell compelling stories about the role of postsecondary institutions in addressing pressing international issues becomes increasingly valuable. Sustainable development innovation programs therefore offer universities the opportunity to create sought after success stories. A number of program mangers interviewed claimed that their programs were actively used as a recruiting tool by their institution for this reason.

In the engineering field these programs offer, in the words of one interviewee, "the opportunity to challenge students with engineering problems in their full complexity" (K. Passino, August 2017, personal communication). The interdisciplinary component of sustainable development innovation projects brings learning opportunities which benefit students and faculty-members by helping them to build a more diverse skillset, something that is increasingly demanded within the engineering profession (K. Mehta, August 2017, personal communication).

Another finding is that humanitarian and development engineering courses have higher female enrollment than traditional engineering programs. This finding is reported across multiple engineering schools where humanitarian engineering is offered as a minor or major course of study (K. Passino and Khanjan Mehta, August 2017, personal communication). For universities where increasing female student enrollment and retention in the engineering field is a priority, offering programming on sustainable development innovation may help to achieve this aim.

Sustainable development innovation programs also offer a clear avenue where universities can foster “hands-on learning” opportunities for students across many different disciplines and generate increased demand for their programs among prospective students who value this approach to learning.

Gaps in Understanding

Technology and enterprise development partnerships between universities in the Global North and South on the topic of sustainable development are not well documented and therefore considered an underexplored area requiring further investigation. A dearth of networking and funding opportunities that help connect faculty members and administrators from developing and developed world universities may make the creation of such partnerships difficult to initiate.

Whether the trend towards the establishment of development and humanitarian engineering programs continues and spreads to more than a few institutions is another outstanding question worthy of monitoring. The creation of minor and major publications, conferences, and workshops on the topic and other developments that enable the expansion of a humanitarian engineering pedagogy should be seen as evidence that this trend is continuing.

Social enterprise incubators are spreading across academic institutions and seek to align the priority areas of sustainability and entrepreneurship. However, the effectiveness of university-based social enterprise programs needs to be measured across key indicators including the rate at which new enterprises are established, whether they are able to achieve financial sustainability and scale their operations, and the degree to which enterprise programs prepare students to join the social enterprise sector. While latter metric may be particularly difficult to quantify, tracking the number of students who work in social enterprise after they graduate and making comparisons across graduates of different universities may help to shed some light (Mehta 2015).

Finally, broader questions regarding the suitability of enterprise-driven approaches to sustainable development remain. Will social enterprise continue to grow in importance in the international development sector? Will university investments in entrepreneurship education for students interested in sustainable development provide them with a relevant education for a sector that is changing in this direction? These questions go far beyond the role of universities but are integral to understanding the real-world demand for sustainable development practitioners that are equipped with engineering and entrepreneurial competencies. At a more granular level, the questions above may be applied to particular geographies and sectors. In some cases, enterprise solutions may be more applicable than in others, and this may change over time as a result of policy, technological, and business developments. Universities that encourage students and faculty to pursue social enterprise solutions to sustainable development issues should therefore take care in monitoring the suitability of this strategy across diverse sectors and geographies.

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Sustainable Development: Sustainability

► Blended Learning and Sustainable Development

Sustainable Diets for Sustainable Development, Importance of

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Definition

Sustainable diets are comprehensive approaches to designing systems to support food choices that optimize human and environmental health. In a single term, sustainable diets are complex. Sustainable diets necessarily include elements like quality, health, environment, values, economy, and governance and politics. Fashioning diets that are sustainable may not be new but a return to approaches used prior to the emergence of chemically enhanced, industrialized, large-scale, specialized agriculture. To achieve sustainable diets would require government policies along with market-driven practices to increase citizen-consumer access to plant-based, whole foods, along with information about food contents, nutrition, how the food was produced and delivered, and how to make delectable dishes for satisfying human consumption.

Introduction

The examination of sustainable diets, and conversely unsustainable pathways, raises profound questions like "Yet what could be more important than the nature, quality and sufficiency of diet for the planet?" (Mason and Lang 2017, p. 2). Many scientists, civil society actors, industry, and governments have been inquiring into what makes up a good diet. Many are looking to eat well in ways that benefit environmental, human and animal health and that are culturally acceptable. Others are seeking to achieve food security, affordability, and accessibility for all. The issues are social, ethical, spiritual, environmental, technical, cultural, political, and economic. As the issues are complex and intersecting, suitably comprehensive and inclusive solutions are sought. Often diet recommendations appear at cross-purposes; greater alignment would minimize disparate public policies and disjointed actions. In spite of growing levels of concern about levels of poor health, declining environments and deplorable conditions for animals, insufficient leadership is being demonstrated to transition to sustainable diets.

Advocacy for Well-Being

Advocates for sustainable diets have been emerging from a broad spectrum of disciplines. Over recent decades many respected authorities have become ardent advocates for sustainable food systems. Mason and Lang (2017) have become well-known for their comprehensive approach to addressing health, environmental, and political issues. Lairon (2012) has been putting forward compelling evidence for governments internationally to recognize the urgency of protecting biodiversity while delivering sustainable nutrition for healthy populations. Early references to dietary guidelines for sustainability were put forward by Gussow and Clancy in 1986. These advocates of systems thinking and comprehensive analyses have recommended inclusion of multiple dimensions along with the anticipated and unanticipated outcomes. Many additional voices have been raised in this area like Meadows (2002), Wilber (2001), and Sen (1981), among many others. Orr and Ehrenfeld (1995) challenged governments to no longer deny the destruction of ecosystems, biodiversity, water and soil contamination that are arising through large-scale, intensified agriculture supported by government subsidies. According to the Environmental Working Group (2017), the US subsidy for corn alone was $94,349,576,890 for 1995–2014. Other crops receiving substantial subsidies include wheat, soya, rice, and sorghum, with sunflower and canola oils also heavily supported. Before Orr came leading voices like Rachel Carson with her compelling case against government subsidies of chemical additives to agriculture in her provocative Silent Spring (1962/2002). Some other prominent critics of agriculture, food production, and marketing practices include Vandana Shiva (1988, 1989, 1992), Frances Moore Lappé (1971), and John Robbins (1987, 2001/2011).

Advancing sustainable states necessitates interdisciplinary collaborative efforts with policy makers from national and municipal governments, businesses, and NGOs, along with partnerships with natural and social sciences, humanities, arts and culture, and measures of sustainability, public review, and political accountability. Sustainable states are "where the needs of the present and local population can be met without diminishing the ability of future generations or populations in other locations to meet their needs and without causing harm to the environment and natural assets" (British Nutrition Foundation 2011). The convening of stakeholders from all sectors for visioning events is essential for expanding thinking, strengthening social connections, increasing multi-sectoral buy-in and catalyzing greater commitment for action (Davies et al. 2013). Gatherings of citizen-consumers, diverse actors engaged in food production and consumption, rural and urban citizens and associations, industry and trade, governmental regulators and nongovernmental organizations, and researchers, planners, and change specialists need to work together to envision healthier futures and implement strategies for sustainable policies and practices.

Obstacles

Many obstacles serve to delay or undermine the progression toward sustainability. The attainment of sustainable practices has been elusive, and sustainable diets have not become widely supported nor understood. Several health, environmental, and social challenges appear intractable. Solutions for one sector, like agriculture, are inadvertently contributing to complications in areas like health and the environment. Industrial food systems are largely focused on producing animal products and value-added "shelf-stable" foods. Industrial systems have adversely impacted "climate change, water stress, energy pressures, demographic change, the nutrition transition, and a host of societal and environmental issues" (Lang 2009, p. 317). Significant rises in climate change are linked to animal agriculture; in fact, many indicate that it has been found to contribute the largest proportion of greenhouse gas emissions and as such ought not be maintained as such or encouraged to grow (Djekic 2015; Burlingame and Dernini 2012; FAO 2006; Springmann et al. 2005).

The growing world population needs food, while ecosystems need preservation; a suitable balance has not yet been forged. "In 2050, when the world's population reaches 9 billion, we will have to be more efficient. We simply can't sustain current practices over the longer term" (Anstey 2011, p. 3). For example, governments offer substantial subsidies to agriculture, particularly corn production, that translate into ubiquitous additives to stabilize and sweeten foods. Meanwhile, decades of epidemiological studies have revealed two-thirds of deaths are from chronic diseases associated with modifiable behaviors such as poor dietary intake and physical inactivity. Child and youth obesity prevalence are climbing. Healthcare or illness costs are consuming greater proportions of budgets with economic and emotional costs are predicted to further escalate (Dodge and Dion 2011; Krueger et al. 2015). When governments recuse themselves from responsibility and place the onus on individuals to manage individual and collective well-being, this often translates into individuals being blamed for their poor health and the corresponding healthcare pressures (Alvaro et al. 2011). Previous top-down, fragmented, short-sighted policy interventions and education campaigns that frame the citizen-consumer as deficient are not reducing noncommunicable diseases (Alvaro et al. 2011) nor are they reducing climate change or sufficiently curtailing unsustainable practices.

Advocates of sustainable diets advise that attention be paid to systematic forces, like the power of advertising and public persuasion, and how such influences can effectively mold (and mould) food consciousness and influence food consumption. With the incessant push to buy select foods through ubiquitous and compelling forms of advertising, it can be understood that these offerings may be viewed as a de facto set of dietary endorsements (Mason and Lang 2017). The market economy and capitalism have traditionally been oriented toward profit more than sustainability. Corporate interests and short-sighted goals can influence governments and their political interests rather than the public good (Moore Lappé 2005). Health professionals criticize governments for their inadequate support that impedes their work; they particularly point to the negligible investments made to preventative health.

Yet even "[t]he public health community has been slow to examine the link between food policy and public health" (Jackson et al. 2009, p. 395). But as Mason and Lang attest, the role of the individual in fostering well-being while not overemphasizing it must not be understated. However, free, democratic societies are hesitant to interfere in citizens' freedoms. There are political reluctance and public conflict over how to rectify individual choice with collective well-being. Citizens must become active agents within healthy food systems and sustainable practices. "In 2012, the global economic cost of obesity was estimated to be around $2 trillion, roughly equivalent to the global cost of smoking or armed conflict" (Mason and Lang 2017, p. 330). Bittman (2015) indicates such significant spending in healthcare could be offset with improvements made with provisioning real food. The worsening of noncommunicable or lifestyle diseases worldwide creates significant drain on social resiliency, emotional well-being, and economic efficiency.

Characteristics of Diets Deemed Sustainable

A growing body of research proposes practical strategies toward reducing greenhouse gas emissions and climate change through strategic production practices and consumption choices (Story et al. 2009; Davies et al. 2013) as well as through reduced food waste (Parizeau et al. 2015). Additionally, producers and processors are being urged to achieve financial well-being through businesses choosing disclosure over concealment, safety over sales, and morality over money (Brownell and Warner 2009). The physical health of consumers and the environment can become requirements of food providers, if political leaders mandate such. But these requirements could contribute to the creative production and delivery of delectable, nutritious, energy-efficient, and low-carbon foods, "sustainable diets" in short. Those contributing sought-after innovations will meet a growing market need for such products and bolster their income opportunities in the emerging greener food economy.

In efforts to protect the well-being of the population governments and health officials work with all sectors to set out to establish dietary guidelines and more sustainable food patterns. By examining the changes in food guides in the United States over many decades, significant shifts can be noted. Guidelines in the 1940s emphasized "protective foods" and "good eating," and in the 1950s–1970s the emphases were placed on "fitness" and "hassle-free food." Trends and pressures from the market place were evident in these shifts as were insights from epidemiological studies. Into the 1980s, a priority became a consumer choice that often made way for overconsumption. This fostered an emphasis in the 1990s of achieving more moderation and sufficient nutrition. By the 2000s, healthy eating became a pronounced theme. Mason and Lang (2017) offer further detail from their review of transitions in food guides over the century. These frequent shifts in focus and priority in the food guides reveals diverse sources of pressure and disparate views on diet analyses. More critique and comprehensive understanding of the impacts of dietary patterns becomes essential. Disjointed efforts in altering food habits and dietary guidelines have not proven effective. Critical systems thinking and analyses are required.

To orchestrate sustainable diets requires concerted efforts to produce and make accessible desired qualities and quantities of food. Within sustainable systems, it is not only the end product that is of concern; it is the whole of the production process. Consumers have a right to know where and how products are made, and many seek connections between consumers and producers. Sustainable systems incorporate details on food quality with clear standards for safe, ethical production, processing, and delivery of food. Elements of food quality include vibrancy and healthiness, the sensory attributes, the appeal of the food – visually, emotionally, and psychologically – and how nutritious and how appropriate for diverse dietary practices (Ranganathan and Waite 2016). As well the social and spiritual dimensions, the sacredness of food would be considered.

Full cost accounting is called for when calculating the inputs and "externalities" in food production, processing, delivering, and pricing of food (Story et al. 2009; Jackson et al. 2009). The price of food ought to reflect costs of production including calculating the cost of air pollution, soil degradation, greenhouse gas emissions, water degradation, and pressures on the environment, on public health and waste management. A social and environmental cost/benefit analysis could be utilized to assess impact on and to protect biodiversity and ensuring its' protection and the many assets of the ecosystem (Lynch et al. 2014).

"The health of the planet, and keeping people healthy through better food choices are macro trends that are going to increasingly shape the future of food and agriculture in Canada" (Anstey 2011, p. 2). People care about their health and well-being as well as that of future generations and the environment (Corscadden and Kevany 2017). The theory of change must place citizens at the center as agents of change active in informing policy and resource management and in measuring what matters. While the language of sustainability has been in use for decades, largely since the 1987 Bruntland Commission, food movements are calling for sustainable practices to become embedded throughout the supply and demand food chains. Several food movements are identifying transformative strategies and deploying facts, values, and actions to deliver more sustainable outcomes. Scrinis (2007) describes these as "alternative agri-food initiatives," for Levkoe they are called "alternative food initiatives" (2011), and Goodman et al. suggest they are "alternative food networks" (2012). "Dozens of inter-connected, but independent, food-related initiatives together are crafting a network of more sustainable, democratic and inclusive food systems" (Briarpatch Staff 2011). Sustainable diets will not become routine for consumers without greater emphases on love of, pleasure from, and succulence in food. The field is ripe for increased opportunities around functional foods and plant-based businesses. Opportunities remain for innovators and advocates, researchers, and change agents to explore succulent food offerings that promise to afford business opportunities along the prescient pathway to sustainable diets.

Transition Strategies to Sustainable Diets and Food Systems

While the principles and practices for transitioning to sustainability have been articulated in many places, they have received insufficient uptake. Shifts will be needed at the policy and household levels. Food environments that encompass political influences, physical infrastructure, social architecture, and cultural beliefs need to be reoriented toward sustainability, resiliency, and prosperity (Jackson et al. 2009; Kevany and MacMichael 2014). Environments must be designed to support the well-being of citizens, protect clean air and water, foster space for safe and nourishing food, and provide access to recreation spaces and natural environments for easy access and enjoyment. These basic elements are foundational for a successful transition. As the British Nutrition Foundation and the Government Office for Science (2011) suggest, it may help to activate different thinking and articulate probing questions. A question might be "what do we want from our food?" This may be more helpful than asking citizens about sustainable diets. Other questions might be the following: Do consumers have endless choice and freedom regardless of food impact? Are government policies and practices, passively or actively, facilitating ill health of citizens? Significant challenges remain, like how efforts to modify eating patterns might better align with people's food purchases and consumption patterns in order to be scaled up (Ranganathan and Waite 2016).

When leaders in fields from agriculture, food, health, and environment, economic development, poverty reduction, and well-being convened at a large forum in 2010 in Rome, a singularly accepted definition of "sustainable diets" was not achieved. The researchers agreed that there is growing academic recognition of the complexities and sensitivities to defining sustainability. They determined that a shared definition would be necessary to guide the development of needed program development, policy formation, research, and funding supports. Members of the forum from the Food and Agriculture Organization and Bioversity International articulated their definition of sustainable diets. "Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (Burlingame and Dernini 2012, p. 7). They also concurred that the growing body of evidence is revealing that current food systems and diets are unsustainable and untenable, and a growing international agreement through conventions, conferences, and reports reveal that change is imperative.

Some helpful instructions that has been proposed are to place emphasis on "values for money" rather than "value for money" and to move away from yield per acre as the highest value (although it too has merit) but to measure instead the number of persons fed per acre (Mason and Lang 2017). Such reorientation forces more focus on measuring what matters. To achieve more sustainable practices and avert further harm from unsustainable systems require shared commitment and an array of interventions. Civic action, democratic governance, and social change are pivotal to usher in sustainable strategies. Many advocates as noted above have been calling for greater food security, public health, and environmental protection particularly when governments and industries are failing to fulfill their obligations. Is not one of the governments' greatest roles attending to the happiness, health, and well-being of the citizens? Past investments in agriculture and food have not produced good health for citizens or animals nor enduring protection for the environment. Yet in contrast, "real food" (Bittman 2015), largely plant-based, whole foods, improves health and preserves natural ecosystems. A plethora of studies conclude that reduced ruminant and dairy consumption will be indispensable for reaching goals for sustainable development. To facilitate the systemic changes to reduce the pace of and recover the biodiversity loss and degradation of ecosystems, all sectors of society have essential actions to take and roles to fulfill. Research and education to empower leaders along with citizen-consumers become paramount to ensuring data-driven decision-making and support for governments and companies that enact the principles of sustainability. The transition to sustainable diets will not be driven simply by consumer choice; it requires political vision, shared leadership, policy supports, and public facilitation. Achieving greater sustainability will become the path of choice through reorientation of values, cultural transitions, and transformative food politics.

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Sustainable Education

► Soft Skills and Sustainable Development

Sustainable Education Methods

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Synonyms

Education for sustainable development; Holistic framework; Multidisciplinarity; Sustainability principles

Definition

Sustainable education methods are the methods that take advantage of multidisciplinary and lead to the development and usage of communication, collaboration, and empowerment skills which are considered to be prerequisites for sustainable societal transformation. Sustainable education methods should not only encompass learning outcomes of knowledge and skills but also seek to foster values and attitudes that encourage critical and creating thinking. It may be claimed that the successful implementation and practice of sustainable education methods encompassing values, attitudes, and behavioral intentions together with cognitive learning outcomes may be one of the learning objectives focused on holistic sustainable development of societies.

Introduction

Institutions of higher education play an important role in society's transformation processes. In this context, many higher education institutions (HEIs) have been incorporating environmental education and education for sustainable development (ESD) into their systems, making sustainable development an integral part of the institutional framework, collaborating with other higher educational institutions, encouraging on-campus sustainability life experiences, and offering "educating-the-educators" programs (Ramos et al. 2015). Sustainable development principles and methods for achieving their implementation require various educational activities and implemented courses to be designed with clear learning objectives focused on holistic sustainable development of societies.

A number of institutions of higher education that integrate sustainable development into their study systems are increasing rapidly. The design and implementation of new courses with learning objectives that are clearly focused on holistic approaches to sustainable development of a society require developing and testing not only new teaching or learning paradigms but also student assessment methods in order to take advantage of multidisciplinarity (Ramos et al. 2015). As Karatzoglou (2013) notes, the engagement of community as well as development and usage of communication, collaboration and empowerment skills are prerequisites for sustainable societal transformation at local and regional levels, which is in line with Barth and Michelsen's (2013) arguments that only the approach focused on learning and process orientation may lead to better results in order to achieve progress in society's becoming more sustainability oriented. The cooperation and communication at all possible levels (student, faculty, local, regional, and international) may raise the success factors in sustainable society development. Aktas et al. (2014) highlight the need for graduates of institutions of higher education to leave "the academic world and enter the workforce with clear insight into the importance and future challenges of sustainable living" (p. 216).

Prerequisites for Sustainable Education Methods

In 2012, the United Nations Educational, Scientific and Cultural Organization under UNESCO reported in "Shaping the Education for Tomorrow" that in order to motivate and empower learners to change their behavior and take action for sustainable development the teaching and learning methods encouraging participation and deep involvement of students should be implemented at all levels of education. It has been widely acknowledged that traditional teaching methods centered on isolated disciplines fail to develop students' ability to solve complex problems or foster critical thinking skills allowing them to see new situations in different ways and from various perspectives. Tilbury (2011) defines learning as developing and fostering the ability to ask critical questions, clarify one's own values, envision more positive and sustainable futures, respond through applied learning, and explore the dialectic between tradition and innovation. The United Nations Educational, Scientific and Cultural Organization report (2012) distinguishes nine types of learning, some of which can be considered conventional while some more cutting-edge. A brief description is included as provided in the report:

> *Discovery learning* – learners are immersed in a rich context where they encounter some element of mystery; they become curious and begin to make sense of their experience through their own exploration.

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Transmissive learning – by using didactic skills (e.g. presenting, lecturing, story-telling) and supporting materials (e.g. workbooks, instruction forms, visuals), a body of knowledge, set of rules or code of conduct is transferred to learners.

Participatory/collaborative learning – although not identical, both emphasize working together with others and active, not passive, participation in the learning process, which tends to focus on resolving a joint issue or task.

Problem-based learning – focused on solving real or simulated problems to better understand the issue or find ways to make real-life improvements. Issues are either identified by learners, or pre-determined (e.g. by teachers, experts, commissioning bodies).

Disciplinary learning – taking questions of a disciplinary nature (e.g. geographical and biological) as a starting point, to better understand underlying principles and expand the knowledge base of that discipline.

Interdisciplinary learning – taking issues or problems as a starting point, then exploring them from different disciplinary angles to arrive at an integrative perspective on possible solutions or improvement.

Multi-stakeholder social learning – bringing together people with different backgrounds, values, perspectives, knowledge and experience, from both inside and outside the group initiating the learning process, to set out on a creative quest to solve problems that have no ready-made solutions.

Critical thinking-based learning – exposing the assumptions and values people, organizations and communities live by and challenging their merit from a normative point of view (e.g. animal well-being, eco-centrism, human dignity, sustainability) to encourage reflection, debate and rethinking.

Systems thinking-based learning – looking for connections, relationships and interdependencies to see the whole system and recognize it as more than the sum of its parts; and to understand that an intervention in one part affects other parts and the entire system (UNESCO 2012, pp. 25–26).

Institutions of higher education have been intensively transforming their study program curricula towards innovative teaching and learning in order to achieve the set aims but attention should be paid to the overall environment and factors influencing the successful implementation and practice of sustainable education methods.

In institutions of higher education, inclusion, expectations, and perception of faculty members, as well as administrative staff could be the main factors underlying the success or failure in sustainable education and its implementation. This statement could be illustrated by the study carried out at a Swedish university with long-term sustainability implementation and the training case study (Sammalisto et al. 2015). The results indicate that one of the most significant factors for a successful implementation of sustainable education is top management's perception and inspiration for the integration of sustainability. Sammalisto et al. (2015) have proposed a model to provide "leaders, faculty and staff with a perception of sustainability in the academic context they can apply to their functions at the university" (p. 45), ensuring that sustainable development is integrated and transformed into practice in all university activities from employee's functions to innovative educational approaches in study courses effecting not only the content but also the learning process and outcomes.

Sustainable Education Methods

Sustainable education methods should encompass not only learning outcomes of knowledge and skills but also should seek to foster values and attitudes that encourage critical and creating thinking. Chalkley (2006) claims that education for sustainability is effective only when together with cognitive outcomes students acquire values, attitudes, and behavioral intentions.

Roure et al. (2018) have developed a consistent and systematic integration framework of sustainable development in a curriculum (civil engineering, in this case), which requires to develop and implement certain protocols for success. The proposed framework mainly focuses on the application of life cycle approaches and tools (e.g., environmental life cycle assessment and life cycle costing) for an engineering curriculum but may be also adapted to nonengineering curricula. The systematic integration framework is built on five steps: *mapping the curriculum* – a first step in renewing the curriculum. In this case, it is aimed at the "identification of existing activities (in course content), the logic of the sequence for integration, and the sustainable development content covered by these activities in the undergraduate curriculum being subjected to the integration of sustainable development" (p. 592); *setting learning targets* defines the set learning targets and constraints of sustainable development to be achieved in a particular course that are based on students' competences and impact on student learning; *developing an action plan for the assessed program* – where the development of "the defined learning activities (e.g., modules), either with a view to modifying existing activities or creating new ones to achieve the SD targets and the established levels of competencies and targets" (p. 592) is required. The authors highlight the demand for determining the educational materials, expertise and teacher training requirements for creating new content creation and maintaining the consistency with the already existing activities in the curriculum. The final steps of this integration framework are *implementation of the action plan and assessing the final performance* where main attention is focused on the assessment of students' prior knowledge and evolutions of the knowledge transfer of introduced concepts is performed. A students' satisfaction survey is another required element for the evaluation of success of the integration framework and identification of possible changes for improvement. As Roure et al. (2018) argue, one of the main factors for ensuring effectiveness of this framework integration is peer support and motivation as well as a possibility to enhance students' experiences in sustainable development as a new pedagogical innovation.

Figueirò and Raufflet (2015) highlight the main perspectives in which sustainable development might be introduced and fostered in curricula of higher education institutions. The authors identify organizational change (when the plan for identification of barriers to the integration of sustainability and the need to develop solutions to overcome them is developed and implemented), teaching techniques and the learning process, curriculum changes, and creation of a new course or program as the most central points for sustainability integration into institutions of higher education. They also present a number of possibilities to integrate sustainability into higher education curricula: a stand-alone course or module when a disciplinary approach is preserved when sustainability is taught without identifying integrative techniques to other disciplines; a cross-disciplinary perspective when an isolated integration across the curriculum achieved through a specific task; an interdisciplinary perspective combining different disciplines for solving specific issues related to sustainability; a multidisciplinary perspective where different fields of knowledge come together to teach sustainability, but each discipline retains its own method and may be responsible for a different topic linked to sustainability; and a transdisciplinary perspective where the main focus is inclusion of different partners (organizations, customers, and citizens) for developing systemic and holistic approach and reducing the limits of each discipline involved.

Barth et al. (2007) state that due to the changes in the professional market, the requirements for skills and competences graduates should possess when leaving institutions of higher education raise the challenge of fostering the students' ability to think in new ways and from different viewpoints. This ability may be strengthened through "combining formal and informal learning settings within higher education – as part of a new learning culture – a variety of contexts can be given and competence development can be enhanced" (p. 416), which implies a dynamic and participative learning process. Figueirò and Raufflet (2015) debate that educational strategies incorporating interactive learning and teaching methods and transforming the learning process to active are among the main factors for a successful student-centered curriculum implementation. As the authors argue, a number of teaching strategies adapted for sustainability teaching may guarantee better students' engagement into the learning process and achievement of learning outcomes. These strategies could be the case study method, action and experimental learning, service learning, problem-based learning, as well as games, debates, discussion groups, field trips, brainstorming, and workshop sessions. The case study method may be a good instrument to discuss challenging issues and raise critical thinking, and awareness of real-world problems when the teacher acts as a moderator and only helps students to look for possible answers in addressing complex and real sustainability problems from the perspective of transdisciplinarity when the issues and solutions are discussed from different approaches. Action and experiential learning method involves "the students' participation in problematization, research, problem solving and critical reflection, using tools such as teamwork, case studies, projects, discussions, and games" (p. 28). Service learning allows students to raise their awareness of the relevance of sustainability from society as a whole to the organizational level, while at the same time, the implementation of this method into courses helps students to participate actively in the learning process. Problem-based learning, as stated by Figueirò and Raufflet (2015), can "turn students into independent thinkers capable of solving complex problems" (p. 28) through engagement in dialogue, research, and reflection on issues related to sustainability. This learning method also emphasizes the incorporation of "multi-stakeholder scenarios and conflicts of interest, span disciplinary boundaries and is focussed on skills and an approach to problem solving rather than on the students learning theory as content" (Dobson and Bland Tomkinson 2012, p. 264).

Tejedor et al.'s (2018) study presents findings on transdisciplinarity as a competence for sustainability education. They argue that especially engineering education professionals do not feel very comfortable when dealing with the transdisciplinary approach due to presence of social sciences and humanities. The authors suggest that the further development of sustainable engineering science "require[s] creating new long-term, participatory, solution-oriented programs as platforms to recognize and engage with the macro-ethical, adaptive and cross-disciplinary challenges embedded in professional issues" (p. 29) and it is not enough to implement innovative experiences at the personal level in order to reach the holistic approach to knowledge. Only the implementation of transdisciplinarity into a wide framework (including curriculum structure, faculty functions, as well as innovative educational approaches) of education may lead to achieving the best results in sustainable engineering education.

Action and experiential learning methods (based on the typology proposed by Figueirò and Raufflet 2015) are analyzed in the study by Gatti et al. (2019) where it is argued that the action learning approach, "and in particular, simulation and gaming, may successfully generate cognitive and affective learning outcomes which in turn may affect students' development of critical thinking skills" (p. 667). Another significant factor proposed by the authors is that inclusion of action and experiential methods creates the possibility to raise the students' motivation for the learning process as well as learning outcomes and attitudes towards sustainability. This is in line with the findings presented by Quesada-Pineda et al. (2018) where they discuss the application of experiential education methods in the course design that resulted in students' higher engagement and empowerment to reflect on their own experiences and abilities to apply their experiences in different contexts.

Vemury et al. (2018) highlight the action-based approach to the development of a teaching and assessment model centered on problem- and project-based learning in a real-world context, where the success of sustainable development education could be increased by effectively using pedagogical methods grounded on problem- and project-based learning strategies. As practical implications, the authors identify the necessity of commitment from senior management together with set commitments for sustainable education in high level strategies of institutions of higher education. The teaching and assessment model centered on problem- and project-based learning could be transferred to courses in various disciplines making sustainable development education aims accessible and relevant throughout a curriculum.

Houston and Lange (2018) discuss that "habits of mind and patterns of praxis necessary for enacting 'situated solidarity,' a practice with great potential for grappling with the complex challenges and marked divisiveness of the twenty-first century" (p. 44) may be achieved through students' engagement in "global/local" community employing the pedagogies of accompaniment and co-labor. Together with encouragement of interdependent and complex place-based knowledge production, students enhance skills of reciprocity and reflectivity, which endorse integrative and holistic education.

Sustainable Futures Model proposed and carried out at Michigan Technological University by Mihelcic et al. (2008) emphasize the significance of integration of the concepts of economic, environmental, and societal sustainability into curricula balanced together with a community-based approach which is considered to be necessary for successful solutions to world's problems. Students' awareness of societal and community issues and the ability to take the integrative and interdisciplinary approach could impact the success of projects at local as well as global levels.

Schneider et al. (2018) discuss the Teaching-Research-Practice Nexus as a possible framework for integrating and transferring the experiences from projects on sustainable development gained by governmental agencies, nongovernmental institutions, and private sector into curricula of higher education institutions. The authors suggest to take into account three aspects, i.e., topics to be linked, their linking mechanisms, and communication tools. This would allow taking advantage of already successfully implemented practical solutions in teaching and learning the emerging topics, like ecological footprints, circular economy, or ecosystem services. It may be considered a good opportunity for institutions of higher education to increase their sustainability by balancing teaching, research, and practice.

Sandri et al. (2018) based on the results of their research highlight a critical gap in research on methodologies to undertake measurement of workplace application of graduate capability in the context of sustainability and present considerations for the necessity to measure competencies, skills, and capability in the context of sustainability education. The challenges identified by the authors call for a further investigation of tertiary education learning outcomes compatibility with professional practices as well as evaluating the effectiveness of sustainable educational methods provided from the perspective of society's benefits, policy of higher education, and professional market.

Concluding Remarks

Education for sustainable development is one of the most important and challenging issues in educational agenda at the international level. It has started with addressing problems in environmental education but during last decades has developed into a framework focusing on society's prosperity as a whole. Institutions of higher education can be reliable contributors to the development of sustainable education only when they fully identify and recognize the transdisciplinarity knowledge as the key factor for universities' openness to civil society as well as knowledge production in other places and redefinition of values (Nicolescu 2018). The introduction of sustainability into curricula should involve not only multidisciplinary cooperation, interdisciplinary orientation but also constant collaboration among various university's administrative and teaching departments or divisions. In many cases, the success of sustainable education inclusion and practice depend on participants' motivation and conscious understanding of values and risks for a society that could be raised or diminished when solving problems or taking decisions.

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Sustainable Facilities Management (SFM)

► Sustainable Facilities Management in Higher Education Institutions

Sustainable Facilities Management in Higher Education Institutions

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Synonyms

Green maintainability; Green management; Sustainable facilities management (SFM)

Definition

Sustainable facilities management (SFM) consists of a set of articulated practices oriented to adapt buildings to the climate. SFM specifically addresses water and carbon footprint controls and reductions and provides for the opportunity to generate research-based knowledge with collective impact and, ultimately, provides a mechanism for achieving the highest performance standards.

Sustainable facilities management (SFM) in Higher Education Institutions (HEIs) may be understood as the set of necessary operations to control and reduce environmental impact of higher education facilities and their operations while potentially achieving the highest safety and performance standards. An integral approach of SFM in HEIs would also consider research-based generation of knowledge through the application of such procedures as well as the collective impact of these actions through community learning, engagement, and organizational change.

Facilities Management (FM) and Sustainable Facilities Management (SFM), Apparent Synonyms

Facilities management (FM) is understood as the operations necessary for the maintenance and preservations of buildings and the built environment for providing a safe and ergonomically comfortable living or working environment for people at a given organization. Sustainable facilities management (SFM) is an emerging field within facilities management (FM) through which to achieve the building's high performance and safety, low resource utilization, low greenhouse emissions generation, as well as other adaptations to climate change such as energy management, waste and recycling management, health and safety management, or control and reduction of the water and carbon footprints.

The management of facilities should ultimately lead to an environment which is habitable and fit for working for people. This consideration of management may be already related to sustainability in the sense that living and working standards must be preserved in time in order not to affect people's living or working. In this sense, FM is considered an array of activities regarding the daily operation and maintenance practice of the built environment in order to preserve the buildings as assets, to provide a safe space for living and/or working conditions, and ultimately, to favorably influence different aspects of the performance of the building such as energy management or water consumption and management in order to improve it and make it more sustainable, that is, to reduce its overall impact on the environment. The most common approach to FM tends to involve the early planning stages of facilities, considering design and materials in order to create efficient buildings. Thus, the current approach to FM involves sustainable design and building techniques in order to create efficient buildings in every sense possible. On the other hand, SFM does not necessarily involve the planning and construction stage of facilities as it also may be put in place on already made facilities, regardless of sustainability in design, materials or construction techniques, or technology. SFM tends to focus on strategic operations management that tends to minimize environmental impact of facilities operations, whether the facility itself has been sustainability oriented or not. No significant distinction between FM and SFM has been found in literature so far, although some authors are beginning to identify differences between FM of sustainable or efficient buildings and sustainable management regardless of the characteristics of the facilities. Although efficiency is not necessarily a synonym of sustainability, the minimization or optimization on the use of natural, human, or economic resources sought by FM is certainly a common goal of sustainability. Also, this tends to lead to a reduction on the environmental impact of human activities, which is also a common goal of sustainability. Although FM and SFM approaches are different in methodologies and objectives, they tend to have positive effects on the control and reduction of environmental impacts of facilities, but no literature has been found exploring and comparing integral environmental, social, or economic effects of either. Since no clear distinction has been consistently made so far in scientific literature, this exploration of the link between FM and sustainability has considered both approaches.

One of the most comprehensive analyses of FM was the one performed by Sha (2007) exploring fundamental aspects of facilities management. Sha (2007) focused and addressed the environmental management practices in an effort to fill the gap between policy research on sustainability management and the technical research based on the processes of FM operations. Sha generally covered FM policy and global trends affecting businesses, general compliance requirements (these mainly based for the UK and Europe), and complemented with case studies. Sha put great emphasis on regulatory compliance and focused on planning management operations for achieving the greater efficiency of all resources used identifying the economic benefits of sustainability practice.

FM is generally analyzed by authors focusing on the technical aspects of operations and their effects on efficiency or else for achieving SFM. Pearce (2017) has focused on the role of the FM professional as the most strategic aspect for achieving sustainability. Pearce (2017) identifies buildings and infrastructure as significant means by which humans contribute to problems such as resource depletion, damage to ecosystems, and climate change. Facility managers have a significant role to play in improving the sustainability of human enterprises by improving the sustainability of the facilities for which they are responsible. Pearce (2017) centers on the role of the facility manager and describes ways in which these professionals can improve the sustainability of the built environment at the facilities, portfolio, and community scales in urban environments through best management practices and provide future directions for sustainable facilities management. Although the focuses are primarily on the role of the facility manager and not on the management activities, it gives substantial input on FM operations. The author identifies facility managers as potential professional drivers for change toward sustainable operations.

Junghans (2011) proposes that FM may contribute to a sustainable development of the built environment. FM directly and indirectly influences the procurement and delivery of construction. FM directly influences the sustainable development of the built environment through the support of primary processes, the development of space and infrastructure, and the development of people and organizations. The sustainability of the built infrastructure contributes to the overall sustainability of the environment. Junghans (2011) explores how FM influences indirectly to the objectives of sustainability concerning society, environment, and economy promoting organizational practices that strengthen sustainability. The findings are that FM contributes to the overall objectives of sustainability. Additionally noted is that there is no common definition nor consistent application of the term “sustainable facilities management” in Europe. This fact also appears to be true for American English-speaking scientific literature as well.

As FM, SFM also may consider a wide array of issues, ranging from the adaptation and sustainable operation practices to operations management based on sustainability performance, although the greater trend in literature focuses on environmental sustainability. Some pieces of literature put emphasis on economical sustainability, few on social sustainability, and even fewer with an integral sustainability approach involving all three dimensions. Although an integral sustainability approach would involve ecological, economical, and social aspects, most of the FM and SFM authors identify sustainability with effects on the ecological ambit. In regard to SFM and consistent with Sha (2007) and Junghans (2011), Nielsen et al. (2016) performed an important literature review and find that the greater stress of research is put on environmental sustainability through a wide array of possibilities, although FM may help in the development of solutions and contributions on societal effects through organizational analysis through an integrated approach, although such is still very limited.

Finch and Zhang (2013) explore FM as a discipline and how it may contribute to sustainable building performance. FM practices and user behavior are part of a multilayer system that may influence a facility’s performance making it more sustainable. Finch and Zhang (2013) defend the fact that intended environmental improvement depends on the behavior of users and the ongoing management of the facility throughout its life. Finch and Zhang (2013) invite to explore the built environment as a multilayer life cycle process in which FM plays a critical intervention in sustainable decision-making processes. Finch and

Zhang (2013) make an interesting contribution through the analysis of life cycle process of the built environment as well as the interaction between FM operation processes and the behavior of users. The discussion of the critical role of behavior and decision-making in facilities processes enriches the discussions of FM as a social driver for sustainability change.

Zakaria et al. (2018) identify and compile critical success factors for a positive impact of SFM. This assessment analyzes the perceptions of facility managers that recognize their practices as SFM. The analysis concludes on 19 success factors. The most common ones identified in literature are strict legislation set by the government, the organization's sustainability policy, the commitment and the perception of practicing facility manager, and the involvement of senior management personnel. According to Imualim et al. (2012), the most important driver for the implementation of sustainable practices around facilities in the UK is legislation. This result is consistent with traditional command and control environmental policies and is one of the most visible tools to enforce sustainable practices around facilities. However, legislation is not sufficient to ensure both compliance and behavioral change among stakeholders. The main issues that ought to be taken into account besides legislation and regulation in order to successfully implement sustainable facilities practices are located at the organizational level and have to do with monitoring, management, and reporting on issues like energy management, waste, recycling management, and carbon footprint.

Green Buildings and Green Maintainability as SFM Practices

Sustainable facilities management (SFM) tends to be oriented to improve the performance of the built assets through the management practices that allow to optimize resource consumption and general environmental impacts. SFM may be implemented in any facility, but "green buildings" or "sustainable buildings" tend to require specific maintenance practices in order to preserve and maximize any benefit that the design, construction techniques, or materials used in the construction may contribute. Sustainable management practices of facilities are currently confused with green building maintenance considering the necessity to link sustainability and maintainability considerations with the facilities management knowledge and practice in order to achieve the expectations of sustainable constructions and green buildings. Current literature review does not reveal a consistent use of SFM, and neither has yet revealed a consistent approach in the use of "green building maintenance."

Adopting a similar approach, Asmone and Chew (2016) find several gaps in literature that allowed them to affirm that SFM and green maintainability are often confused. Asmone and Chew (2016) define the terminology and find fundamental issues in green building maintenance in which environmental sustainable performance is not sustained through its operational and maintenance phases and propose mechanisms to link facility knowledge from its operation stages with design and construction stages. Based on identified literature gaps, Asmone and Chew (2016) propose a link between facility knowledge from its operation stages with design and construction stages in order to potentiate the opportunity to push forward synergistic design decisions to achieve lifetime sustainability of built environments. Asmone and Chew (2016) also propose the concept of green maintainability of facilities in order to bridge this knowledge gap and create high performance, low-risk, and cost-effective facilities while maintaining minimum resource utilization and emissions generation. This approach strengthens the integral view of FM from operations to maintenance in order to enhance environmental sustainable performance of facilities while proposing a definition for "green maintainability."

On a similar approach, Chew et al. (2017) defend the concept of "green maintainability." According to them, the economic, environmental, and social impacts and opportunities of green FM are identified as "green maintainability" throughout the life cycle of a facility. Chew et al. (2017) develop and present a methodological framework for the research of green FM. This approach is meaningful and relevant since both efficiency and sustainability approaches tend to lack consistent methodologies for their reporting schemes, making it difficult for a strong scientific evaluation and even record tracking in order to prove goal achievements. While most of the observed methodologies tend to be descriptive, traceability is often overlooked resulting in methods with scarce reliability in their goal results.

Sustainable Facilities Management in Higher Educational Institutions (HEIs)

As it was observed before, FM and SFM are practiced in management operations of facilities regardless of the use or application of the facility itself. Although there are some examples of specific management practiced for certain types of specialized facilities such as the case of hospitals, no relevant literature is found that specifically explores facilities management of education facilities. In the case of education facilities, several specific applications of SFM practices are found in literature such as LEED building management, or monitoring and control of greenhouse gas emissions of buildings oriented to carbon neutrality, but literature tends to be descriptive of case studies rather than methodology based, and the lack of consistency makes it difficult to identify harmonic systematization of such experiences.

Mcmillin and Dyball (2009) suggest that universities can optimize their role as agents of change with regard to sustainability by adopting a "whole-of-university" approach to sustainability. Their proposal considers linkages through research, educational, operational, and outreach activities as well as student engagement in all of these activities. Mcmillin and Dyball (2009) suggest collaborative spaces within the curriculum for students, academics, and managers to critically reflect on university's performance with regard to sustainability. This whole-school approach integrating management operations, research, and educational activities and outreach is widely explored in practice, although literature evidences that sectoral dimensions and analyses tend to prevail over crosscutting approaches, making it difficult to come up with a harmonic systematization of documented experiences.

According to UN Global Compact (UNGC 2012), assertive leadership of HEIs in sustainability practices is crucial for achieving quality education. The active engagement of responsible practices of HEIs, such as management operations, contributes to the well-being of involved stakeholders such as students and academic and administrative staff, while they become an educational and ethical statement of the institution. Research-based knowledge and ethical behavior of a university community benchmark HEIs. The Global Compact initiative recognizes that HEIs hold a responsibility as organizations and must control their impacts on environment such as waste and pollution they generate, natural resource and biodiversity preservation, their energy input, and adaptation to climate change. As institutional drivers of change, HEIs have several action domains according to UNGC (2012). These include local community involvement, risk management, and sustainable performance indicators. UNGC implicitly recognizes a sustainability link in facilities management through these social responsibility levers of HEIs as organizations.

Under this same idea, Dave et al. (2014) recognize facilities management department as a key operational unit of HEI given the fact that it may intervene in early planning of the design, construction, and operation of educational infrastructure and is permanently involved in the management strategies for optimization in the use of natural resources and pollution control of daily operations. Dave et al. (2014) identify these as "core biophysical strategies on energy, carbon and climate change" (Dave et al., 2014:12). These authors identify water consumption, waste generation, and biodiversity protection and enhancement as sustainability-related crosscutting issues that impact facilities management. Also, FM or SFM may intervene in the design and development of future infrastructure and even in sustainable procurement of certain goods and services. Dave et al. clearly pinpoint SFM operations as strategic for sustainable campus performance.

Also, as education institutions, UNESCO (2017) recognizes that HEIs play a fundamental social role in student engagement. Humanity needs an urgent paradigm shift, a mindset change that enables a transformation in our lifestyles and the way we think and act as societies if we are to successfully face the challenges of climate change effects. In order to achieve this goal, societies need new skills, values, and attitudes that lead to more sustainable behaviors. Thus, education systems must respond to this need by defining relevant learning objectives, learning contents, and pedagogical methods that are able to empower learners, as well as every other participant, and HEIs are no exception. Even though there is no direct association between learning objectives and FM or SFM per se, UNESCO (2017) identifies the capacity of learners to participate in, evaluate, and influence decision-making-related management strategies of local, national, and international enterprises as behavioral learning objectives for several SDGs. Clearly, the ability to participate through student engagement is an indicator aspect of SFM in HEIs that should be further explored as suggested by other cases in literature not oriented to education facilities mentioned before. Literature review in this area is difficult since a great number of experiences have been documented, but methodologies, approaches, and outcomes are as varied as sectors, scopes, or dimensions of sustainability are explored through HEI strategies.

HEIs in all the globe explore reality-based learning supported on the use of the built environment and facilities management as a learning tool. This behavioral or cognitive approach to reality-based learning through FM or SFM practices is a well-received strategy among HEIs in American continent. Such is the case of the experiences documented through Cohen and Lovell (n.d.). Perhaps the greatest difficulty in the implementation of such strategies within HEIs is the assessment of sustainability through traditional FM or even emerging SFM indicators.

As opposed to linear or sectoral FM or SFM approaches, no significant literature is found to asses FM or SFM specifically in HEIs. As identified by Ramos and Moreno (2013), given that HEIs are knowledge institutions, they foster sustainability assessment initiatives more than supporting policy and management issues as they would do in other enterprises or corporations. Under this role, universities should be ready to integrate and well reflect the uncertainty values of nonlinear complex processes, where limits are often unknown. Moreover, Sonetti et al. (2017) suggest the fundamental role of SFM in order to successfully transform into a sustainable university and propose a sustainability assessment transition framework for HEIs that integrates (a) the built-environment quality improvement, (b) the civil society engagement, (c) the industry partners' involvement, and (d) the public institutions support and collaboration in policy implementation.

Adams (2013) explores sustainability reporting and performance management in the university sector. Findings evidence that university practice in sustainability reporting and performance management significantly lags other sectors and fails to optimize the potential of the sector to influence transformational change through knowledge transfer. This research evidences the need for increased accountability, improved management of performance, and the need for a more innovative approach. Clearly, literature review shows the important role of FM or SFM in HEIs sustainability transition, but the widespread array of possibilities is not explored through applied science.

It is important to mention that while different approaches to SFM are identified in scientific literature, no justice is made to the extraordinary diversity of experiences documented in non-scientific literature. Such is the case of the vast majority of experiences documented through the International Sustainable Campus Network (ISCN). ISCN (2018) recognizes that as institutions committed to learning and teaching, HEIs have the possibility of testing new ideas and technologies and measure change and impacts. ISCN members, which are HEIs all over the world, increasingly integrate the Sustainable Development Goals into governance, operations, teaching, learning, research, and engagement, and they descriptively document case studies in yearly reports. The scope of possibilities observed in real-life examples reflects sophisticated possibilities of research related to SFM ranging from campus as a living laboratory to rich and diverse campus sustainability strategies based on management practices. Although not recorded for scientific purposes, the annual collection of documented experiences published in their yearly reports offers an interesting array of possibilities for exploration, as many of these experiences are operations and management based and may have followed scientific methods under the scope of living laboratory approach or case study-oriented techniques or methods applied for a particular purpose. Some of the case studies may have been documented under scientific methods and literature and could deserve constant observation, special consideration, and further follow-up for identification of SFM methods or frameworks in the near future.

Final Comments

Further research and discussion on the meaning and application of SFM and green maintenance is urgently needed. Also, research on the applications of SFM on green building management is necessary in order to assure long-term benefits of sustainable infrastructure.

Literature review suggests that significant efforts are made to document SFM in HEIs through core biophysical sectoral analyses, such as energy, carbon, and climate change strategies as well as those related to natural resource consumption. There is a substantial amount of literature documenting sustainability-oriented FM experiences in different universities around the world. In this context, a wide array of diverse approaches, methodologies, and even the use of description instead of method descriptions makes it difficult to document a scientific approach relating FM and sustainability or sustainability assessment. There are great opportunities to define what should be understood as SFM and green building management both in general and applied to HEIs. Also, objective and consistent framework development is needed both for documenting ecological, economic, and social impacts of SFM and also for appropriately documenting the insertion of SFM in a whole-school or systemic approach considering educational, management, research, and outreach activities simultaneously.

Research and evidence is needed in order to document the use of the built environment as learning environment. Clearly, the use of higher education facilities could have a great potential in learning outcomes as well as in the development of assessment frameworks for continuous improvement of a great array of FM practices.

There is a significant opportunity in the development and proposal of public policies in education as SFM is also observed as a learning tool. The exploration of the possibilities of the linkage of successful SFM practices to controlled learning experiences may reveal public policy opportunities linking management practices in HEIs to practical learning experiences. Also, the visibility of successful SFM practices may contribute to a synergistic effect of nonformal education on collective or societal behavior.

Finally, regarding higher education, there is limited assessment on the effects that FM or SFM have either on personnel or on the university community. Studies should be conducted in order to assess and learn the effect that SFM practices and their observance have on any individuals exposed to the practice in the form of nonformal sustainability education, particularly on the student community, which is widely viewed as a prospective catalyzer of social change.

Cross-References

▶ Building Lifecycle and Sustainable Development
▶ Global Campus Sustainability Ranking
▶ University Operations for Sustainable Development

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Sustainable Future

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Definition

A sustainable future is a prospective period of time 50 years or more from the present, characterized by a shift in civilizational values away from consumerism, materialism, and industrialization. The phrase is a misnomer, given the assumption of futures studies that the future is not singular, but a number of possible alternative futures, many of which could embody humane, ecological, and nonviolent cultures.

Introduction

Half a century ago, the environmental movement and foresight and futures studies set in motion a discourse about whether humans could survive on our planet, long-term. The roots of this discourse extend further back into the past, the idea of a biosphere, Malthusian challenges, and visionary futures preceded Earth Day, but the scientific and public debate about whether human technological development, resource use, and the limits to growth were an existential threat blossomed in the 1960s and early 1970s. To better understand our chances of surviving our growing dominance over the planet and nature, this chapter explores the definitions, assumptions about sustainability and the future, examples of visioning, and opportunities to create a sane, humane, and ecological future (Robertson 1978). One place to start is to define some terms and state assumptions about the idea of a sustainable future.

Concern for human agency in threats to long-term survival emerged from the peace movement and a new phase of environmental activism, reflected in Carson's (1962) influential *Silent Spring*. There was a growing litany of environmental and ecological challenges: air and water pollution, species extinction, desertification, ozone depletion, overpopulation, and the greenhouse effect. A pivotal contribution to the debate resulted from the MIT computer modeling of human population growth, resource use, and pollution that resulted in *The Limits to Growth* (Meadows et al. 1992, 2004). *The Limits to Growth* was both controversial, yet widely influential in raising concerns about the long-term future of human civilization, given that most of the nominal computer runs showed likely population growth collapse or die back as a result of the exhaustion of resources and/or health and longevity impacts of pollution. *The Limits to Growth* made problematic both the idea of sustainable long-term growth and current economic models (both liberal democratic and communist economic systems used industrial models), and also suggested that there was no one outcome, that many alternative futures were possible.

At the same time, other forces of global change, such as decolonization, mass communication, population growth, energy use, and social movements emerged that were both connected to and informed by developments in computer modeling and futures studies. One of the major advocacy groups for encouraging public and private leaders to consider the implications of *the Limits to Growth* was the Club of Rome, led for many years by the Italian industrialist Aurelio Peccei. Numerous foresight activities were launched and global conferences organized such as Mankind at the Turning Point and the World Futures Studies Federation, to better understand and explore the tools that were needed to better navigate our collective journey into the future. Sustainability, as a word, took off, as is illustrated in a Google Ngram view, and has been among the more popular words in modern culture (Hosey 2016). Global sustainability, as a concept, was cemented with the work of the Brundtland Commission (Brundtland et al. 1987). But, the meaning of sustainability is contested, and the phrase "sustainable development" is considered by many critics (see degrowth, below) to be an oxymoron.

Futures studies offers a different dimension to the topic, by immediately making problematic the idea that there is a singular future, but insisting that there are rather multiple, or alternative futures. One way this has been expressed is that there are many ways to think about the future, and that there are possible, probable, and preferred futures (Gidley 2017). Those concepts have a clear bearing on how we think about what sustainable futures might be, but reinforce the notion that there is not one single future ahead of us, but a wide range of possible futures. In other words, there is not a single sustainable future, but a range of possible futures that are sustainable. Futures studies makes the claim that the future cannot be predicted, but that we can better understand the role of paradigms, driving forces, and personal and collective choices that may help determine the future that emerges. Polak (1973) made a strong case that the future is largely determined by the images that we have in our heads, and Dator (2009) identified archetypal images of the future that exist in popular culture and literature (business as usual, collapse, conserver/totalitarian, and transformational).

Forecasting and futures studies are also grounded in assumptions about time, time lines, time frames, and linearity (the arrow of time). When we talk about sustainable futures, how long is our time frame? On a cosmic timescale, the question of human survival is more esoteric, but certainly on geological scales, it is questionable how long humans will be around, simply based on the longevity of the species that have come before us. Gaia, the living planet, over 4 billion years old, certainly has eons left to go, but how long will it be habitable for humanity (Lovelock 2015)? Presumably, our concept of what is sustainable includes something that looks like the world we live in at the present, yet the threats of a sixth major extinction makes that problematic. So, what is the timescale that we are considering? At the very minimum it is reasonable to assume at least a century or two into the future, given that most humans with an average life expectancy have a 200-year consciousness of the present (Slaughter 2008) extending through our grandparents and grandchildren.

The evidence mounts that human impact on the planet has been significant, and continues unabated. That clearly is not sustainable, if we want the vast majority of humankind to live the lifestyles of the top billion. Yet, one of the most remarkable developments has been the enormous growth of middle-income populations across the developing world in the last quarter century. The loss of rain forest, fisheries, soil fertility, and losses from climate change continue. Our desire for sustainability is a mirror of how dire environmental threats are becoming. In other words, catastrophe and collapse narratives are the writing on the wall that massive behavior changes are needed to avert major catastrophe. Sustainable futures are the antidote for, and necessary response to the empirical facts. Global warming is already having significant impacts on weather, sea level rise, hurricanes, and drought and wildfires. Sustainable futures are threatened by the focus on apocalyptic visions, popular literature and movies, and even religious and mythic eschatology of coming End Times.

Whether the reality of doom and gloom prognostication is warranted or not, the message is clear that, as the Apollo astronauts put it, “we are fouling our own nest.” And there are other threats to our existence, a long litany of low probability, but high-impact events, such as asteroid impacts, nanotechnology mishaps (gray goo), global pandemic, nuclear war, and other extinction level events. Most of those are unlikely to become self-fulfilling prophecies, but Polak (1973) raised concerns that cultures with apocalyptic eschatology run the risk of living their future dreams. Other futurists have advocated more positive approaches to the global challenges, arguing that doomsaying is psychologically damaging, and numbing, and that optimism is a better solution, and that we should envision preferred futures and work to build them (Hurley 2007; Slaughter 2010; Gidley 2017).

There are two relevant developments within futures studies that bear on sustainable futures: the three horizons approach to visioning and scenario-building (Sharpe et al. 2016; H3 Uni 2018) and post-normal futures studies (Sardar and Sweeney 2015; Sardar 2017). Three horizons (3H) describes time horizons, not characterized as much by time, or chronology, as by fitness – the extent to which reality and worldview fit the current (short-term) future that we live in. That is to say, given that the future is constantly unfolding, the Business As Usual or Continued Growth present unfolds into the future. Other alternative futures that are “out there,” such as envisioned by post-humanists or deep ecology greens, are still alien because they have not yet emerged. Therefore, Horizon 1 is Business As Usual – present trends extended (although there are conflicting trends). Observed phenomenon tend to fit the paradigm. Horizon 3 is the future that is unfit – the values, behavior, and actions do not fit the Horizon 1 future. Horizon 2 is that middle term future that is the transition from one present/future to the next.

The 3H framework seems to align well with the *Limits to Growth* models, whether one is looking at the standard run, or the many model iterations that demonstrated die back and overshoot (Catton 1982) in the MIT World 3 model. Whether modeling transportation speeds, population growth, or any number of other aspects of industrialization, the growth model is a J curve. The J curve aligns well with Horizon 1. Horizon 2 is the period of time that represents the most turbulence, chaos, and catastrophe (S curve). In many of the computer runs, the collapse or correction phase, is followed by a steady state or sinuous balance between growth and the lack of it. It seems logical to think of sustainable futures as those distant points in time that will follow the turbulence and chaos of Horizon 2. In other words, sustainable futures may be post-apocalyptic. They are Horizon 3 futures, in that sense. In the MIT standard run, Horizon 2 occurs near 2030, and Horizon 3 sometime after 2100. In other runs, they come sooner, or later, and the severity of the changes also varies in amplitude, but the S curve remains.

The Horizon 1 paradigm is being challenged, leading toward emerging futures characterized by complexity, chaos, and contradiction (Sardar and Sweeney 2015; Sardar 2017). Postnormal theory appears best to explain late-Horizon 1 growing turbulence and contradictions and the emergent Horizon 2. Arguably, the seeds of Horizon 3 sustainable futures are being sown in the end of the growth period, and will survive or flourish during transformation and transition out of the industrial era. The steady state that is suggested in the word "sustainability" may only happen after the postnormal period is over, a century or more downstream – if we make it that far.

Aspirational Futures

Somewhere between dystopian and utopian visions of the future lay sustainable futures, neither horrible nor perfect, but adequate to allow for the co-evolution of the biosphere and humanity. Arguably, there is a large literature in science fiction and futures studies of that portray or advocate sustainable societies. They range from deep green to trans-humanist visions of humans migrating to the solar system and the stars. Sustainability is sometimes in the eye of the beholder, but there is a range of alternative visions for humanity. In addition, futures studies provide an ample toolkit of visioning and scenario building techniques to create and manifest preferred futures.

Aspirational futures have roots in the early utopian literature, and blossomed after Earth Day. Examples in ecological and science fiction literature depicting sustainable futures included Le Guin's *The Left Hand of Darkness* (1969) and *The Dispossessed* (1974), Piercy's *A Woman on the Edge of Time* (1976), and Callenbach's *Ecotopia* (1975). The architecture and design of Paolo Soleri has also informed thinking about human scale and green urban design and the recent *Ecotopia 2121* (Marshall 2016) illustrated the potential of alternative conceptions of the built environment that are more nature-oriented. One of Dator's (2009) archetypal Four Futures was named the Conserver Society, named after the Canadian group that has worked on sustainability since the 1970s (Trim 2015).

One of the keys to open us to a more sustainable future is the preferred futures and visioning work that emerges out of peace studies and futures studies. For at least three decades, futures and visioning have laid the foundation for strategies to envision and realize preferred societies. Many of these can be traced to the pathfinding work of Boulding (1990) in peace studies and Schultz (1995, 2015) and Markley (1998) in futures studies. This has occurred within the broader context of growth in futures, foresight, and anticipation studies over the same period that has had wide impact in the private sector, and somewhat less impact on the public sector, except in Holland, Europe generally, and European Union. Nevertheless, the influence continues to grow. There are entire professional networks, such as Teach the Future (2018) whose mission is to enhance foresight education for youth. While it is a cliché that youth are the future, there seems to be a strong case to be made that young people must be involved in imagining and then creating the futures that they want to inhabit.

In the nearly half-century since the birth of the environmental movement, unquestionably the broad outlines of sustainable futures are defined by it. What the Club of Rome called the "global problematique" is the litany of environmental and ecological challenges: deforestation, pollution, desertification, species extinction, overpopulation, and resource depletion. The response to this call to action was the creation of thousands of environmental groups, NGOs, and more recently, social entrepreneurs committed to the green agenda. Mainstream environmental groups were challenged by the emergence of deep ecology groups, such as Earth First!, the Rainforest Action Network, and Sea Shepherd.

One stream feeding the sustainable futures movement is clearly the movement away from industrial food and agriculture production. Organic agriculture continues to grow and has had widespread impact on the discourse about fossil fuels, industrial chemicals, and wholesome food. The USDA food pyramid has come under attack, in part because of the growing conflict of values around the consumption of meat, and dairy, and growing problems with obesity. Our relationship to food and its reliance on fossil fuels has precipitated other movements such as farm-to-table, food co-ops and share exchanges, and slow food. Popular culture is awash with messaging that is encouraging more sustainable practices and consumption, such as whole foods, vegetarian diets, and eating lower on the food chain.

Another stream is the environmental movement generally, and especially focused on the human footprint on Mother Nature. Schumacher's *Small Is Beautiful* (1973) represented the growing awareness of and interest in appropriate technology, as an antidote to the industrial processes, and with an emphasis on human scale, green technologies. Futurists Satin (1979) and Elgin (1992) argued for less materialistic and consumer behavior, globally conscious local (glocal) action. Appropriate technology has evolved into a spectrum of technological applications at the human scale, using solar, wind, and water resources for development projects. Solar, 3-D printing, and emerging smart technologies (Rifkin 2015) are the emerging dominant technologies in the new economy likely to be important in both transitional (Horizon 2) and sustainable futures (Horizon 3). It appears there is no lack of tools to achieve those futures, but growing debate and discourse about the values embedded in specific technological toolsets.

There are also various streams of politics that feed sustainable futures, both converging and conflicting. Tribalism, localism, and nationalism are contrasted with planetary and globalization forces, so local struggles can include strange bedfellows. Greens have had marginal success in many parliamentary systems. Anarchists and anti-globalization groups, Occupy Wall Street, and other anti-capitalist organizations and individuals comprise another potential source of energy for transformation of the system. Radical social scientists and political economists are heavily involved in the degrowth movement (Assadourian 2012). Degrowth advocates argue that overconsumption is the most fundamental problem exacerbating environmental issues and social injustice. Degrowthers promote the idea that happiness and well-being should be based on shared work, cooperation, and less material consumption. The movement celebrated its 10th anniversary of the first Degrowth conference in Paris (Demaria 2018) and three major degrowth conferences are slated for 2018, including at the EU Parliament.

Another approach to building sustainable futures is the mission and projects of Seeds of a Good Anthropocene in Europe and South Africa (Hichert 2017; Pereira et al. 2018). This initiative is designed to generate and collect alternative futures visions for the planet, to develop positive futures that are both desirable and sustainable. Their aim is to push back against prevailing dystopian and apocalyptic forecasts, and to imagine better paths for Earth and humans (Stockholm Resilience Center 2017). Nevertheless, it does seem like this project reflects a realization that the good Anthropocene may not be fully realized until Horizon 3 comes much closer – and optimism that de-growth strategies could pay off in the shorter term, and with less planetary and human suffering over the next century.

Perhaps incremental, but necessary steps out of the formal economy include the work over the last four decades on alternative measures of growth. Henderson (1994) described the struggle to substitute alternative measures of wealth and progress to Gross Domestic Product (GDP) as nothing less than a tug-of-war between worldviews, epistemology, and methodology. Bhutan adopted a Gross National Happiness measure to replace the GDP in 2011 (Adler 2011). As climate change continues to run up costs for reconstruction, remediation, and insurance, it makes sense to argue that GDP does not serve as a good measure for overall health and well-being of national economies. There appears to be at least the beginning of some delinking of economic growth measures and overall social and political well-being.

Stone (1985) asked in a classic 1971 law review article if "should trees have standing?" and started a debate about whether the Earth or features of the landscape deserved legal rights. Seed et al.'s (1988) Council of All Beings laid the foundation for many groups and organizations to put themselves in the place of and to defend the rights and existence of different species, rivers, and mountains. In 2011, Bolivia passed the world's first laws that granted nature equal rights with humans (Vidal 2011). In 2017, New Zealand's Whangwanui River was given the rights of an individual (Roy 2017) and Indian courts quickly followed suit for the Ganges and Yamuna rivers (Safi 2017).

The international community has not ignored concerns about sustainability since the Brundtland report, but has continued to deepen the global discourse on climate change and what to do about it. The Intergovernmental Panel on Climate Change (IPCC) has continued to sound the alarm over the potential costs and consequences of global warming, and the Paris climate accords commit governments and organizations to action. Critics argue that the actions may be too little too late to mitigate the more serious consequences of global warming. The Sustainable Development Goals (SDGs) are now the driving aspirational goals and vision for humanity and the planet in 2030. The 17 goals and 169 targets are currently in the process of being implemented and operationalized at the national level. As the carbon dioxide level in the atmosphere continues to rise, now above 410 parts per million, the SDGs may be just scratching the surface of what is required for transformational change to avoid planetary catastrophe, but they are a step in the direction of addressing sustainability and resilience, and perhaps easing the transition through Horizon 2.

The SDGs preamble clearly addressed the necessary transformational change required. It seems also that nation-states are singly and collectively unwilling or unable to mitigate the consequences of global warming on one hand, and peak oil and resource depletion on the other hand. It may be up to the non-state actors, particularly the array of nongovernmental organizations (NGOs): charities, faith-based organizations, non-profits, intergovernmental NGOs, intergovernmental research NGOs, and the public sector to respond to the challenges and emerging crises ahead. It will require all of us, individuals and families, to play a role in making the changes to our lifestyles in order to see something resembling sustainability.

More roots of the sustainable futures phenomenon can be found in the cultural demographics of postindustrial societies, such as the population identified as *cultural creatives* that account for approximately 25% of the total US population (Ray and Anderson 2000; Thomashow 2018), and by extension some proportion of the population in other mature industrialized countries. Cultural creatives are less consumer-oriented, less materialistic, more spiritual, and politically progressive. Within this subset of the population, there is an array of groups, movements, communities, and individuals working to realize some are part of their vision of a desirable future. What follows are some examples, but hardly a comprehensive accounting, of alternative approaches to social, political, and economic systems that are threatening the planet. There are a variety of approaches to housing, such as the eco-village movement, intentional communities, and cohousing. There has been growing interest in traditional and natural building techniques, such as straw bale, adobe, cob, in response to the carbon footprint and energy use involved in mainstream construction techniques. On the other hand, professionals in all fields seem to be paying greater attention to sustainability, from engineers, to the travel industry. Private sector interests are also working more closely with UN climate work, as exemplified by the Principles for Responsible Management

Education (PRME) initiative. In the US, which has recently backed away from the Paris climate agreement, some state and local jurisdictions, such as the State of California, are taking a lead in the national climate change policy discussions.

There has been no lack of doom and gloom visions and scenarios in the subsequent time and space since the *Limits to Growth* (Catton 1982; Ehrlich and Erlich 2013; Oreskes and Conway 2014; Lynas 2008; Lovelock 2015). Popular culture is rampant with post-apocalyptic hyperbole. Yet, positive normative scenarios of and visions of the future do compete for our eyeballs. Among the more visible futures organizations promoting positive futures has been the Millennium Project, the brainchild of futurist Glenn who authored a collective effort to generate positive Middle East peace scenarios (Glenn 2009) and a global normative scenario produced early in the millennium (Glenn 2014). The Millennium Project continues to be one of the largest global networks of futures oriented activists and researchers, and it publishes an annual *State of the Future* report.

The next section is both about global futures, but very much about the local and personal nature of preferred images of the future. There is a long tradition within futures studies that has explored and encouraged young people to envision and imagine positive futures. Youth futures workshops began with pathfinders including Ray Lorenzo, Simon Nicholson, and Anita Rubin (J. Dator, personal communication, April 24, 2018) and has continued in the UK, Finland, and spread to many other parts of the world. Through the work of the World Futures Studies Federation, the Millennium Project, UNESCO, and university organizations, there are no regions that have not seen some foresight and visioning projects, and few countries where youth and communities have not had a chance to engage foresight and futures studies. The following are just selected examples, and not at all a comprehensive listing of such futures and visioning work.

As noted earlier, futurists Bishop, King, Bol, and Lee are advocating more widespread foresight education for youth in the USA and Europe (Teach the Future, 2018). Experiential futurist Candy (2016) reported on a profoundly moving project involving positive personal images of the future of Syrian refugee girls. Similarly, community empowerment and visioning work has also been carried out in underserved communities, favelas, in Brazil (A. Roldan, personal communication, April 24, 2018). One large project in Finland covered 21 municipalities and small towns in Southwest Finland. Futures workshops were used to create common cultural strategies to affect a more unified and innovative cultural environment (European Union 2010). Other community building, futures oriented projects have taken place in Australia (Futures Foundation 2002; Ouyen, Australia 2008), Canada (Canmore 2006, 2010), the US Pacific Northwest (Thomashow 2018), Nepal (Imagine Nepal 2018), Chicago (Imagine Chicago 2018), and Suffolk County, UK (European Futures Observatory 2012). Hawaii 2050 involved hundreds of people in an immersion experience into four alternative futures of Hawaii, some of them more preferred, by some, than others (Candy 2016). These are only a sample of many of the activities taking place across the planet.

Visionaries and futurists, who have contributed to preferred spiritual futures, include De Chardin, Harman, Markley, Hubbard, Wilber, and others. Organizations that are noteworthy in this area include the Institute of Noetic Sciences, the Naropa Institute, the Scientific and Medical Network (UK) and a host of healing and holistic health networks and organizations, holistic and complementary medicine, midwifery, massage, and other healing traditions are a key facet of an emerging paradigm that reflects values of sustainability, stability, and balance. Many advocates of sustainable futures that honor these faith and spirit traditions see ecumenical convergence in contrast to religious intolerance. Futurists Slaughter (2004) and Inayatullah (2004) have made significant contributions to the macro-historical, integral, and spiritual perspectives that inform foresight and futures studies and therefore the discourse on sustainable futures. Another source for sustainable futures are nature religions, such as Wiccans and neo-pagans, eco-feminist spirituality, many indigenous peoples' religions, and other metaphysical traditions that have strong nature attachment, such as Sufism, Hinduism, Taoism, Buddhism, and Shinto.

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Cultural creative are more inclined towards spirituality than religion, but many are also agnostic or atheists (Ray and Anderson 2000). There is certainly no universal agreement about the role of spirituality or metaphysical laws in the creation of preferred futures, but certainly many desirable futures include some expression of faith, particularly as it relates to Mother Nature.

Key to our survival as a planetary species may be the requirement that we evolve a planetary consciousness, which presently eludes most humans, but may be growing in influence. Futurist Lombardo (2017) is the most visible advocate for sustainable and more highly conscious planetary futures, following the paths of Elgin (1992) and Russell (1995). Lombardo argued that our central mission and obligation as a species is to envision and create *good futures* – preferred, sustainable futures. If larger numbers of the planet's population are able to function at higher levels in Maslow's hierarchy of needs, able to evolve further up the dynamic spiral to higher consciousness (Beck and Cohen 1996), then we may be able to break through the limits to physical growth and coevolve peacefully with the planet by envisioning, planning, and creating good futures.

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Sustainable Growth

▶ Sustainability Barriers

S

Sustainable Higher Education Systems

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Synonyms

Greening higher education

Definition

A sustainable Higher education (HE) system may be defined in terms of the network of local, national and international HE institutions and their systems that sustain the core functions of HE, including the delivery of teaching and learning, research, and outreach, by addressing social, economic, and environmental targets and constraints influencing the HE institutional context. A sustainable HE system not only sustains the functions of HE institutions but supports the aims of sustainable development by advancing citizens' knowledge and skills to meet the needs of society and the economy and by promoting stewardship of the natural and built environment.

Introduction

Higher education (HE) systems comprise institutions whose function is to support, develop, and deliver teaching and learning at post-secondary or tertiary level. Much of this teaching and learning is delivered at universities, although it is also provided through colleges and polytechnics, and specialist course providers, including business schools, agricultural colleges, and conservatoires. HE systems have a key role in the development of citizens, society, and culture, including changing current attitudes and practices toward sustainable development (Alonso-Almeida et al. 2015), as well as helping to support the economy through the provision of an educated workforce (Williams et al. 2013). While there are many sub-systems within the HE system providing, for example, a range of facilities for staff and students from accommodation to laboratory and sports facilities, the main HE system is focused on the provision of HE teaching and learning. This provision can be full-time or part-time and via campus-based face-to-face teaching, distance learning, or blended learning systems. Many HE institutions also conduct research and/or provide enterprise services in partnership with other organizations in the private, public, and third sectors, thereby supporting a view of HE as a system with permeable and fluid boundaries, which contributes to society through the creation and transfer of new knowledge, including knowledge of sustainable development (Gough and Scott 2007).

A sustainable HE system is arguably one in which the whole set of institutions involved with HE functions, including government and other support agencies, as well as higher education providers, work together to meet the sustainability triple bottom line of social equity, economic prosperity, and environmental protection (Elkington 1999). Most of the literature, however, defines sustainable HE at the campus or university level. Hence a sustainable campus community is defined by Cole (2003) as "one that acts upon its local and global responsibilities to protect and enhance the health and well-being of humans and ecosystems. It actively engages the knowledge of the university community to address the ecological and social challenges that we face now and in the future." Similarly Velazquez et al. (2006) defines the sustainable university as "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 fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles." Such definitions emphasize the local and global responsibilities of HE systems to minimize negative social, economic, and environmental impacts, protect the ecosystem, and support the transition to sustainable lifestyles.

The HE sector has been concerned with its role in sustainable development over some decades (Gough and Scott 2007). However, Owens (2017) observes that HE has only recently been introduced explicitly into the Sustainable Development Goals (SDGs), following the United Nations (UN) General Assembly, which established a UN commitment to the 2030 Agenda for Global Sustainable Development (UN 2015). At this time, the UN replaced the Millennial Development Goals, which had focused on primary and secondary education in developing countries, with 17 SDGs of which some included targets and actions applicable to HE. The main SDG applicable to HE functions is SDG 4, which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." This SDG includes targets by 2030 to ensure equal access to affordable and quality tertiary education (target 4.3) and to integrate key sustainability concepts across the curriculum (target 4.7) through the Global Partnership for Sustainable Development framework (UN 2015). In this way, the UN's 2030 Agenda consolidates the importance of the Education for Sustainable Development (ESD) initiative led by the United Nations Educational, Scientific and Cultural Organization (UNESCO), which gained traction as an important high-level educational initiative to support the SDGs at the time of the 2012 Rio +20 United Nations Conference on Sustainable Development, following the 1992 Earth Summit in Rio de Janeiro (UNESCO 2014).

Although a sustainable HE system should fulfil HE's main functions and help to address social, economic, and environmental dimensions of sustainable development, the focus in this entry is predominately on environmental sustainability. This is because the social and economic responsibilities and effects of HE, such as providing access to minority groups and disadvantaged students or meeting the educational requirements of national or local economies, are widely discussed topics in their own right, while the environmental sustainability of HE is a relatively new subject, although one in which there is a growing body of literature published, for example, in the *International Journal of Sustainability in Higher Education*. Environmental sustainability is typically measured against reductions in negative environmental impacts, energy use, and greenhouse gas emissions. This is relevant to the following UN SDGs: SDG 7 "Ensure access to affordable, reliable, sustainable and modern energy for all" with reference to prioritizing energy-efficient practices; SDG 12 "Ensure sustainable consumption and production patterns"; and SDG 13 "Take urgent action to combat climate change and its impacts" (United Nations 2015). This entry summarizes some key approaches to promote environmental sustainability in HE, including:

- Greening the curriculum to encompass education for sustainable development
- Greening campus buildings and site operations
- Designing HE teaching and learning delivery systems, such as distance and online education systems, which potentially minimize impacts on the environment

A further role that the HE system can have in improving environmental sustainability is through research on environmental science and related subjects carried out in universities and other HE institutions when transferred to and applied in society.

Approaches to Sustainable Higher Education Systems

This section introduces and discusses key HE initiatives and research studies that address sustainable higher education systems.

Higher Education for Sustainable Development

HE has a key role in the development of society and the economy, and therefore HE providers have a vital role in changing current practices toward sustainable development (Alonso-Almeida et al. 2015). This may be achieved through education, research, policy formation, and information exchange to support the diffusion of environmental knowledge and literacy across society (ULSF 1990). Alshuwaikhat and Abubakar (2008) also point to the importance of HE institutions in educating most business and political leaders and professionals. Thus, the highest priority for sustainable HE systems has been on "greening the curriculum" to educate students and others for sustainable development.

Education for Sustainable Development (ESD), also known as Sustainability Education and Education for Sustainability, was established in 2005 (UNESCO 2014) and since then has propagated several HE international initiatives. The first major HE sustainability initiative is the 1990 global Talloires Declaration of University Leaders for a Sustainable Future, established by the Association of University Leaders for a Sustainable Future (ULSF), which now represents a commitment by over 500 university leaders in more than 50 countries to integrate sustainability and environmental literacy in teaching, research, operations, and outreach (ULSF 1990). This includes a commitment to educating all HE students and training HE staff in environmental literacy, as well as raising public, industry, and government awareness of the need to move toward an environmentally sustainable future. A second key initiative is the European Copernicus Charter first established in 1993, which by 2011 with the Copernicus CHARTA 2.0 had signed up over 320 European universities. It has similar aims to the Talloires Declaration and calls for "institutions of higher education [to] pay particular attention to their role(s) in realising processes of lifelong learning for sustainable development by involving formal, non-formal and informal learning in this direction" (Alliance Copernicus 2011). A third international Higher Education Sustainability Initiative (HESI) was set up in 2012 as part of a multiagency UN program with participating HE institutions, which has secured commitments from global university leaders to integrate sustainability into the curriculum as well as on campus (UNESCO 2014). In 2000, the Global Higher Education for Sustainability Partnership (GHESP) consortium was set up to bring together the ULSF, COPERNICUS-Campus, the International Association of Universities, and UNESCO as a voluntary partnership to promote sustainable development in HE teaching and research worldwide, as part of the UN Decade of ESD (Anonymous 2005).

In HE there has been high levels of student demand and interest in sustainable development together with increasing inclusion of ESD curricula focused on sustainable development and the ways this may be achieved (Ryan and Cotton 2013). Although ESD curricula usually include environmental studies and/or science content, many also incorporate the social and economic dimensions of sustainable development (Sinakou et al. 2018). The learning delivery methods favored by proponents of ESD are typically student-centered pedagogical approaches, including participatory and experiential learning through reflection on action and discovery, designed to encourage critical thinking about sustainable futures and challenging current beliefs, values, and assumptions about the status quo (Cebrián et al. 2015). Moreover, the phenomenon of massive open online courses (MOOCs) has been viewed as a mechanism to promote mass education in sustainable development, as well as encouraging pro-environmental behavioral changes and delivering socioeconomic benefits (Lane et al. 2014).

A large body of relevant academic work on environmental and sustainability education is available in journals, notably *Environmental Education Research* and the *Journal of Environmental Education*, while the *Journal of Education for Sustainable Development* addresses innovative approaches to ESD and the impacts on students' environmental attitudes and behaviors. Such journals offer a useful source of conceptual and empirical studies for the interested reader. However, while much more research is needed on the outcomes of ESD for students, a few research studies have already observed pro-environmental changes in student behaviors as a consequence of study on HE courses with ESD content. In one such study, students developed ideas for sustainable living and subsequently instigated behavioral changes, following measurement of their ecological footprints arising from their household use of transport, energy, shopping, the house and garden, water, and waste (Roy and Caird 2001). In another study, learning about sustainable development led many students to make pro-environmental behavioral changes, for example, reducing car use, improving home energy efficiency, recycling waste, or shopping for locally produced food (Roy et al. 2005).

The ambitions of ESD have not been uncontested in academic discourse. Critiques of ESD address the challenges posed around whether education should be harnessed to a specific purpose, even if the purpose is mainly well regarded, when such approaches may be construed as encouraging students to accept a doctrine and set of sustainable development values rather than to think creatively (Jickling and Wals 2012). In their book *Higher Education and Sustainable Development: Paradox and Possibility*, Gough and Scott (2007) state "…on one side, it is often argued or assumed that universities exist to provide a future society with the skills base it will require. In another view, universities exist not (merely) to service the economy but to contribute to the intellectual and moral improvement of the human condition." These authors pose the question of whether HE can achieve sustainable development goals and also produce educated independent thinkers. Shephard (2015) identifies concerns among academics about sustainability advocacy as an important factor in explaining HE institutional barriers to offering ESD curricula. However, while further considerations and resolutions are required, the adoption of innovative pedagogical approaches with an emphasis on developing critical and future thinking in ESD should go some way toward overcoming such institutional barriers (Cebrián et al. 2015). These authors also identified the importance of institutional strategies to promote academic engagement with ESD, including organizational support and leadership, quality assurance processes, professional development, and establishing reward structures. Moreover, following Gough and Scott (2007), many academics regard ESD as essential to achieve sustainable development, although problematic for HE.

Greening Campus Buildings and Site Operations

A second major approach to making HE systems sustainable focuses on "greening the campus." This includes ensuring the energy and resource efficiency of campus buildings and improving environmental management of campus site operations, such as reducing water consumption, pollution, and waste (e.g. Sorrell et al. 2000; Williamson 2012; Robinson et al. 2018). Alshuwaikhat and Abubakar (2008), for example, recommend that "a sustainable university campus should be a healthy campus environment, with a prosperous economy through energy and resource conservation, waste reduction and an efficient environmental management. . .."

Greener campuses and site operations as part of sustainable HE systems have been promoted in various national, regional, and international institutional partnership initiatives. Several HE initiatives, some of which are mentioned above, include the Talloires Declaration, which represents a commitment to integrate sustainability into campus site operations as well as in teaching and research. One of the Declaration's actions is to "Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations" (ULSF 1990). Similarly, the HE institutions participating in the HESI initiative led by several UN agencies have committed to supporting "green campuses and local sustainability efforts" (UNESCO 2014). Moreover, the COPERNICUS Charter for sustainable development has similar aims to these international initiatives concerning the incorporation of sustainability practices into universities, which includes greening campuses. It is also notable that countries and continents have their own associations and programs for developing sustainable HE systems, such as North America's Association for Advancing Sustainability in Higher Education (AASHE) established in 2005, which includes among its activities the development of sustainability performance measurement, resources, and toolkits (see, e.g., Urbanski 2017).

Such initiatives are only effective, however, if followed by an implementation plan. A good example is the Australian National University's Environmental Management Plan whose sustainability targets for 2021 relative to a 2014 baseline include plans to decrease total carbon dioxide emissions by 30%, increase renewable energy generation by 50%, increase the recycling rate to 85%, reduce emissions of key pollutants by 25%, reduce water use per person by 50%, increase sustainable commuting to 80%, offset 100% of air travel emissions, and conserve all protected ecological communities, habitats, and species on campus (Australian National University 2017). Another example is Groningen University, a pioneer institution in the COPERNICUS Charter initiative, which developed a 2015–2020 Roadmap based around the aims of the university to be carbon neutral by 2020 through a program of energy efficiency, renewable energy, green buildings, waste reduction and separation, and water conservation (University of Groningen 2018).

Many HE institutions have now established sustainability policies to manage campus and site operations, for example, concerning building construction and operations, procurement processes, the efficiency of information and communication technologies (ICT) systems, pollution control, and water and waste management (Caird et al. 2015a). While sustainability reporting is in the early stages and only supported by relatively few mainly European universities in the international context (Alonso-Almeida et al. 2015), the growing commitment to sustainability is evident from university websites, where many universities have policies aimed at preserving green spaces, wildlife, and biodiversity in campus design and planning (University of Durham 2018; University of Edinburgh 2018; University of Southampton 2018). Moreover, under the worldwide Greenhouse Gas Protocol Initiative, HE institutions are obliged to report on carbon management, including (Scope 1) direct carbon dioxide emissions from sources that they own or control, such as heating and cooling buildings, (Scope 2) indirect carbon dioxide emissions from the generation of electricity purchased by the institution, and (Scope 3) indirect emissions that arise from the impact of activities outside institutional ownership and control, such as staff and student travel, water supply, waste disposal, and supply chain procurement (WRI/WBCSD 2014).

It is generally recognized that activities giving rise to Scope 3 emissions are the most difficult areas for HE systems to manage, not being under direct institutional ownership and control (Caird et al. 2015a; Versteijlen et al. 2017). This is demonstrated by Townsend and Barratt (2015) who measured the carbon footprint of Leeds University, UK, to identify the Scope 3 emission hotspots. The areas producing the highest greenhouse gas emissions across supply chains were utilities and construction, followed by purchase of machinery, computers and manufactured products, transport, and communication. They also summarized the results of carbon footprint studies in six other universities worldwide, which showed that Scope 3 emissions dominated those produced and the major carbon impact areas in these universities were building construction and travel.

Versteijlen et al. (2017) calculated staff and student travel to be the main component of Scope 3 carbon dioxide emissions accounting for 40–91% of the total emissions of six Dutch universities. Similarly, high emissions from staff and student travel were also reported in university case studies in the UK (Ozawa-Meida et al. 2013) and USA (Bailey and LaPoint 2016). In response, some HE institutions have introduced sustainable transport plans, for example, promoting the use of bicycles and providing access to public transport for staff, students, and visitors and discouraging single-car commuting through car sharing and parking restrictions, for example, the University of Bristol (2017) and the University of Nottingham (2018). A particular concern is with the emissions from international air travel, which is associated with HE aspirations for the expansion of their numbers of international students (Davies 2015). Preliminary research by Fawcett (2005) indicates that carbon equivalent emissions from international students' air flights to and from the UK are comparable to the carbon dioxide emissions from the whole HE sector's building stock. Fawcett observes that "there is little evidence that the sector has begun to acknowledge the additional damage to the climate involved in recruitment of international students."

Sustainable HE Teaching and Learning Models

Approaches to improving the environmental sustainability of HE systems may be broadened beyond greening campuses and the curriculum to include the design of teaching and learning delivery systems. Very few studies have examined this approach to HE system sustainability (see Alharthi, Spichkova and Hamilton 2018). The first major quantitative research to examine how the design of HE delivery systems impacts on the environment was the "Factor 10 Visions" study "Towards Sustainable Higher Education" (Roy et al. 2005). This conducted an environmental audit of 20 full- and part-time HE courses in the UK institutions to include staff and student travel; the purchase and use of computers, printed educational materials, and paper; student residential energy use; and campus buildings and site operations. This enabled an assessment of the energy use and carbon dioxide emissions involved in the production and delivery of campus-based and distance HE courses. The campus-based courses were delivered through traditional face-to-face teaching, whereas the distance HE courses were delivered either by mainly print-based materials or by blended print and online materials both with some supportive face-to-face, telephone, or online tuition.

The “Factor 10 Visions” study found that on average the production and delivery of the distance HE courses used 87% less energy and produced 85% fewer carbon dioxide emissions than the campus-based courses when standardized per hundred student hours of planned teaching and learning. The much lower impacts of distance learning compared to campus-based courses are mainly due to a major reduction in the amount of student travel, economies of scale in utilization of the campus site, and the elimination of much of the energy use associated with students’ accommodation. The courses with online provision appear to offer only a small reduction in energy use and carbon dioxide emissions (20% and 12%, respectively) when compared to mainly print-based distance learning courses. This is due to high student use of computing and consumption of paper for printing off online material (Roy et al. 2008).

These significant results were submitted to the Higher Education Funding Council for England (HEFCE) as part of its consultations on sustainability in the HE system. However, perhaps because the results were considered most applicable to distance HE systems, HEFCE did not give priority to recommendations around increasing the use of distance teaching and learning in promoting HE system sustainability. Instead the previous two approaches discussed earlier – greening the curriculum and the campus – were viewed as more relevant, at least in the UK system (HEFCE 2010).

With the proliferation of ICTs transforming HE over the past two decades, there was a need to revisit questions concerning the design and environmental impacts of HE teaching and learning delivery systems. The “SusTEACH” project extended the “Factor 10 Visions” study to examine the pervasive use of ICTs in transforming HE teaching and learning and the likely impacts on energy use and carbon dioxide emissions. This study first developed a new classification of HE courses and modules in the UK institutions based on their primary teaching and learning model (Caird and Lane 2015) and then conducted an environmental assessment and analysis of the energy use and carbon dioxide emissions involved with different teaching and learning models of course and module production and delivery (Caird et al. 2015b). The SusTEACH study, which surveyed 19 campus-based and 11 distance learning courses and modules, supported the findings of the previous study on the main uses of energy and sources of carbon dioxide emissions involved in producing and delivering UK HE. Moreover, the aggregated results showed that distance HE teaching and learning models (which included print-based distance-taught models, blended ICT-enhanced distance-taught models, and online models) reduced average energy use by 88% and achieved average reductions in carbon dioxide emissions of 83% when compared with campus-based HE models (which included traditional face-to-face models and blended ICT-enhanced face-to-face models), again when standardized per hundred hours of student teaching and learning (Caird et al. 2015a). A comparison of distance and campus-based HE systems showed that the distance learning provision on courses and modules was the most important factor in explaining the major differences in the resultant uses of energy and consequent carbon dioxide emissions. As with the “Factor 10 Visions” study, the strikingly lower impacts of distance learning were mainly due to a significant reduction in student travel and residential energy use and efficiencies of scale in utilizing campus site facilities and operations (Roy et al. 2008; Caird et al. 2015a).

Addressing the specific role of ICTs in HE models of course production and delivery, the SusTEACH study also calculated the average energy use in megajoules (MJ) and carbon dioxide emissions in kilograms (kg) associated with HE teaching and learning models standardized per student per hundred study hours. The SusTEACH research findings showed that the energy and emissions impacts were *from lowest to highest* as follows:

Online models	363 (MJ) and 36 CO_2 (kg)
Blended ICT-enhanced distance models	501 (MJ) and 45 CO_2(kg)
Print-based distance models	623 (MJ) and 49 CO_2 (kg)
Blended ICT-enhanced face-to-face teaching models	4259 (MJ) and 246 CO_2(kg)
Traditional campus face-to-face models	4293 (MJ) and 278 CO_2(kg)

These results showed that online and blended ICT-enhanced HE models were comparatively better than the print-based distance teaching models at reducing the main sources of energy use and therefore achieved significant carbon reductions. The picture was more complex in campus-based HE systems when examining blended ICT-enhanced face-to-face teaching models, which only achieved slightly lower impacts than traditional campus models. Where ICTs are used to design courses and modules to reduce the need for student travel and commuting, and to reduce the use of residential and campus buildings and facilities, then significant reductions in energy use and carbon dioxide emissions can be achieved. However, the analysis of the SusTEACH findings revealed that a third of the energy use and carbon dioxide emissions associated with the blended ICT-enhanced campus model was attributable to student air travel between home and term-time residence. In some cases, this blended model involved students traveling long distances to attend the campus for short periods of face-to-face teaching while also learning online for part of the course. As discussed in the section "Greening Campus Buildings and Site Operations," HE aspirations to increase the numbers of international students raises significant sustainability concerns, although the likely carbon dioxide emission generated by international student air travel is rarely discussed (Davies 2015).

Very few other studies comparing the environmental impacts of different models for delivering HE teaching and learning exist. One of the few is Harlow's (2016) case study comparing the environmental impacts of online and on-campus students associated with travel, campus and residential energy use, and use of ICTs and paper at the University of Waikato, New Zealand. This used a slightly different methodology but broadly supported the findings of the UK Factor 10 Visions and SusTEACH studies. This study showed that the online delivery model achieved reductions in energy use (approximately 60%) and carbon dioxide emissions (72%) compared with the on-campus model. The relatively lower reductions achieved compared with the UK studies were attributable to the New Zealand context, where the national energy mix includes a high proportion of renewable sources, where climatic factors reduce energy demand, and where geographical factors result in shorter journeys for teaching and learning (Harlow 2016).

In a US study focused on student travel, Campbell and Campbell (2011) surveyed 500 students enrolled on online courses provided by three Californian university campuses. The students were asked to estimate their reduction in car use as a result of studying online compared with attending on-campus. The results indicated savings of 50–100 kg of carbon dioxide emissions per semester per student. The survey also found increased student satisfaction with studying online due to the reduced environmental impacts but noted that although the number of US students learning online was growing, senior faculty members in American universities were still generally resistant to online courses (Allen and Seaman 2010).

Another study by Oliveira et al. (2017) noted a significant increase in the use of distance education in Brazil in order to widen participation, including through reaching students in areas not served by conventional HE institutions, and to reduce costs. They then modelled the energy use per student in delivering a technical management course via face-to-face campus and online distance education systems. The result was that the online education system used about *twice* the energy of the campus-based system. This finding was due to the "emergy" energy accounting technique used (Odum 1996); the assumption that staff and student travel to campus was all via a fixed bus route that used less energy than the computers required for the online system; and that only a few more students were taught online than by the campus system. However, the study found that as student numbers on the course increased, the online system began to use less energy than the campus one with a crossover number of 300 students. So, while some of these results seem to run contrary to those of the other studies mentioned above, they point to the methodological complexities and contextual factors involved in making such comparisons. Nevertheless, like the other studies, this one demonstrates the value of scale economies that may be gained through the use of distance and online course delivery.

A limitation of the studies comparing distance, blended, and campus-based HE systems is that they focus on energy use and carbon dioxide emissions while ignoring other environmental impacts, such as resource depletion, air and water pollution, threats to wildlife, and waste. However, some studies have shown that energy use and carbon dioxide emissions are often a good indicator of these other environmental impacts (e.g., Kalbar et al. 2017), and so reducing energy use and carbon dioxide emissions will often result in a reduction in other negative impacts.

Conclusion

This entry has examined sustainable HE systems and several contemporary initiatives that support sustainability in terms of both the main functions of HE and its internal operations. It has focused on the environmental sustainability of HE systems, with particular reference to reducing energy use and carbon dioxide emissions. Existing HE sustainability initiatives have focused predominately on "greening" the curriculum through Education for Sustainable Development initiatives and "greening" campus buildings and site operations through institutional sustainability policies and practices. However, the authors of this entry also argue that such current initiatives should be broadened to consider the design of teaching and learning models for course production and delivery to support sustainable development. Until recently, there has been little attention to sustainable HE teaching and learning models and how the use of ICT and distance learning can reduce negative environmental impacts.

This entry has focused on empirical studies of the benefits of online and distance HE systems for reducing energy use and carbon dioxide emissions with reference to SDGs 7, 12, and 13 (United Nations 2015). Online and distance HE systems can also have wider benefits across social and economic dimensions of sustainability, beyond the environmental dimension, offering the potential to promote social sustainability, for example, by increasing the availability, accessibility, affordability, and equity of HE with reference to SDG 4 "Ensure inclusive and quality education for all and promote lifelong learning," as well as promoting economic sustainability, for example, by improving system efficiencies, economies, and effectiveness with reference to SDG 12 "Ensure sustainable consumption and production patterns" (United Nations 2015). This is achieved by widening access to learning beyond the campus context, achieving scale economies and scale efficiencies by spreading costs across larger student numbers, and substituting the main uses of energy and sources of carbon dioxide emissions using distance methods and ICTs.

In conclusion, initiatives that attempt to reduce HE energy use and carbon dioxide emissions have a valuable role in achieving sustainable HE systems. In particular, it is recognized that staff and student travel, building construction, campus site operations and procurement, and student residential buildings are the main sources of energy use in the HE system. Hence reducing carbon dioxide emissions should be achieved through substitution and reduction measures focused on these areas, and key ways of achieving this include greening campus buildings and site operations, making greater use of distance and online HE teaching and learning systems, and educating students to understand how they can contribute to sustainable development.

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Sustainable Investing

► Value-Based Investments in Sustainability

Sustainable Lifestyle

► Green Living Guide and Sustainable Development

Sustainable Literacy

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Introduction

Sustainable literacy appears in the literature as sustainable development literacy, literacy for sustainable development, and/or sustainability literacy. Sustainable literacy is generally conceived as an understanding of sustainability and the identification and translation of issues that have sustainability implications. Although the concept has been around since 1987, it took prominence in higher education institutions during the UN Decade of Education for Sustainable Development (DESD). Recently, sustainable literacy has been identified as a core pillar for achieving the Sustainable Development Goals 2030.

The paper outlines the emergence of sustainable literacy as a concept. The next section first provides an overview and formal definition of sustainable literacy. Specifically, how the term literacy fits with sustainability to form the concept of sustainable literacy is discussed. The following section details the conceptual genesis of sustainable literacy and how it came to be an important feature in institutions of higher education. Next, a description of the evolution of the term related to its practice is reviewed. In particular, this section outlines how sustainable literacy has been implemented and assessed. The fifth section summarizes some key challenges, critiques, and debates within the field. Finally, some future directions are suggested that would facilitate the continuous institutionalization of sustainable literacy.

Definition of Sustainable Literacy

Sustainable literacy, sustainability literacy, sustainable development literacy, and environmental literacy are often used interchangeably, although the latter concept is narrower in scope. The UNESCO (2006) defines literacy as knowledge or education in a particular field or fields. More specifically, literacy is a set of tangible cognitive skills related to reading and writing and is typically measured through proficiency and mastery over these sets of skills. In the context of sustainable literacy, literacy has also been concerned with the dissemination of knowledge related to sustainability that would provoke changes in people’s values and lifestyles (Stibbe 2009).

Sustainability and sustainable development are also closely related concepts. The former term is broader and places less emphasis on a particular pathway to sustainability. Moreover, there are serious disagreements and debates with what sustainability and sustainable development mean both in principle and in practice (Rosenbaum 2004). The benchmark definition of sustainable development comes from the UN World Commission on Environment and Development: “a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional changes are all in harmony and enhance both current and future potential to meet human needs (WCED 1987 p. 43).” Similarly, the Brundtland Commission defined sustainable development as a type of behavior that “meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987, p. 8).” Recently, the Sustainable Development Agenda 2030 also established that genuine sustainability sits at the intersection of five key dimensions: people, planet, prosperity, peace, and partnership. The overarching consensus of these definitions is that something “sustainable” must include economic, social, and environmental dimensions operating in harmony with each other (Byrch et al. 2007). More broadly, sustainability draws upon the ideas of equity, social justice, and fairness for current and future generations.

Together, sustainable literacy refers first to a general understanding of sustainability and the identification of issues that have sustainability implications. Secondly, sustainable literacy is about the acquisition of knowledge and tangible cognitive skills to contribute to a more sustainable world. That is, it is about the cultivation of sustainable attributes, competencies, dispositions, and values (Stibbe 2009). Sustainable literacy is more than just knowledge about sustainability; it concerns acquiring knowledge related to sustainability and garnering the attitudes, values, and cognitive skills to be translated into sustainable outcomes (Dale and Newman 2005). As such, it entails more than simply knowing things about the environment, economics, or equity, but rather involves a willingness and ability to engage intellectually and personally to improve on the environment, economics, and equity.

Sustainable literacy builds from the concepts of "environmental literacy" and "ecological literacy." However, sustainable literacy encompasses wider and broader concerns related to the interrelationships between the individual, living, and natural systems. This is most evident in the definition of a sustainability literate person: "one who has knowledge, attitudes, values, and skills needed to be able to tackle issues and implement interventions to achieve a sustainable future (Dale and Newman 2005)."

Much of sustainable literacy is cross-disciplinary and concerns pedagogy, the question of how educators can engender sustainable literacy in student learners. In this regard, many disciplines are beginning to incorporate aspects of sustainable development literacy. At an upper lever, some are given a step forward to foster transdisciplinary knowledge. In this context, the term "sustainability science" emerged as a transdisciplinary effort to create relationships between natural and social sciences (Rapport 2007; Jerneck et al. 2011).

The Roots of Sustainable Literacy

Sustainable literacy does not have its own stand-alone history. Instead, education as a core pillar to sustainability and sustainable development form the historical backdrop for sustainable literacy as it is recognized today. Education as a key component to sustainability and sustainable development started to emerge with the onset of a growing public concern regarding environmental degradation. Around this same time, the *Journal of Environmental Education* was first launched that included the now-classic article "The Concept of Environmental Education (Strapp 1969)." In this publication, the definition of the field was first summarized.

Continued support for environmental education continued to grow leading to the development of the National Environmental Education Act in the United States. It was followed by the inauguration of the United Nations Conference on the Human Environment in Stockholm, Sweden. The conference was one of the first to recognize large-scale human-environmental problems and spearheaded the creation of an international program of environmental education (UN1972). Several international initiatives followed including the Belgrade Charter in 1974, launched by UNESCO and UNEP. The Belgrade Charter later became the basis for the Intergovernmental Conference on Environmental Education in Tbilisi, Georgia, formally known as the Tbilisi Declaration. The Tbilisi Declaration was the first transnational conference to acknowledge the critical role of education in the safeguarding and protection of the environment. Moreover, the declaration was one of the most significant documents in the field of sustainability and laid out the essential objectives and features of education for the environment. The three goals of environmental education agreed upon were *(1) to foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas; (2) to provide every person with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; and (3) to create new patterns of behavior of individuals, groups, and society as a whole toward the environment.*

These ideas influenced subsequent initiatives including the Brundtland report which first introduced the concept of sustainable development as an outcome of the UN World Commission on Environment and Development in 1987. Since the first use of the term "sustainable development," education had

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only been theoretically accepted as a key component to sustainable development. The 1992 Rio Earth Summit was where it was explicitly stated that education was a significant component of sustainable development. One key outcome of this conference was Agenda 21 that specifically delineated education as a tool for achieving sustainable development (UNCED 1992). UNESCO also published a report on education for sustainable development for the decade of 1992–2002, highlighting the significant role education has played and the potential for the future (UNCED 1992).

The 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, was another key turning point. The summit purported that education needs to play a more leading role in sustainable development, locally and globally and across multiple settings (UN 2002). This led to the development of the UN Decade of Education for Sustainable Development from 2005 to 2015, where each partnering country was called to implement education as a policy for sustainability into all formal education systems. Following the World Summit, the 2015 United Nations Sustainable Development Summit was held in New York. One hundred and ninety-three nations adopted the 2030 Agenda of Sustainable Development that included 17 Sustainable Development Goals (SDGs). The 17 Sustainable Development Goals were more ambitious than previous initiatives as the goals aspired to eliminate poverty, safeguard the planet, and guarantee prosperity for all people. The SDGs include the goal of an inclusive and quality education.

Currently, the field of sustainable literacy is still being defined and developed. *Sustainable Education: Re-visioning Learning and Change* (Sterling 2001) *and The Handbook of Sustainability Literacy* (Stibbe 2009) are key publications that differentiated itself from conventional environmental education.

Acquiring and Assessing Sustainable Literacy

Sustainable literacy has evolved to a certain level of maturity from curricular design to research, operations, and administrative tasks. Importantly, what and how to attain and assess literacy for sustainability have been key questions within the field. Numerous publications and several extensive review papers have synthesized the existing literature on the key literacy competencies and frameworks critical for student learners to possess (Ansari and Stibbe 2009; Wiek et al. 2011). These competencies include multiple "bottom lines" and contexts of well-being, climate change, collective action, good citizenship, community participation, information technology, psychological aspects, behavioral features, and researching sustainability (Ansari and Stibbe 2009). A second review publication identified somewhat overlapping literacy competencies: systems thinking, anticipatory, normative, strategic, and interpersonal competencies (Wiek et al. 2011).

Researchers have also provided frameworks aimed at improving and cultivating sustainable literacy (Pappas 2012; Kokkarinen and Cotgrave 2013). Some of these frameworks include competencies related to awareness of real-world issues related to sustainability; foundational knowledge of sustainable development; self-confidence, values, and a personal identity that aligns with sustainability; problem-solving skills, systematic and creative thinking, and decision-making skills; self-confidence in one's own contribution to attaining sustainability; and possessing the ability to translate theory into practice.

Sustainable literacy assessment has also been an important component to this work. In the sustainability literature, several frameworks have been identified. Most of the assessments have focused on the importance of sustainability knowledge, varying between general knowledge regarding sustainability or assessments that focus on more local level sustainability competences. Specifically, some assess how effective these competences are taught (Remington-Doucette et al. 2013), others assess the effectiveness into curriculum (Cairo et al. 2013; Gaard et al. 2017; Lozano 2011), and others access the holistic content of syllabi (Widener et al. 2016).

Many institutions of higher education have also formulated their own sustainability literacy assessment tools. Other institutions have developed and used more standardized tools for measuring sustainability literacy. Additionally, a lot of large-scale initiatives have been carried out to assess the performance of educational institutions in cultivating sustainable literacy. One of these initiatives is the Sustainability, Tracking, Assessment, and Rating Systems (STARS). STARS monitors the sustainability performance of higher education institutions. One of the main components of STARS is the sustainability literacy assessment. In the assessment, students are administered a survey that evaluates their knowledge concerning sustainability topics and their broader values and behaviors related to sustainability (Singh et al. 2012). The "Platform for Sustainability Performance in Education" is another program that contains sustainability assessment tools. One of those tools is the sustainability literacy test. Similar to STARS, the test is a multiple-choice assessment of economic, social, and environmental responsibility. To date, roughly 250 universities across 50 countries have committed to utilizing sustainability literacy tests as a prerequisites for matriculation (Rio+20 2012).

Challenges, Critiques, and Debates in the Field

Despite copious publications with sustainable or sustainability literacy in its title, scholars have struggled with providing a guiding or agreed-upon definition of sustainable literacy. From the very beginning, the term was full of misconceptions, which some have argued has hindered progress (Leal 2000). Instead of a formal definition of sustainable literacy, researchers have often relied on highlighting their theoretical lens through which they view the issue of sustainability. Moreover, up until a few years ago, sustainability was strongly linked to environmental issues, but has grown beyond that (Wals 2014). In this regard, one of the biggest challenges has been about the boundaries of sustainable literacy.

In addition, the field has debated and has no agreed-upon outline of what key literacies are critical for students to possess, which are most valuable, and what are the best ways to measure each literacy competency. There is a great deal of terminology ambiguity, "laundry lists," and fragmented literacy competencies with little systematic theoretical justification. There is some consensus within the literature around the necessity to define key literacy competencies to then attach to specific learning outcomes. Some scholars, however, have argued that given the complex nature of sustainability, there can be no single recipe or literacy competency framework (Hyland 1993). Other researchers have contended that sustainability literacy competencies are something that will never be complete because of the changing conditions of the world (Ansari and Stibbe 2009).

Some scholars in the field have also critiqued the pedagogical approaches to sustainable literacy and education for sustainability more generally as being overly reductionist, individualistic, and irrelevant in the face of the complexity of issues related to sustainability (Scott and Gough 2010; Tomkinson 2009). Some have suggested that the reductionist and individualistic view puts too much emphasis on decontextualized "problem-solving" literacies and not enough prominence on literacy competencies that directly relate to complex real-world problems and to politicized (as opposed to individualized) solutions to sustainability. Moreover, scholars have noted that a reductionist and individualistic lens also ignores student learners as already socially and politically engaged in a complex system of the world. Sustainable literacy and other related concepts have also been criticized as overly value-based, prescriptive, and the only desired outcome of education and literacy (Jickling 2000).

Finally, the idea of viewing sustainable literacy within a framework of complexity has emerged within the last decade (Allenby 2006; Martin 2013; Morris and Martin 2009; Kaufman 2009). This framework suggests that unsustainability is inherently complex and involves many undefined elements that interact with each other creating different and new problems through feedback loops (Kaufman 2009; Nuhoğlu 2010). Sustainability is so complex that it has been described as a "wicked" problem, "wicked" in the sense that it is difficult to solve, highly resistant to resolution, and interconnected to a host of other problems (Morris and Martin 2009). Scholars have suggested that these multifaceted issues require new ways of thinking (e.g., systems thinking), understanding, and acquiring literacy for sustainability that need to be rooted in complexity (Coonan 2011; Morris and Martin 2009). Scholars have cited broad pedagogical techniques including problem-based learning, integrating conceptual and material content, illustrative interconnections, an emphasis on malleable processes and structures related to sustainability, and an understanding of the intersection of natural, physical, and social phenomenon including lifestyles, cultural diversity, and gender. However, to date, there is no agreed-upon method for students to engage with complexity related to sustainability literacy. Moreover, what complexity looks like pedagogically is still in its infancy and lacks some detailed elaboration.

Future Directions

The future of sustainable literacy is the Sustainable Development Goals 2030. In particular, the fourth goal of the Sustainable Development Goals 2030 is inclusive and equitable quality education to promote lifelong learning opportunities for all (UNESCO 2017). The Sustainable Development Goals 2030 is the main driver for addressing literacy for sustainable development. In fact, it is expected that the sustainability trend will initiate fundamental changes that will define a new role for universities (Beynaghi et al. 2016). This would include the incorporation of more holistic perspectives into disciplinary curriculum (Correia et al. 2010), the implementation of transdisciplinary, solution-oriented, and capacity building projects (Fukushima et al. 2017), and assessments of sustainability literacy, more generally.

Being that education is a core component to achieving the Sustainability Development Goals, the future of sustainable literacy must be built under the highest norms of ethics that lead the social changes in societies. Efforts to link ethics, corporate social responsibility, and sustainability in curriculum have been present in several universities around the world from several years ago (Christensen et al. 2007; Mathison et al. 2014). Future efforts need to continue to employ a utilitarian ethics approach that encourages individuals and groups to behave sustainably according to the Sustainable Development Goals (Salamat 2016).

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Sustainable Mobility

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Synonyms

Accessibility; Connectivity; Green travel; Sustainable transport.

Introduction

Sustainable mobility refers to the provision of infrastructure, services, technologies, and information to enable access to goods and services, and participation in activities in a manner that, like all other forms of "sustainability," allows for the continuation of such access and participation across future generations. While movement is a direct synonym for mobility, terms such as "connectivity" and "accessibility" are more relevant, reflecting the need to discuss a broader concept than solely physical travel or the balance of transport modes. Economically, sustainable mobility should ensure that connections between workers and jobs, supply chains, and consumers are efficient and reliable, supporting business continuity and contingency planning. Socially, sustainable mobility concerns equitable and affordable access to goods, services, employment, and education, in ways that promote healthy living and community cohesion, while reducing risks to personal safety. Environmentally, sustainable mobility is the promotion of any means of travel that limits air and noise pollution, greenhouse gas emissions, and the consumption of natural resources.

Car travel is sometimes seen as the antithesis of sustainable mobility, despite the fact that electric vehicles, new vehicle technologies, and new models of car ownership and use (e.g., car clubs, lift-sharing) all address some of the issues of unsustainable mobility caused mainly by society's promotion and increasing reliance on the private car over the course of the twentieth century. This entry attempts to recognize, albeit briefly, the diversity of initiatives that can reduce the environmental, social, and economic impacts (the "triple bottom line") of mobility in the understanding that only through radical change, employing every option available, will mobility truly become sustainable for all.

Moving between places, accessing services, and participating in activities are all actions that everyone in society is involved in, and as such, mobility and sustainable mobility initiatives are something that have the most impact if they involve as many individuals and groups as possible. It is equally important to engage both "push" and "pull" factors to engender true behavioral change, but this is most effective where the local community is empowered to identify which initiatives are most acceptable. Furthermore, as mobility concerns interactions between peoples and places, it is important that initiatives involve both stakeholders responsible for the built environment and those who live and work within it. This entry discusses the origins and context in which the concept of sustainable mobility developed; and then highlights the multitude of options and alternatives, which students and stakeholders can explore in order to achieve more sustainable mobility for themselves and their communities.

Sustainable Mobility: Context, Initiatives, and Involvement

Context

If the concept of sustainable development was born in 1987 out of the UN report, *Our Common Future* (Brundtland et al. 1987), also known as the Brundtland Report, then the concept of sustainable mobility was not far behind, even if the term took some time to emerge. City and transport planning have a shared history, and policies for development and mobility have evolved in parallel. The permeation of ideas of sustainability in both fields might be viewed as a response in many developed nations to the slum clearance, development of dormitory towns and suburbs, and road-building projects of the 1950s and 1960s, which resulted in sprawl, car dependency, and the hollowing out of urban cores. This began to generate a community backlash that engaged directly with the future of urban forms, the transport networks that bound them together, and the "sustainability" of car-driven policies. Major motorway projects that would have demolished entire neighborhoods were scrapped in response to protests. Jane Jacob's seminal work, *The Death and Life of Great American Cities*, explored ideas of connectivity, the purpose of pedestrian space, and the role of the street as public realm in great detail long before the Brundtland Report or concerns about climate change were recognized (1961).

Indeed, not only in terms of energy use and carbon emissions, but also in terms of safety, space limitations, and integration with development, it became clear by the 1970s in many parts of the developed world that providing for unlimited car ownership and use was not possible. Although the 1973–4 oil crisis briefly limited the growth in car use in many countries, the 1970s campaign in the Netherlands that recognized that the most vulnerable members of society, namely, children, were disproportionately the victims of traffic accidents had a more lasting impact on their national transport policy (Melia 2015). Meanwhile, in the UK, it was the desire to limit sprawl that first spawned the iconic Green Belt policy and gradually resulted in a shift in the focus of professional transport planners from the supply side concerns of predicting growth, building roads, and providing transport services, to the identification of demand side policies, introducing market-based competition and managing existing capacity (Banister 2002).

By the 1990s, there was a growing recognition of not only the impact of the transport sector on the local environment, but also on the global environment and the unsustainability of trends in car travel (Banister 2002). The transport sector, including aviation, accounts for 23% or almost a quarter of global greenhouse gas emissions (Sims et al. 2014). In countries like the UK, transport has failed to decarbonize as quickly as other industries and, following steep cuts in emissions from the energy sector in recent years, has become the single most polluting sector (Bell et al. 2016). A significant amount of local air pollution also comes from transport sources, particularly in urban areas, and indeed, regulations of and for vehicles are often implemented in order to mitigate these local air quality impacts on human health, rather than greenhouse gas emissions (Sims et al. 2014). Overall, it is globally recognized that in order to reduce greenhouse gas emissions from transport sources, the link between economic growth and more people being able to travel further and faster needs to be broken (Sims et al. 2014). Thus, increasing sustainable mobility involves promoting the idea that travelling less is economically beneficial and improves quality of life. Some research in developed nations indicates that this idea may already be taking hold, as the phenomenon of "peak car" is explored and the "digital age" accelerates (Goodwin 2012; Lyons 2015).

The concept of "peak car" gives hope for the trajectory that cities and countries around the world might follow to achieve sustainable mobility. This is necessary, as from neighborhood concerns about safety and air quality to global climate change, sustainable mobility is recognized alongside other sustainable development goals at an international level. Yet it is also still inextricably linked with the built environment and urban form. None of the 17 Sustainable Development Goals agreed by the UN-Habitat 2030 Agenda for Sustainable Development refer directly to sustainable mobility or sustainable transport (United Nations 2015). Instead, a target of the 11th goal, Sustainable Cities and Communities, promises "access to safe, affordable, accessible and sustainable transport systems for all" as measured particularly by road safety and access to public transport (United Nations 2015). This underlines the important role of density and urban design in achieving sustainable mobility. Not only is a certain population density necessary to support public transport services, it is also necessary to support sufficient jobs and services in a local area so that the people who live there, if their streets are well-designed, have options like walking and bicycling for at least a proportion of their journeys.

The latter is particularly relevant as the public health costs of physical inactivity have become more urgent in the last decade. The decisions made as to how land uses are located and places are designed ultimately have the most influence on whether sustainable mobility is both a practical and an attractive travel choice (Headicar 2015). Furthermore, an increase in mobility or accessibility choices for individual journeys or opportunities increases sustainable mobility and accessibility overall, simply by there being alternatives for those who might not be able to depend upon a single mode like the car due to age, infirmity or affordability. Thus, most of the initiatives described below consider the means to increase choice by decreasing the distances to opportunities, providing new services or facilities, or redesigning and charging for less sustainable mobility options to make the relative convenience of different alternatives more balanced and better reflect the true sustainability costs of mobility choices. Since higher proportions of university populations are often already engaged in travelling by more sustainable modes, universities are well placed to develop both the study and practice of sustainable mobility in the future (Whalen et al. 2013).

Initiatives

Land Use

As noted, sustainable mobility represents a key component of sustainable development and sustainable place-making, and therefore, integrating land use and transport decisions in a holistic manner becomes essential to creating places in which people can and do travel sustainably. Although most car trips are short, most car mileage, and thus the majority of emissions and other impacts of these miles derive from longer distance travel, a necessity for those who live in more dispersed, rural areas (Headicar 2015). Yet designing places for sustainable mobility requires more than a simple formula for density. A mix of land uses within a compact area makes a variety of opportunities available to access through a variety of means, increasing choice, while managing that access, for example, through the layout of the public realm and road space will encourage those making the choices to look on sustainable mobility more favorably (Melia 2015). Furthermore, although local accessibility to goods, services, and jobs will enable some people to work locally, certain industries and services will only be viable in larger centers. Thus, good public transport or even bicycle connectivity to a wider region can enable access to additional opportunities whilst still providing sustainable mobility. Well-designed places, with convenient options by multiple means of travel, a healthy mix of land uses, and ideally some targeted parking management and restraint could also reduce the regular need for a car, and thus individual car ownership. As recognized by the sustainable development goals, urban living, while potentially the source of other problems, like waste disposal and sanitation, has the most potential to offer sustainable mobility choices to residents. Urban areas can also allow for more efficient, and thus more sustainable, delivery of goods, but this depends upon bringing freight and logistics facilities closer to their customers through land use initiatives like urban consolidation centers and links to ports and rail freight terminals.

In terms of land use initiatives and creating places designed to enable sustainable mobility options, institutions of higher education are well positioned to contribute. Many are major landowners as well as being places of teaching and research. At the same time as integrating the theories and knowledge of both land use and transport in educating future city planners, urban designers, and transport engineers, among other disciplines, there are often opportunities for practical applications of these theories. Whenever there is any development of new facilities or accommodation for the institution or land is being developed or re-developed for sale or other external use, sustainable mobility options should be integrated into those facilities to serve both the expansion and its new residents or employees, and also others within the existing University community.

Infrastructure

Physical infrastructure may form part of some sustainable mobility initiatives. Headline projects tend to be road or rail networks connecting regional or subregional areas. Yet to achieve sustainable mobility, neither interurban trains nor guided busways, and new roads even less so, are sufficient. Such projects may temporarily improve the flow and reduce the emissions from vehicle traffic but are unlikely to change behavior. Investment in transport interchanges, dedicated cycling facilities, and infrastructure to enhance the public realm, from benches and trees to decking over road or rail lines, are also necessary (Hickman et al. 2013). Again, these are measures which create places where land use, activity, and mobility function together. Pedestrianization, traffic calming, filtered permeability (where there is more choice of routes for sustainable mobility than general traffic), and reclaiming parking space for other uses or re-allocating parking spaces to shared or electric vehicles, the latter with associated charging infrastructure are further examples of physical measures which enhance sustainable mobility (Goodwin 2012; Melia 2015). Nor should other forms of connectivity be ignored, as energy and digital infrastructure improvements can increase access without increasing travel, especially as travel and online accessibility become ever more interchangeable for younger generations (Lyons 2015) (Fig. 1).

Sustainable Mobility, Fig. 1 Filtered permeability, Malmo, Sweden. (Melia 2015, Fig. 7.3; with permission from the author)

The integration of transport and Information and Communication Technology (ICT) infrastructure and connectivity is particularly relevant to institutions of higher education, which tend to serve a predominantly younger or at least more technologically savvy population. ICT tools can substitute remote or virtual accessibility for some proportion of physical mobility. Higher education stakeholders and estate managers may also be involved in small-scale infrastructure projects that encourage sustainable mobility options like walking and cycling but are perhaps less likely to have a role in larger public transport infrastructure decisions other than as a local stakeholder in consultation. Parking infrastructure is also a key responsibility of estate managers who work in higher education, and its location, design, and management can be balanced to promote or discourage sustainable mobility. For example, the University of Bristol, England, maintains only sufficient on-site parking for about 25% of its staff and charges those eligible to use that parking, thus discouraging car travel to its campus, while other measures offer a range of sustainable mobility alternatives (Cairns et al. 2010).

Services

One such measure is offering a free shuttle bus service between the University and a major transport hub, and also working with the local bus operator to negotiate higher quality, more frequent services to the institution (Cairns et al. 2010). Bus services have the most impact if they are appropriately designed to meet the needs of communities, businesses, and particularly recently arrived markets such as at new developments (Hiblin et al. 2016). Newly arrived students without set travel patterns in their adopted community could also be defined as a new market. This gives the higher education sector opportunities to propose, develop, and sponsor public transport services, pump-priming them to become commercially viable. As large trip generators and employers, designated, university-branded public transport services are common. In order to promote their use, and to encourage and expand sustainable mobility by populations accessing higher education, services should be not only direct but also frequent, comfortable, affordable, and convenient. Special offers for student tickets are common initiatives. A study of the impact of offering students at the University of California Los Angeles (UCLA) transit passes at 50% of the usual fare indicated that this incentive was not only positively correlated with increased bus use but also resulted in more active travel and car-sharing among pass-holders (Zhou 2012). Providing free Wi-Fi on board for those who are working or socializing on their phones and laptops during the journey also increases the attraction of bus use. Indeed, there is a recognition that public transport vehicles have become places where travelling is no longer the sole activity and that encouraging this trend will increase sustainable mobility choices (Goodwin 2012) (Fig. 2).

Other sustainable mobility services could include lift or taxi-share services and the sharing of private vehicles, including both bicycles and cars through car or bike pools, car clubs, and bike-share schemes. As long as such services are safe, affordable, and, through the management of parking and drop-off/pick-up locations and policy, more convenient, they can make a significant contribution to sustainable mobility. By reducing the need for individual ownership and maintenance of a car, such initiatives are more suitable to those who need the flexibility of a private vehicle on an occasional basis but will gladly avoid the fixed costs and unsustainable impacts of vehicle ownership. They may also delay, perhaps indefinitely, the purchase of a private car by succeeding generations, who will develop habits such as shared ownership, which are conducive to more sustainable mobility in the future. Conversely, being able to hire a bicycle to ease multimodal journeys away from places of permanent residence, or for temporary use whilst a student, may make the future purchase of a bicycle more likely.

Technologies

There are proponents of electric and autonomous vehicle technology as key forms of sustainable mobility. Yet, while these may address some environmental and safety concerns, they do not deal with the impacts of congestion on the economy, nor do they address social aspects of community severance by traffic or the physical inactivity car travel generates, with all its impacts on human health. However, when such technologies are combined with other approaches that improve the efficiency of mobility through sharing, linking trips, routing and timing, then the result is more sustainable mobility (Banister 2008). Thus, applying such technology to suit particular geographies (e.g., shared car parking spaces with electric charging points) can make a valuable contribution to sustainable mobility in that geography.

Technological developments can also provide a valuable contribution to encouraging behavior change, as data collection and analysis of technology enables targeted and personally tailored information (Banister 2008). This information may be used to make sustainable mobility options more flexible, rewarding, and responsive to individual needs, for example, by optimizing the route of on-demand shared transport, providing social interaction between sustainable transport users, and giving feedback on service quality, potential disruption, or even personal health statistics.

Sustainable Mobility, Fig. 2 Launch of Claret Bus to the University of Reading, UK. (Courtesy of Reading Buses 2014)

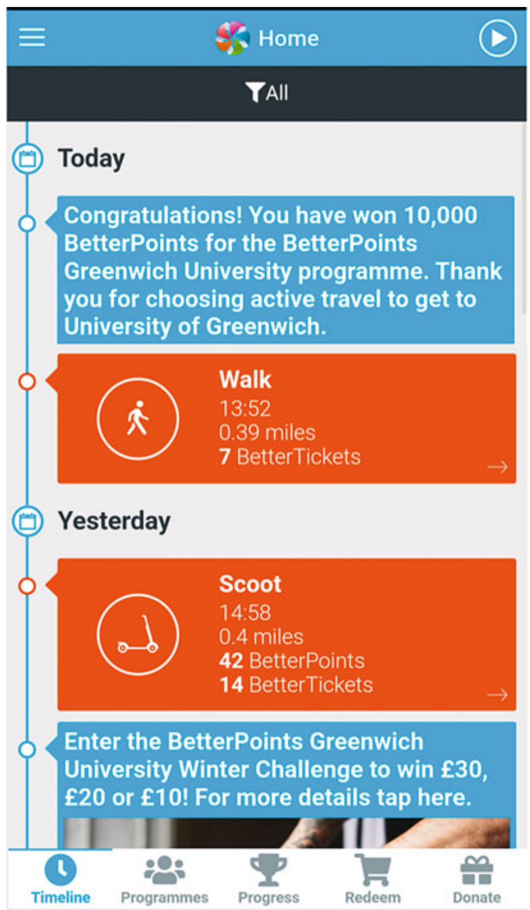
Information

Technology can now provide timely notification of any disruption to ones' journey, making all forms of transport more reliable, and unifying transport options so that accessibility is maintained even where a particular route is closed or a particular mode is delayed. Such information, as well as the more basic information about the existence of various options, is essential if people are to be able to make sustainable mobility and sustainable accessibility choices. Travel planning is a common approach to making information available in many organizations, including those in the higher education sector. A travel plan often consists of the results of a survey of how people within the organization travel, the options available to them to travel differently, a set of targets for changing modal shares within the organization, and some measures that the organization or its partners (e.g. the local highways authority or transport operator) will take to achieve those targets. Yet static travel plans have often achieved limited shifts towards more sustainable mobility. Instead, a more dynamic, ongoing, and personalized approach, using appropriate technology, targeted to different groups within the community, often delivered via "events," and usually accompanied by incentives like "taster" bus tickets, has proved more effective (Hiblin et al. 2016). For example, at McMaster University in Canada, a study revealed that since only those who already use a bicycle value the time they spend travelling on it, more personalized and targeted interventions, such as training, rewards, and maintenance assistance, were required to encourage cycling in the first place (Whalen et al. 2013).

As mentioned above, ICT are developing rapidly as more people access goods, services, socialize, and learn online, thus supplementing and in some cases replacing physical access (Lyons 2015). Initiatives that encourage substitution, particularly where unsustainable mobility is the alternative, have a valuable part to play in increasing sustainable mobility, but ICT has an even more important role in bringing information on sustainable mobility options together into one mobile application or similar. Digital media can be most effective if it offers real time information, can be personalized, and potentially even motivates and rewards behavior change (Hiblin et al. 2016) (Fig. 3).

Freight and Long-Distance Travel

So far, this discussion of sustainable mobility has mainly focused on the mobility of people rather than goods, and daily, local, or regional journeys, rather than global mobility. This is partly because long-distance travel by both people and goods presents a particular challenge. Although sea transport is substantially more carbon efficient and thus environmentally sustainable than air transport, for high value, low weight goods and for passengers, air transport is often considered economically essential, especially where there is no high-speed rail alternative (Sims et al. 2014).



Sustainable Mobility, Fig. 3 Travel planning app with rewards. (Courtesy of BetterPoints 2018)

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Furthermore, at many universities, like other organizations that operate at an international scale, working and partnering globally is seen as an invaluable asset, and thus limiting such interactions would be socially as well as economically unsustainable. Finally, air and sea travel are governed at a national and international scale, limiting the influence of individual institutions in defining standards and regulations.

However, there are opportunities for universities to not only support research into improving the fuel consumption and efficiency of air travel but also to consider innovative means of operation to reduce long-distance travel by staff and students. For example, the virtual and distance learning options which have been proliferating over the last decade offer alternative means to recruit students from around the world to participate in higher education, without incurring the environmental and social equity costs of air travel. Research and collaboration can also occur more easily at a distance through video conferencing and file-sharing systems. Universities often have even greater power when it comes to goods, through centralized procurement systems that can be tailored to meet the targets of Sustainable Development Goal 12, Responsible Consumption, and Production (United Nations 2015). For example, increased purchase of local goods often has local social and economic as well as environmental benefits. Other low-weight, high value goods that might otherwise increase air freight could be produced on-site by technologies such as 3D printing. Low tech solutions include upcycling.

Involvement

Incentives and Community

It is difficult to completely separate some of the above initiatives from the concept of incentives and community engagement. For information to be delivered effectively, people have to be engaged, and engagement occurs when a "buzz" is created around the topic of sustainable mobility. Means to create this include events with refreshments and trained people with which to discuss sustainable mobility, challenges that allow competition between individuals or subgroups within an organization, and/or incentives like free tickets to try the bus, rail season ticket loans, bicycle maintenance sessions, or led walks (Hiblin et al. 2016). Events, challenges, and incentives also help build a sustainable mobility community within an organization and encourage participants by providing the peer support that will enable continued motivation. This is especially the case where there is a strong, local brand or recognizable "champion" within the community for members to approach.

Research suggests that all the initiatives above, including incentives, will only have a limited impact if there is not also some restraint on unsustainable mobility choices (Melia 2015). However, by building a community around sustainable mobility, local people from different parts of that community might be able to agree on and implement some of the "sticks" to accompany any program of "carrots" that might be funded only briefly. Such disincentives might include reducing parking space or availability, parking charges, or even creating a culture of peer disapproval. In the area of higher education, such measures could be introduced top-down but might be more successful and politically palatable if a community around sustainable mobility is nurtured and empowered to make decisions, design options, and perhaps even implement initiatives as per the higher rungs on the "ladder of participation" (Arnstein 1969). For example, at UCLA, a realization that paying for parking on a seasonal basis increased car use resulted in the implementation of daily parking passes, which gave users both more flexibility and the potential to reduce their travel costs dependent upon their choices (Zhou 2012).

Students and Stakeholders

The sector of higher education is comprised of diverse groups of people. Besides students and faculty, there are those that manage the land, buildings, and other property belonging to the institution and those that maintain and repair the estate. There are those involved in daily administration and those that plan for future development. There are also external stakeholders, the community within which the institution sits, the businesses that serve its population, the local government that manages the public space around it, the utility providers, and the transport operators that run services through it. All these groups of people and organizations, internal and external, are involved in how more sustainable mobility could be achieved within the setting. Different groups will have different levels of influence and responsibility but only together can they determine the distribution of land uses that both encourages sustainable mobility and functions appropriately, the new public transport services that are both practical and attractive, the information that is both accessible and fit for purpose.

Yet the concept of involvement, of participation, is even more important if students and stakeholders in higher education are teaching, researching, developing, and influencing sustainable mobility decisions outside their own immediate communities. While encouraging sustainable mobility is often seen as an accepted good, discouraging unsustainable mobility is often politically unpalatable. One only has to consider the constant pressure for politicians not to raise the cost of car use – for example, freezing fuel duty in UK budgets year after year – to recognize why public or community acceptability must be in place to steer the agenda (Banister 2008). Thus, as well as empowering decision-making, the final element of sustainable mobility to note is its ability to be adopted incrementally, with initiatives implemented upon a trial basis or installed in such a way that they can be adapted to future changes in surrounding land uses (Banister 2008).

Conclusions

Sustainable mobility is an integral part of sustainable development, interacting with and responding to surrounding land uses and how spaces are designed and managed. In isolation, mobility as a human activity might be seen as unsustainable, supporting sprawl, dividing communities, and polluting the environment. Yet when integrated with sustainable places, it becomes not only sustainable but unifying, supporting economic agglomeration, improving the quality of life, and preserving the environment. There are many mobility options which are sustainable and many initiatives which will make mobility more sustainable over time. For students and stakeholders, in the higher education sector or in other sectors, all the elements of context and potential initiatives described above could define sustainable mobility in different cities or countries, but the best definition will be the one that has been uniquely assembled to fit the local community and place it serves.

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Sustainable Organizations

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Introduction

Sustainable organization is a concept that describes organizations that follow or are committed to advancing the principles of sustainable development. The Agenda 2030 urged organizations to become more sustainable in order to fulfill the UN Sustainable Development Goals. Becoming a sustainable organization is a complex issue that requires the radical transformation in many organizational structures to strengthen their corporate sustainability.

This chapter presents the basic premise of a sustainable organization starting with a definition of the term followed by a description of the strategies used to balance the economic, social, and environmental dimensions in sustainable organizations. Next, an explanation of how the standards from the International Organization for Standardization have played a role in implementing sustainability initiatives are provided. Following this discussion, a description of how corporate social sustainability is an important characteristic of a sustainable organization is detailed. Finally, some future directions are provided with regard to how sustainable organizations can evolve to reach the Agenda 2030.

Definition of a Sustainable Organization

As with other definitions related to Sustainable Development, the term sustainable organization is a concept in evolution that has been shaped by cultural values. For this reason, there is no a standardized definition of a sustainable organization. However, to become a sustainable organization, a commitment to continuous learning toward sustainability is a fundamental endeavor. Broadly speaking, a sustainable learning organization can be thought of as an organization that is immersed in a system's thinking framework with the objective to transform itself toward sustainable development. More appropriately, a sustainable organization aims to reach one or more of the UN Sustainable Development Goals into the Agenda 2030. The Agenda 2030 was developed in January 2016 and is composed of 17 goals to address global challenges including poverty, inequality, climate, environmental degradation, prosperity, and peace and justice (UN 2015).

According to Velazquez et al. (2011, p. 36), a sustainable learning organization can be conceptualized as "an organization with enough sustainability knowledge, would act according to, and would be considered as a role model to prevent, eliminate and/or reduce the environmental and occupational risks associated with its operations while enhancing and strengthening its profitability." Specifically, sustainable organizations develop goals and initiatives directly analogous to the dimensions of sustainable development (Allen 2016). Usually, these kinds of organizations promote links not only with their internal stakeholders but also with external stakeholders including communities, governments, and others (Lozano 2008).

The term corporate sustainability is related to the concept of sustainable organizations. Corporate sustainability integrates organizational influences, internal and external drivers, and supporting and hindering factors, yet a stand-alone corporate sustainability definition is still lacking (Engert et al. 2016; Pinto 1995). Although, the terms sustainable organization and corporate sustainability are used interchangeably, in this chapter, corporate sustainability is considered the means to become a sustainable organization.

Theoretically, to become a sustainable organization, upper administration incorporates sustainability into its strategic planning through balancing the three pillars of sustainable development: economic, social, and environment. For years, it has been argued that the triple bottom line approach is vital to help organizations operationalize and carry out sustainability (Ahi and Searcy 2015). The triple bottom line is a technique for measuring corporate sustainability performance (Hubbard 2009). It takes into consideration managerial strategies to improve production and obtain profits, as well as environmental management considerations to not pollute or waste natural resources. The triple bottom line approach involves a systems perspective, which, in practice, has traditionally been limited to the scope of a firm and/or an industry (Whiteman 2013). Consequently, sustainable organizations promote sustainability initiatives via two distinct routes. The first route is the promotion of sustainability initiatives that are compatible with economic growth of an organization. The second route is the promotion of sustainability initiatives across broader social and environmental domains (Hahn et al. 2015).

Win-win situations are not straightforward, as sustainable organizations often face trade-offs to reach economic, social, and environmental goals (Baumgartner and Rauter 2017). Moreover, because of the issue of complexity on sustainability systems, gains in one area often create loses in another. Therefore, a consideration of trade-offs is frequently part of sustainability assessments within sustainable organizations (Morrison-Saunders and Pope 2013). At the same time, sustainability assessments are also very complex because they involve many cultural and value-based dimensions related to sustainable development (Sala et al. 2015). Perhaps for this reason, sustainability appraisals conducted by a team of experts have demonstrated higher odds of success; although individuals have been shown to also can carry out effective appraisals (Thérivel and Minas 2012).

Big organizations supported by strong administrative structures have led the field of corporate sustainability appraisals. Usually, the more advanced firms, the better the environmental performance (Gimenez et al. 2012). Being sustainable, however, is not exclusive to big corporations. Small- and medium-sized organizations can also be sustainable organizations as long as they incorporate the principles of sustainable development into their daily operations.

Approaches to Becoming a Sustainable Organization

There are different approaches to becoming a sustainable organization that can be adapted with the purpose of fitting within particular organizational structures. Rather than comparing the prestige of the different frameworks, the research literatures suggest that organizations should first review their specific circumstances when deciding the most suitable approach. Across the whole range of alternatives, the standards of the International Organization for Standardization (ISO) are the most well-known and have received a lot of attention from big organizations in both developed and undeveloped countries.

The ISO has published nearly 600 standards related to the Sustainable Development that parallels the United Nations Sustainable Development Goals (ISO 2018). As corporate sustainability has increasingly become an important component to organizations, the ISO 14000 family of standards increase its importance around the world (Zobel 2013). From this family of standards, the ISO 14001 standard has become the most used for environmental management systems for several decades (Campos et al. 2015).

According to information posted on the ISO website, the ISO 14001 standard is based on continuous improvement by using the plan-do-control-act cycle (ISO 2015). Under this approach, organizations first identify areas of opportunity to improve their level of sustainability. After this, sustainability plans are formulated, implemented, monitored, and checked to verify that the planning outcomes have been reached. If this is the case, the cycle begins again, identifying new and better methods to strengthen corporate sustainability.

The ISO 14000 family of standards consists of two kinds of standards to help organizations be more sustainable. The first standard contains guidance documents that offer a series of instructions for implementing specific issues in a corporate sustainability. This includes labeling, life cycle assessment, environmental auditing, and others. The second standard includes specification documents that describe requirements to prevent organizations from being audited. Without a doubt, the ISO 14001 is the most important specification standard because it outlines the specific requirements to certify environmental management systems. Technical committees from the ISO review the standards and access their reliability with regard to the actual conditions of the market and/or stakeholders' desires. The newest version of the ISO 14001 was issued in 2015, ISO 14001:2015. According to the ISO 14001 brochure (ISO 2015), the recent requirements of ISO 14001: 2015 framework includes:

(a) Environmental management to be more prominent within the organization's strategic direction
(b) A greater commitment from leadership
(c) The implementation of proactive initiatives to protect the environment from harm and degradation, such as sustainable resource use and climate change mitigation
(d) A focus on life cycle thinking to ensure consideration of environmental aspects from development to end of life
(e) The addition of a stakeholder-focused communication strategy

Environmental sustainability is not the only area of focus taken into account by a sustainable organization. For this reason, the 14,001 standards can be integrated with other standards including the ISO 50001 standard, which provides the requirements for energy management systems (de Sousa Jabbour et al. 2017). Recently, the current trend is to incorporate standards into an integrated management system that addresses stakeholder demands while promoting efficiency, saving resources, and bolstering corporate social initiatives (Asif et al. 2013). Because corporate social responsibility involves issues closely related to sustainability, the ISO 26000 was created to guide organizations to operate social initiatives (Hahn 2013). Since its creation, the ISO 26000 standard is the state-of-the-art standard for corporate social responsibility (Castka and Balzarova 2008).

It is assumed that the ISO framework is a reasonable and effective approach to help organizations become a more sustainable organization as long as the managerial structure of the organization is ready for its implementation. Pursuing an ISO standard allows organizations to obtain benefits to enhance an organization's image, reduce its liability, increase its market share, and reduce cost, among other benefits. Despite these benefits, the effectiveness of the ISO standards in improving corporate sustainability has been questioned. It has been documented in the research literature that some firms have adopted the ISO 14001 just as a symbolic strategy to legitimize their environmental performance (Ferrón Vílchez 2017). In addition, the field has debated the effectiveness of ISO standards for small- and medium-sized enterprises despite the fact that these standards are intended to be applicable to all sizes and all kinds of organizations in countries over the world. Moreover, there are studies underscoring the lack of direct benefits for small- and medium-sized enterprises when reaching an ISO 9001 certification (Ilkay and Aslan 2012). In the same way, the ISO 26000 standard has been subject to criticism because it is not a certifiable standard and is argued to be inconvenient for small- and medium-sized enterprises due to its high costs and the time that is required to be set up (Sethi et al. 2017).

Considering the above, another approach to sustainability for small- and medium-sized enterprises has been to focus on conducting sustainability and/or environmental audits rather than to implement a whole sustainability management system. A sustainability audit refers to a general examination of the policies and daily processes and activities performed within an organization that lead to unsustainability patterns of production and consumption resulting in poor corporative sustainability. Audits are one of the important requirements within the ISO structure that usually requires no more than the technical knowledge of the daily administrative and operational tasks.

Corporate Social Responsibility and Sustainability

One of the strongest characteristics of a sustainable organization is its social responsibility. Corporate social responsibility has been defined as "the voluntary integration of social and environmental issues into business activities and relations with stakeholders, combined with a readiness to sacrifice profit for the sake of certain social interests" (Witkowska 2016, p. 28). Although the concept of corporate social responsibility dates back to the 1950s, it was during the end of the 1990s and the early 2000s where organizations started to promote corporate social responsibility initiatives into their management structures as a strategy to respond to the economic, social, and environmental demands of their stakeholders (Aggarwal and Singh 2018; Steurer et al. 2005). The concept gained momentum when the European Commission, followed by other developed and developing nations around the world, started to link corporate social responsibility with the term corporate sustainability (Kleine and von Hauff 2009). Since then, corporate social responsibility has evolved and has become institutionalized and internalized into organizations. Moreover, in 2019, it has been argued that corporate social responsibility is the means by which to address the challenges posed by the Sustainable Development Goals in the UN's Agenda 2030 (Nurunnabi et al. 2019).

Firms of any size and in all sectors of the economy can embrace corporate social responsibility initiatives. Organizations with stronger governance mechanisms, stronger financial structures, and larger presence in the marketplace are more likely to embrace social responsibility initiatives because these initiatives work as strategic differentiator for customers and other stakeholders (Doh et al. 2015). More broadly, embracing social responsibility helps organization build a favorable reputation, but it is not just a question of reputation and altruism; nowadays, it is also about profitability (Chiarini and Vagnoni 2017; Zhou and Ki 2018). These types of organizations expect that after fostering social initiatives, the consumers in the market will reward sustainable organization in economic and financial terms (Carroll 2015).

Successful organizations have been the ones that understand the principles of corporate social responsibility and adjust their organizational structures accordingly (Isaksson et al. 2014). For this, organizations have relied on the implementation of voluntary instruments such as ISO 14001, ISO 26000, the Global Reporting Initiative, and the United Nation Global Compact, among others (Zinenko et al. 2015). In spite of instruments, organizations still face difficulties in monetizing the impact of implementing their social responsibility initiatives (Kudłak et al. 2018).

Future Directions

Nowadays, there is a great sense of urgency to accelerate actions to achieve the 2030 agenda in all sectors of the economy and society (UN DESA 2018). This is going to require the conversion of all kinds of organizations to be more sustainable. However, if organizations continue doing business as usual, it won't be possible to reach the Sustainable Development Goals by 2030.

The 2030 target date might be too close to be reached. As such, the conversion of traditional organizations to sustainable organizations may take more time since many organizations around the world are just starting to learn how to become sustainable organizations. Of course, there are well-stablished organizations that have embraced sustainability and require just small adjustments to declare themselves sustainable organizations, but most other organizations are just beginning to address their growing sustainability concerns and the pressure from different stakeholders.

As aforementioned, the International Organization for Standardization has claimed that there are approximately 600 standards that could help organizations reach the UN Sustainable Goals. Therefore, it is expected that ISO standards will play a key role in guiding the path for organizations to become sustainable organizations. Although the ISO standards have proven successful in big organizations, it is important to highlight that they are limited in the case of small- and medium-sized organizations because the requirements of ISO standards could be costly, cumbersome, and demanding in terms of organizational resources. Another important characteristic of a sustainable organization is its social responsibility. Beyond philanthropy or altruism, sustainable organizations must build a favorable reputation without affecting their profitability.

Despite current constraints and challenges, it seems reasonable to assume that all types and sizes, organizations around the world need to keep making efforts to become a sustainable organization. Hopefully, further sustainable achievements in organizations will inspire other organizations to become a sustainable organization, thereby achieving the sustainable development goals.

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Sustainable Transport

► Sustainable Mobility

Sustainable Transportation Methods

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Definition

Sustainable transportation methods may be defined as the means by which transportation takes place in line with the principles of sustainability, which, for instance, entails as little CO2 emission as possible in urban mobility and process management in organizations.

Introduction

Nowadays, the use of the concept of sustainability is discussed in much research around the world, a fact that has resulted in the dissemination of divergent conceptual interpretations according to the objective of each piece of research, resulting in a considerable increase in its importance. In this chapter, we look at how concepts of sustainability serve current demands without compromising the ability of future generations to meet their own necessities, providing an improvement in the quality of life for society.

To ensure a sustainable way of life, it is necessary to integrate three specific areas, known as the triple bottom line, being economic equity, the environment, and social development. Regarding the economic aspects, the interconnected global systems are highlighted that demand integrated actions to promote solid growth for long periods and at the same time ensure that no community will be left behind. In reference to the environment, it is necessary to concentrate the efforts in the adequate use of natural resources by solutions that are economically viable, aiming to reduce the resources consumption, pollution, and maintain natural habitats. Social development is related to securing employment, food, energy, health services, education, water and sanitation, and beyond this, to secure cultural and social diversity and labor rights and train all members of the society to participate in determining their future.

According to Jha et al. (2013), sustainability in transportation usually refers to the contribution to the sustainable development of a community that has and uses a certain system. Traditionally, the development of transportation infrastructure is based on guidelines that minimized the initial operation costs and emphasized traffic mobility considering social and environmental necessities. Recently, global concerns about climate changes, environmental impacts, and limited financial resources illustrate the necessity of a different approach in the selection of transportation solutions. Hence, there is a growing desire to provide environmental sustainability in the transportation infrastructure system. A sustainable transportation system must be safe, healthy, available, and renewable, working in a fair way and limiting the emission of polluting gases and the use of nonrenewable resources.

This discussion is justified by the fact that the transportation sector is a booster of global economic development. It is emphasized that this theme is important to the public and private sectors that together must constantly concentrate efforts for the development and continuous improvement of the triple bottom line.

Against this background, this chapter proposes to present an overview of research about sustainable transportation methods, highlighting the principal practices that are being used in the world and evidencing their advantages, obstacles in the practice of using them, and the research methods and strategies used. Methods used to optimize urban mobility are considered, along with reductions of pollutants (CO2) and improvements in transportation management in the organizations considering their supply chain.

In this chapter a systematic literature review was adopted as the research strategy, since it considers the peculiarities and parameters of sustainable transportation methods. The stages corresponded to the definition of the publication periods considered, the keywords, the database, and the criteria of inclusion and exclusion of the articles. After this, relevant information was extracted, the information synthesized, and, finally, the creation of this chapter (Fig. 1).

Sustainable Transportation Methods

The utilization of sustainable transportation methods is defended throughout the world, aiming in a general way to reduce energy consumption and the emission of polluting gases. Below is presented an overview of the methods that are being used for the improvement of urban mobility, the reduction of pollutants, and the management of industrial processes (supply chain). It is highlighted that the activities and operations of transportation are important for economic development, allowing goods and services to flow between the zones of production and demand, besides the mobility and accessibility of the population. Sustainable transportation methods aim to reduce the social and environmental impacts during the execution of transportation activities.

Urban Mobility

Sustainable transportation methods focus on the improvement of urban mobility aiming to ensure access and the fast movement of the population in big urban centers. Urban transfers usually involve many means of transportation, and transit can occur using different transportation modals.

<table>
<tr><th colspan="6">LITERATURE SYSTEMATIC REVIEW</th></tr>
<tr><th colspan="6">Research Question: “What is the overview of the utilization of the sustainable transportation methods considering articles published between the years 2013 and 2017, the types of used methods, the benefits and difficulties in their use?”</th></tr>
<tr><td>Keywords</td><td>Period</td><td>Inclusion Criteria</td><td>Databases</td><td>Total of downloaded articles</td><td>Total of articles after criteria</td></tr>
<tr><td rowspan="4">Sustainable transportation methods

Green Transportation</td><td rowspan="4">January 2013 - November 2017</td><td rowspan="3">Publications with proposition of the use of sustainable transportation methods

Publications with comparisons between the sustainable transportation methods</td><td>Web of Science</td><td>2</td><td rowspan="4">11</td></tr>
<tr><td>PROQUEST</td><td>1</td></tr>
<tr><td>SCOPUS</td><td>31</td></tr>
<tr><td>Exclusion Criteria

Publications where the keywords are not in the title, abstract or in the keywords

Articles in non-English language</td><td>ScienceDirect</td><td>11</td></tr>
</table>

Sustainable Transportation Methods, Fig. 1 Parameters of the Review Protocol for Sustainable Transportation Methods

Hsu and Wang (2015) defend the promotion of sustainable transportation ensuring accessibility and mobility. The authors discuss the idea of the use of different ways of transport to secure a reduction in environmental impacts. The utilization of electric buses combined with vehicles of rapid transit is more efficient alternatives in terms of energy instead of the use of conventional private cars. However, users still prefer to use private vehicles due to the speed of travel. The focus of the discussion is in the means of transition from the use of conventional private cars to the use of different ways of transportation by integrating terminals aiming to reduce the time of travel from origin to the destination. Another point to be analyzed is the low rate of occupation of collective transportation, because this scenario aggravates the environmental impacts.

In relation to the rate of collective transportation occupation, Guimarães and Junior (2016) say that the evaluation of the performance of the urban transport of passengers is relevant, because it has economic, environmental, and social impacts. The authors used in their research the concept of eco-efficiency for the evaluation of the performance of the transportation system in the State of Rio de Janeiro, in Brazil. The route analyzed was Rio-Niterói. The big ferries had the best performance compared to the conventional ferries, and according to the authors, this can be explained by the fact that, although the ferries have the biggest capacity between the evaluated alternatives, they also have a low rate of occupation (32%). Analyzing the conventional bus, a performance level very like the ethanol-powered cars was identified that also can be explained by the occupation rates (96% for the bus, against 23% for those cars powered by ethanol). Beyond this, the cars that use gasoline had the worst performance, being the most used alternative. Analyzing the actions that could increase the occupation of the means of transportation; the necessity of the integration of the modals, fares, attendance pattern; and quality of the available infrastructure was identified. Such integration of the aforementioned criteria is important to enable the use of means of transport.

Analyzing the impacts and the effects of the economic crisis in relation to the promotion of the usability of sustainable transportation, Galanis et al. (2017) did research in the city of Volos in Greece (of about 130,000 residents) where a survey was applied with 605 random participants in 2013. It aimed to identify, firstly, the demographic data, the purchasing power, the possession of bicycles, and the private vehicle and driver license ownership. Then the respondents presented their possibilities to change their means of transportation in routine and recreational transit, comparing the time before and during the economic crisis. Moreover, they answered about the personal and road safety and security when using bicycles as transportation. The results show that citizens changed their habits of transportation during the years of economic crisis in Greece in favor of ways of sustainable transportation, and according to the authors, this position is justified by the increase of unemployment and decreasing personal income, with people choosing public transportation, bicycle, or walking instead of the use of private vehicles. The conclusion is that an economic crisis has a positive impact on sustainable mobility favoring the ways of transportations which are economic, environmental, and sociable.

Bachok et al. (2015) did research centered on the applicability of indicators of international sustainable transportation in an important region of Malaysia, known as Klang Valley. The research strategy used was a case study by an electronic survey applied to the relevant professionals in the transportation field (transportation planners, traffic engineers, public operators and transportation managers, transportation economists, environmentalists, academics and researchers, as well as urban and regional planners). The research focused on the level of the public transportation service. The sustainability of the public transportation in Klang Valley could be achieved by the implementation of a consistent and coherent evaluation of the performance indicators of transportation.

Still, analyzing the development of the public transportation system, Patlins (2017) made a study aiming to define sustainability in this scenario. The research consisted of a bibliographic review where it was verified that the analysis and comparison of the transportation systems in different cities and countries, as well the analysis of the future requirements of the transportation system is the theme of much research in many European countries. It was identified that there is still no definition in the literature of principles of sustainable development for public transportation systems. What is noticed is that much discussed in the literature are the aspects related to development of the urban transportation systems, but not from the point of view of sustainable development. The author sought to improve the definition of sustainability, aiming at the development of the transportation system. These systems cannot be sustainable without understanding environmental sustainability. The sustainable development of the public transportation system is an aspect of global sustainability and must be measured quantitatively by indicators.

In reference to mensuration, Jha et al. (2013) made a quantitative analysis of the sustainability and green transportation by considering a project of a roadway and its maintenance planning. The results pointed out that, when the maintenance cost is considered in the planning, a different result is obtained being slightly cheaper when the cost of the roadway maintenance is not considered. This means that if all the factors are the same, it can allow a solution of a sustainable roadway if the cost of maintenance during its cycle life is incorporated in the planning stages of the roadway.

Reduction of CO2 Emission

Buwana et al. (2016) did research in Kasongan City, capital of the Katingan district. The increase of the use of roads instead of the Katingan River, considered initially the principal means of transport in the region, is justified by the fact of the increase of motorcycles, which reached 91.9% in 2013. The transportation sector contributed around 53.33% of the total emission of CO2 produced per year. The research discussed important criteria regarding the choice of the most appropriated alternative to develop sustainable transportation systems using the analytic hierarchy process (AHP). The results showed that the best alternative is to optimize the integrated systems of roadway – water transportation using terminals integrated at strategic points in the region. Social acceptance becomes the principal aspect that must be met to increase economic activity. The authors believe that this strategy can increase the use of public transportation and consequently reduce CO2 emissions.

Mehar et al. (2014) produced research about sustainable transportation systems that aim to reduce pollution and the emissions of greenhouse effect gases. The focus of the research was electric vehicles, where they described the components of sustainable means of transportation and their solutions, projects, and standardization. For the authors, a transportation system is composed of three principal categories: fleet management, schedule planning, and energy usage. These categories if managed and well planned provide a reduction of CO2 emission in transportation activities.

The negative effects of transportation for the environment have led researchers to focus on green transportation programming in the last few years. According to Salehi et al. (2017), transportation activity has harmful environmental effects. This sector emits a considerable amount of greenhouse gases. The authors believe that the efficient transportation scheduling/planning can decrease the harmful environmental effects and consequently improve supply chain operations. The trade-off between the transportation cost of a truck and the total emission of carbon as an index of environmental sustainability was analyzed. The model proposed by the authors allows for manufacturers and transportation companies to trade-off between the total costs of transportation and the total carbon emission. These practices of processes management and supply chain are detailed in the next section.

Process Management in Organizations

Lin et al. (2013) said that sustainable development in industry requires a transportation scheme more embracing of the operations of logistics services. Green logistics (GL) has increased as a tendency in the management of the distribution of goods and the collection of products at the end of their life cycle. The focus is on maximizing the economic and environmental value by recycling and emission control. The research focused on the practice of the delivery and collection of water bottles, proposing an optimization model based on generic algorithms to design an efficient ecological transportation scheme in terms of economic and environmental costs in direct and reverse logistics.

Khan et al. (2017) affirm that the sustainable supply chain performs an important role in the environmental and financial questions of an organization. In the last few decades, companies were showing a greater tendency to implement favorable practices for the environment in their business. There is no doubt that some motivating factors exist in relation to sustainable development, as financial gains cost reduction in terms of recycling, reutilization, and remanufacturing. On the other hand, the pressure from customers and strict governmental laws in relation to the environment also pushes the companies to adopt ecological practices. The results prove that green practices have a significant and positive association with company performance.

Conclusions

It is possible to produce an overview of the research already undertaken about sustainable transportation methods, highlighting the principal practices that are being used, pointing out their advantages, obstacles to the use in practice, and the methods and strategies of the research adopted. Considering the methods identified and used in urban optimization, reduction of pollutants (CO2), and improvements in the transportation management in organizations, it is perceived that there is a quantitative divergence in the research done, when studied deeply, which highlights the large amount of research involving urban mobility by the analysis of the level of public transportation service in different regions in the world. It is important to point out there is a lack of research to analyze and propose sustainable transportation methods in organizations, more precisely methods to optimize the transportation activities of supply chains.

In relation to the research methods and strategies utilized, it is possible to highlight the case study, survey, bibliographic review, and the Monte Carlo simulation. In reference to the analysis tools, the following were identified: the usage of the AHP method, cost management techniques, definition and analysis of the usage of the performance indicators, the concept and definition of eco-efficiency, the usage of the concept of trade-off, and the development of an ecological transportation model by the generic algorithm.

Analyzing the advantages of the use of sustainable transportation methods, it was perceived that there is unanimous agreement in the research analysis about the approach given to the reduction of the pollutant gases as CO2 in the atmosphere. Beyond this, it is possible to perceive the improvement of the conditions of urban mobility and the benefits generated in the companies' performance that cherish the use of sustainable practices. However, the high cost in the usability of sustainable transportation methods is highlighted and the population culture in relation to the non-utilization and identification of the importance in the use of those methods, a fact that has improved considerably over the years. Finally, it is believed that a greater amount of research must be undertaken, aiming at the development and improvement of sustainable transportation methods, analyzing their definition, importance, new practices, and the awareness of all involved, considering the social, environmental and economic benefits, to ensure the meeting of the current demand without compromising future necessities.

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► Sustainability Evaluation

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Sustainable University

► Green Universities and Sustainable Development

Sustainable University Accreditation and Certification

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Definition

A sustainable university accreditation is a process of evaluating programs, research, and operations of a university to establish whether sustainability goals and standards are met. It evaluates a university's performance and commitment to sustainability and translates that evaluation into a general assessment that allows for comparison across similar higher education institutions. On the other, sustainable university certification means verifying that university buildings, services, processes and products fulfill all the specified requirements of relevant sustainability standards, technical regulations, or other guidelines.

Introduction

Globally, there is a growing attention to the urgent need for sustainable development (SD), which seeks to strike a balance between humanity's pursuit for socioeconomic and technological development on the one hand and environmental protection and promotion of social equity on the other hand. SD is a process of societal transformation steered by some principles that emphasizes the necessity for sustaining the natural resources and the environment that societies rely on (Brundtland Report 1987; Tilbury et al. 2002). The major reason behind the SD movement is the pressing need to confront universal environmental and development challenges that significantly impact finite resources and exacerbate inequality. Humanity is facing increasing environmental problems such as biodiversity loss, pollution and climate change, as well as challenges of poverty, conflicts, social exclusion, and inequality (Abubakar and Dano 2018; Gazzeh and Abubakar 2018). The multifaceted notion of SD leads to increasing numbers of initiatives such as preservation of ecosystems, cutting emissions of greenhouse gases (GHG), energy efficiency, promoting low-carbon vehicles and public transportation, waste management, equitable delivery of basic public services, and educating communities to change the way they think and to act responsibly to foster sustainability (Abubakar 2017; Sinakou et al. 2017). Also, expectations for SD have evolved with growing number of declarations/charters, government legislations, and growing pressures by NGOs, media, academia, and the public on the need to recognize the importance of living sustainably.

There is also increasing realization of the significant contribution of education in achieving sustainability goals. The *Agenda 21* report requires countries to utilize education as a vital tool in promoting SD and increasing people's capability to tackle issues affecting development and the environment. The 36th chapter of the report explicitly recognizes the need to reorient existing education to address SD through improving basic public education and training. Also, the UN Decade of Education for Sustainable

Development (2005–2014), the UNESCO and climate change education for sustainable development, the Global Action Program on Education for Sustainable Development, and the UN's 2030 Sustainable Development Goals (SDGs) are other declarations and agenda that underscore the important role of education in fostering SD. As such, universities are seen as the vanguards for building a more sustainable future by imparting skills and knowledge toward finding novel solutions to global environmental and socioeconomic challenges (Laurie et al. 2016). Sustainable universities strive to lessen the negative impacts of their operations on people and the environment, and their campuses function as model communities and living laboratories for sustainable practices (Alshuwaikhat and Abubakar 2008; ASHEE 2010). Although the utilization of sustainability accreditations, certifications, and awards for encouraging sustainable practices in universities and colleges has been rapidly growing, the issue has not been given adequate attention in the literature (Alshuwaikhat et al. 2017a; Cole and Valdebenito 2013; Guerra et al. 2017; Yoder and Miller 2014). Therefore, this paper highlights the contribution of sustainable university accreditation and certification in fostering sustainability in higher education institutions. It specifically reviews the concepts related to sustainable university accreditation and certification and comparatively analyzes the indicators and procedures used by some major global campus sustainability accreditation/certification frameworks.

Concepts Related to Sustainable University

This section reviews the concepts of a sustainable university, education for sustainable development (ESD), and sustainable university accreditation to provide a background for and conceptual framework of the chapter.

Sustainable University

A sustainable university is a community that protects and enhances the well-being of humanity and the environment by improving the efficiency of campus operations and reducing their adverse effects, and continuously improving environmental quality and saving resources (Alshuwaikhat et al. 2017b). Sustainable university adopts a systematic approach to environmental management and implementing campus-wide sustainability initiatives such as green buildings, resource use reduction and recycling, low-carbon transportation, energy efficiency, air quality and safe drinking water, and partnership approach to environmental sustainability by including the campus community in its environmental management and enhancement. It also fosters active community involvement in running the affairs of the university and inculcates in its students the culture of living sustainably and to export such values to the wider society. It embeds a culture of sustainability into education, research, and community services, minimizes the physical imprint of campus operations and activities on the ecosystem by means of green development, and disseminates such morals to the society. As promoters of innovation and progress, sustainable universities can help tackle environmental sustainability challenges on their campuses and provide opportunities for cost savings in operations (Ried 2008).

Education for Sustainable Development (ESD)

ESD embodies a vision of providing an education that focuses on knowledge, skills, and ethics for guiding and motivating people to live in a sustainable manner (Tilbury et al. 2002). ESD can play a vital role in helping to bring about sustainable living through courses focusing on sustainability and modifying existing curriculums to reinforce local, national, and global sustainability goals and action plans (Abubakar 2013). It also empowers university community to participate in local initiatives toward more sustainable lifestyles and living conditions. Globally, communities are recognizing that current trends of economic and technological development are unsustainable and that public education, training, and awareness are vital for encouraging societies to embrace sustainable behaviors (Laurie et al. 2016). Environmental literacy supports a sustainable society by lessening the rates of resource consumption and ecological footprints and stresses the impacts human population dynamics, including energy generation and use, agriculture, manufacturing, construction, and transportation, have on the ecosystem (AASHE 2010).

Sustainable University Accreditation

Accreditation involves an evaluation process and a confirmation that an institution, organization, or company adheres to some standards set by an authoritative body that formally recognize the achievement of the required competency, efficiency, or quality. Accreditation of HEI is a kind of quality assurance process in which programs and services of the institution are evaluated by an external body to establish if the required criteria have been achieved (Yoder and Miller 2014). It can be done for the entire HEI, indicating that each of the components of the institution contributes in achieving the objectives of the accreditation (Weybrecht 2015). A sustainable university accreditation and certification refers to a process of evaluating programs, research, and operations of a university to establish whether sustainability goals and standards are met. It is a tool that evaluates a university's performance and commitment to sustainability and translates that evaluation into a general assessment that allows for comparison across similar HEIs. On the other hand, certification means verifying that products such as buildings, processes, or services fulfill all the specified requirements of relevant standards, technical regulations, or other guidelines. It primarily involves ensuring conformity with given norms.

Sustainable University Accreditation and Certification Frameworks

Sustainable university accreditation and certification is performed by agencies that have been accepted as regulatory bodies. Their stamps indicate approval of procedures and operations according to certain standards. This section reviews four prominent global accreditors that universities can apply to them for accreditation and certification of their programs, buildings, and operations.

Sustainability Tracking, Assessment, and Rating System (STARS)

This is a transparent framework that allows HEIs to assess their sustainability performance through a self-reporting rating process. Developed by the Association for the Advancement of Sustainability in Higher Education (AASHE) for mainly North American HEIs, the STARS rating can attest the level of a university's commitment to a comprehensive SD process in all of its activities. The system evaluates university's contribution in mitigating adverse environmental impacts of its operations and in fostering human and environmental health, securing livelihoods, sustainable economy, social justice, collaboration, diversity, and other positive social impacts. It also assesses the extent to which students gain the education, competences, and attitudes required to address contemporary sustainability challenges as well as to export those skills to local and international communities. According to AASHE (2017), STARS rating system is one of the most comprehensive and verified campus sustainability framework for achieving long-term sustainability goals. As of 2018, about 900 HEIs have registered and are using the system globally (AASHE 2018).

Leadership in Energy and Environmental Design (LEED)

The LEED is an independent certification system or a sustainability scorecard for green buildings, developed by the US Green Building Council (USGBC). Universities are increasingly utilizing this sustainability rating system to support them to design and retrofit buildings and infrastructure to become environmentally friendly. It can fulfill a university's environmental sustainability goals by structuring and guiding its sustainability planning process and the implementation of sustainable campus operations and maintenance initiatives (USGBC n.d.). It can assist universities to design, build, or improve their buildings based on environmental sustainability guidelines to reduce the negative impacts of buildings on humans and the environment. It also facilitates efforts for improving indoor environmental quality, energy and water efficiency, solid and liquid waste management, and the use of environmentally desired products and equipment for operations. Because the system can be applied to large-scale projects that integrate ecofriendly concerns in campus planning and development, it is attractive to universities that are designing, expanding, or upgrading major developments. Employing LEED at the beginning of the planning and design stages of a project enables taking a whole approach to development and can spur innovation and diverse design solutions, to ensure ecological advantages (Ried 2008).

Building Research Establishment Environmental Assessment Method (BREEAM)

It is one of the well-known methods used to assess, rate, and certify the sustainability of buildings in the world. Administered by Britain's Building Research Establishment, BREEAM integrates sustainability principles within building and infrastructure development to lessen their life cycle impacts on people and the environment (BREEAM n.d.). The method assesses new and existing infrastructure, buildings, and communities; offers a reliable, environmental label; and produces values for sustainable buildings. Its guidelines can encourage long-term performance optimization of campus buildings and facilities. Its building certification standards can be utilized throughout the design and construction stages of the campus development project to ensure expert recognition of university's commitment to sustainability. As of 2017, the system has certified over 250,000 projects, and more than one million have been registered for certification in at least 70 countries globally (BREEAM 2017).

ISO 14001: Environmental Management System (EMS)

The ISO 14001 provides a framework and guidelines for environmental management best practices to aid institutions, corporations, and organizations toward designing and implementing an EMS that recognizes their environmental policies and a set of clearly defined objectives and targets to reduce the environmental aspects of operations and to promote continuous environmental audits and improvements (Boiral et al. 2018). It can help universities to minimize waste, pollution, and their environmental footprint, to conform to environmental legislation, and to manage their operations in a sustainable manner. It provides guidelines and harmonized standards for monitoring and reviewing operational efficiency and rectifying problems. It offers practical tools for simplifying and integrating universities' environmental protection programs into a more consistent framework to improve their environmental performance (ISO n.d.). It also consists of clear arrangement of responsibilities, training programs for staff proficiency, and awareness about the significance of reducing waste and air emissions and improving worker health and safety. It gives a university the flexibility to develop its EMS that is suitable to its characteristics, operations, location, and risk levels (Morrow and Rondinelli 2002).

Sustainable University Accreditation and Certification Process

This section comparatively describes the criteria and procedures for sustainable university accreditation and certification used by three renowned systems: (a) STARS, (b) LEED, and (c) BREEAM, selected because of their popularity and wide adoption globally. Other systems include ATHENA, CASBEE, Green Globes and Green Start (Poveda and Lipsett 2011)

Criteria for Campus Sustainability Accreditation and Certification

Sustainable university accreditation and certification is conducted using a variety of criteria. Although STARS' accreditation of universities uses several criteria, those criteria related to campus operations are dominant. Whereas, accreditation criteria used by LEED and BREEM focus mainly on environmental issues related to campus operations (Table 1).

What follows is a brief description of the sustainable campus ranking and certification criteria in Table 1. The criteria are grouped into (a) campus operations, (b) academics, and (c) sustainability planning administration, which also comprises campus/public engagement, innovation and leadership, and institutional characteristics.

Campus Operations

Constructing new buildings and operating the existing ones can have significant negative impacts on the environment. Given that buildings account for about 40% of the world's energy utilization and the production and transportation of building materials including their raw material extractions have a serious impact on the environment, they constitute an important criterion for sustainability assessment, accreditation, and certification (USGBC n.d.). According to the USGBC, about two-fifths of raw materials worldwide are used in the construction sector, contributing to natural resource depletion and environmental degradation. Similarly, energy and water consumption rates influence the environmental sustainability of universities. As such, green buildings and infrastructure mean fresh air and natural lighting, water conservation, energy efficiency, and switching to renewable and cleaner energy sources like solar, biomass, wind, and low-impact hydropower. Energy generation from fossil fuels is the chief source of GHG emissions, which pollutes the air and contributes to climate change and health problems. Implementing conservation measures and generating renewable energy locally can help universities save money and support local economy (AASHE 2017).

Sustainable campus operations also consist of effective waste management initiatives like waste reduction and recycling that help universities to improve their environmental sustainability performance. Likewise, green transportation options like mass transit, pedestrian walkways, bike sharing, bicycling, carpooling, and telecommuting increase access, cut congestion, and decrease emissions. Transportation accounts for 29% of global energy use (USGBC n.d.). Similarly, the university natural environment promotes the well-being of its community and creates a safe learning and working environment. Indicators include outdoor air quality, grounds and greenspace management, conservation of native plant and animal species, and reduction in workplace injuries and occupational disease (AASHE 2017).

Academics: Curriculum and Research

Sustainable universities provide programs and courses that cover sustainability issues and prepare students to steer the society to a sustainable future by equipping them to become leaders, scholars, workers, and professionals that will influence the society. The curriculum of such programs and courses primarily and explicitly focuses on topics such as environmental preservation, resource conservation, climate change, economic efficiency, livable settlements, good governance, health and safety, gender equality, empowerment, and other socioeconomic issues expedient toward addressing sustainability challenges (Abubakar 2013; ASHE 2017). Interdisciplinary sustainability courses focus on sustainability as an integrated concept or the application of sustainability within a field, thereby offering knowledge and abilities associated with comprehending and addressing key sustainability challenges (Alshuwaikhat and Abubakar 2008). Similarly, conducting research to address sustainability challenges is one of the indicators of a sustainable university.

Sustainability Planning and Administration

Campus sustainability planning and administration involves having an institutional sustainability framework consisting of policy, plan, and an office to implement, manage, and coordinate campus sustainability efforts. Institutional vision and mission statements guide the development of a campus sustainability plan for coordinating and guiding SD transitions, education, research, outreach, and responsible environmental stewardship. Campus sustainability plan is a road map for establishing SD objectives and decision-making toward sustainable campus. It is a pointer to a university's commitment to sustainability by tracking progress, identifying and documenting achievements, and managing the resources devoted to attaining sustainability goals. It can help in incorporating fiscal and environmental ethics and social responsibility within the campus community and promoting campus-community partnership in governance where stakeholders collaborate in goal setting, decision-making, and financial management. It also involves outreach and awareness campaigns and public legislation/ policy advocacy to address local sustainability challenges. As models to community members and leaders, HEIs can be influential facilitators and partners in envisaging, planning, and acting toward creating a sustainable future at local and international levels.

Procedure for Sustainable University Accreditation and Certification

Campus sustainability accreditation remains a complex and challenging process given the plethora of assessment tools as well as the several differences in the environment, size, operations, and activities taking place in HEIs' (Abubakar et al. 2016). Below is the description of the procedures used for sustainability certification by STARS, LEED, BREEAM, and ISO 14001.

STARS

Universities can participate in STARS using two options. The free basic option allows universities to track their sustainability progress and share their data for displays and benchmarking. The other option is the subscription-based full access that leads to Platinum, Gold, Silver, and Bronze rating. If a university is not interested in pursuing a rating or in making its scores public, it can participate as a Reporter to share its accomplishments and have the institution's data used for benchmarking purpose. Rating is obtained after completing an evaluation process that uses more than 150 criteria to measure a university's SD performance and achievements in several areas, including teaching; research; organizational planning, human resources, water, and waste management; transportation; innovative practices; and the university's impact on the community (Table 1).

Sustainable University Accreditation and Certification, Table 1 Criteria used in rating/certification by STARS, LEED, and BREEAM

STARS	LEED	BREEAM
(a) Operations	Operations	Operations
Materials	Buildings	Buildings
Energy	Materials and resources	Energy
Waste	Energy and atmosphere	Waste
Water	Innovation in design	Water
Transportation	Water efficiency	Transportation
Grounds	Regional priority	Land use and ecology
Food and dining	Sustainable sites	Health and well-being
Air and climate	Indoor environmental quality	Pollution
Purchasing		Management
(b) Academics		
Curriculum		
Research		
(c) Engagement		
Campus engagement		
Public engagement		
(d) Planning and administration		
Planning and coordination		
Diversity and affordability		
Investment and finance		
Well-being and work		
(e) Innovation and leadership		
Innovation		
Exemplary practice		
(f) Institutional characteristics		

Source: AASHE (2017)

The rating is based on the total scores a university gets by pursuing relevant credits across the criteria, excluding non-applicable points. Though all applicable points are considered in the scoring, universities can decide which ones to or not to pursue. A team of STARS Steering Committee members and AASHE staff allocate the points.

LEED

A university interested in LEED certification can register the whole campus under the LEED for Communities category or it can pursue a registration for a particular development project under LEED for Neighborhood Development. The certification procedure involves registering the campus/project by completing the required forms and making payment (after ensuring that minimum certification requirements have been met), technical review process, and then certification decision (USGBC n.d.). The university then earns points from a number of criteria, including building design and operation, energy use, water efficiency, indoor air quality, and sustainable sites based on whether they are worthy of LEED certification and at what level (Table 1). Contingent upon the total points achieved, a university project can earn one of the four LEED certification levels: Platinum, Gold, Silver, or Certified. The process is devised to help institutions, organizations, and corporations to design and construct buildings using innovative solutions that reinforce environmental and public health, in addition to cost savings throughout the life cycle of projects. This kind of certification can assist universities to determine the extent to which their buildings or the entire campus are environmentally friendly and sustainable. LEED is among the widely recognized independent verification programs for buildings. According to USGBC, buildings with Platinum or Gold certification use 25% less energy and 11% less water, produce 34% less GHG emissions, and have 19% lower maintenance costs than typical non-LEED rated buildings, thus lowering utility bills (USGBC 2011).

BREEAM

This system uses sustainability indices which are scientifically based to assess a variety of environmental matters such as ecosystem, energy efficiency, pollution, materials, water consumption, health and well-being, land use and ecology, transportation, solid and liquid waste, and environmental management processes (Table 1). In the BREEAM certification procedure, buildings are rated on five scales: *Outstanding*, *Excellent*, *Very Good*, *Good*, and *Pass*. The assessment, conducted by independent, licensed assessors, can help a university to focus on the master planning of its whole campus. It also facilitates the design and construction of buildings that are conducive for living and working and are economically efficient, and can coexist in harmony with the natural environment (BREEAM n.d.).

ISO 14001

To obtain ISO 14001 certification, a university develops an environmental policy, prepares an EMS plan, including objectives, procedures, and targets, and then implements the plan, followed by evaluating the environmental performance of the EMS and executing corrective actions. Then the university applies for ISO 14001 certification by providing background information, obtaining the necessary requirements and standards, and supplying the desired timescales to achieve certification. After which a pre-assessment is done to evaluate the EMS against the requisites of the applicable standards. This gap analysis will highlight any issue that needs to be addressed prior to the formal assessment. Then the first-stage assessment is conducted to determine whether the mandatory requirements are being met and whether the EMS can proceed to the next stage. The second stage evaluates the efficacy of the EMS by confirming whether controls have been implemented and the system is fully operational. If the assessment is satisfactory and the university EMS complies with the relevant ISO standards, certification will be recommended after a certification manager reviews the two stages to confirm competency, fairness, and impartiality. Also, the university is needed to present the EMS for post certification review through the continuous assessment process. The first surveillance visit takes place within 6 months of granting the certification (ISO n.d.). ISO certification helps universities to enhance its environmental performance, fulfill compliance obligations, and achieve environmental objectives (Fisher 2003; Morrow and Rondinelli 2002). ISO 14001 certification lasts for 3 years and renewal is subject to mandatory audits to ensure compliance.

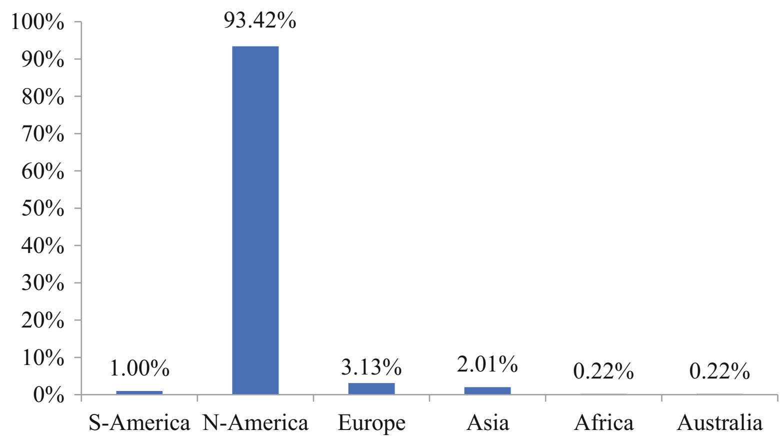
Distribution of Universities and Colleges Using STARS Rating in 2018

Universities are currently rated not only by their academic ranking but also by the sustainability performance of their campuses. Given that universities have entered an era of open global competition due to global ranking of their sustainability performance, this section seeks to analyze the distribution of HEI ratings conducted by STARS, selected because it is the most comprehensive sustainability reporting tool for universities.

From inception to date, 898 universities and colleges from all over the globe have registered to use the STARS Reporting Tool. The distribution of HEIs that use the tool by continents indicates that North America leads other continents with around 93% of the total HEIs (Fig. 1). This is not surprising given that the system is mainly developed for colleges and universities in North America. European HEIs came distant second with 28 HEIs or about 3%, followed closely in the third place by Asia with 18 HEIs (2.01%). There are two HEIs (0.22%) from Africa and two from Australian continents. Possible reason for the underrepresentation of HEIs from Asia and Africa in STARS is perhaps lack of awareness about the rating system or lack of resources required for participation.

Table 2 shows the distribution of HEIs that are participating in STARS rating in 2018. A university can earn points toward a STARS

Sustainable University Accreditation and Certification, Fig. 1 Most HEIs that are using STARS are from North America. (Data source: AASHE 2018)



Sustainable University Accreditation and Certification, Table 2 Distribution of HEIs that participate in STARS by rating type, 2018

	Platinum	Gold	Silver	Bronze	Reporter	Unrated	Total
S-America	0	0	0	0	1	9	10
N-America	3	123	208	69	33	402	838
Europe	0	0	2	0	2	24	28
Asia	0	0	0	0	2	16	18
Africa	0	0	0	0	0	2	2
Australia	0	0	0	0	0	2	2
Total	3 (0.3%)	123 (13.8%)	210 (23.4%)	69 (7.7%)	38 (4.2%)	455 (50.7%)	898

Data source: AASHE (2018)

Bronze (25–44 points), Silver (45–64 points), Gold (65–84 points), or Platinum (85–100 points) rating or just earn recognition as a STARS Reporter. The Stanford University, University of New Hampshire, and Colorado State University, all in the USA, are the only three HEIs in the world that received STARS Platinum ratings – the highest possible – in recognition of their outstanding sustainability achievements. While 13.8% of the HEIs that have registered to use STARS have earned Gold rating, a little less than one-quarter (23.4%) got Silver rating. About 7.7% and 4.2% of the HEIs obtained Bronze and Reporter ratings, respectively. The unrated HEIs constitutes constitute about half (50.67%) of the total registered.

STARS certification can help reduce university's environmental footprint by minimizing the enormous impact of building and operations on the environment. A university that conducts the certification can more effectively understand and manage sustainability in all segments of the institution, meaningfully compare its performance with other HEISs over time using a common set of measurements, develop far-reaching involvement of campus community, incentivize continual environmental improvement, facilitate information sharing about sustainability practices and performance with other HEIs, and build a more diverse and robust community (AASHE 2017). Indeed, a healthy environment is more comfortable for learning and working and can increase students and staff productivity.

Conclusion

A path to SD will be much smoother if nations worldwide are committed to ESD. The goal of sustainability accreditation and certification is to evaluate HEIs' courses and programs and environmental performance of their campuses. There is a growing popularity of using accreditation to assess the ecological performance of new and existing developments. Accreditation helps to establish principles of continuously improving the quality of academic and operational activities at universities and highlights the daily efforts of university community to incorporate SD into their thinking and actions, which gives them an increasingly distinct cultural trait and major source of pride and motivation. It provides universities with a framework to improve their environmental performance, prevent adverse environmental impacts and decrease their environmental incidents and liabilities, rise operational efficiency by removing waste from their systems and operations, and respond to changing environmental conditions in balance with socio-economic needs. It also helps to validate and recognize institutional commitment to sustainability and fosters awareness of environmental impacts of operations among university community and establish a strong image of corporate social responsibility.

Sustainability accreditation and certification helps in fulfilling compliance obligations, influencing the way campus buildings, facilities, and operations are designed, built, and managed. It assumes a key role in the wide effort of reducing energy consumption of buildings and promoting and transferring best practice to the society. It demonstrates publicly university's commitment to protecting the environment and gaining competitive advantage with students. Implementing environmentally sound initiatives helps in achieving financial and operational benefits, strengthening the university image, and communicating environmental information to relevant stakeholders. Given the diversity of activities and operations taking place at universities, as well as variation in their sizes and locations, the adoption of accreditation and certification standards is also not uniform and could lead to diverse outcomes depending on the university and its sustainability goals.

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Sustainable University Profiles

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Introduction

Sustainability is an issue that has been discussed in higher education institutions since the late

1990s or even earlier. However, the concept of a sustainable university was developed much more comprehensively during the UN Decade of Education for Sustainable Development, a UN initiative from 2005 to 2014 aimed to provide oversight, advice, and educational resources worldwide to help create a more sustainable future (UNESCO 2018). Since that time, it is expected by the international community that more universities around the globe will adopt the principles of sustainable development under the guidelines set forth in the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development.

This chapter outlines the evolution of the concept of a sustainable university, and several strategies for the implementation of sustainability within universities are presented. The first avenue is teaching; the most obvious characteristic of this approach is the so-called greening of the curriculum or curriculum for sustainability. The second strategy that is discussed is research; in fact, numerous universities already conduct multidisciplinary as well as transdisciplinary research projects in order to tackle both local and global concerns regarding sustainability. The third strategy addressed is the greening of the campus. This includes any initiatives at operations and management levels that are undertaken to reduce the environmental impact of the universities' own activities. Last, but not least, possible future directions that could allow the universities to continue to become even more sustainable in the future are suggested.

Defining the Term

Sustainability in higher education institutions (HEIs) became a more serious topic of discussion almost three decades ago when more than 350 universities signed the Declaration of Talloires in 1990 (ULSF 1999). Universities have subsequently shown a real concern about environmental problems including population growth, climate change, loss of biodiversity, and toxic waste to name just a few (Junyent and de Ciurana 2008). However, the process for institutionalizing sustainable development in HEIs has been slow, and it has taken a long period of time because it was necessary first to raise awareness among the various universities' stakeholders and to overcome some of the barriers that existed to achieve any real change (Lozano 2006).

At the beginning of this evolution, there were many professors and researchers implementing sustainability initiatives, but these were not unified in purpose or in terminology. Their efforts were too diffuse and not well-connected under a shared purpose. This resulted in confusion among stakeholders, who did not know what they were necessarily agreeing to when supporting these various sustainable initiatives (Kliucininkas 2001). Currently, one of the most cited definitions describes sustainable university as 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" (Velazquez et al. 2006).

The idea of sustainable universities did gain momentum as the UN Decade of Education for Sustainable Development progressed and became popular among HEIs. Since then, several changes have been incorporated in an institutional way in the curricula, research, administrative tasks, and campus operations (Shi and Lai 2013; Lidgren et al. 2006; Lozano 2010; Alshuwaikhat and Abubakar 2008). Approaches that incorporate the concept of sustainability vary depending on the particular characteristics and interests of each HEI (van Weenen 2000).

Some HEIs have implemented sustainability initiatives using standardized instruments, while others have done it in a tailored way (Disterheft et al. 2015). Currently, the SDGs should become the umbrella used to guide potential sustainability initiatives taken by HEIs. These institutions have made efforts to implement programs such as greening the campus and the development of local, national, and international networks to foster alliances between institutions so that they can share ideas for the application of principles directed toward being a sustainable university (Adams et al. 2018).

Sustainability-oriented networks in HEIs usually implement initiatives that involve teaching, research, and campus operations, among other areas (Dlouhá et al. 2018). The next section covers the main avenues that are taken by universities to foster sustainability.

Teaching

The UN Decade of Education for Sustainable Development encouraged the process of reorienting curricula around the world toward the teaching of sustainable development (UNESCO 2014). This reorientation has not been easy or automatic since there have been barriers that have deterred the proposed improvements (Holm et al. 2015). Despite this, there are success cases at several universities where they have effectively implemented changes to the curriculum in order to offer more significant contributions to sustainability and where graduate students will be prepared to solve present and future challenges in regard to the environment (Stough et al. 2018.)

The fourth goal of the SDGs encourages universities to provide a quality education. This embodies three categories of learning objectives, which are the cognitive learning objectives, the socio-emotional learning objectives, and the behavioral learning objectives. This goal aims to stimulate universities to provide an inclusive and equitable quality education that promotes lifelong learning opportunities for everybody (UNESCO 2017a).

Usually, sustainability curriculum focuses on how to modify personal values and attitudes in favor of sustainable development. Nevertheless, despite this impetus to integrate these values into higher education, many improvements are still necessary to continue to develop universities' abilities for sustainability (Nejati and Nejati 2013) because this strategy has not always resulted in behaviors supportive of sustainability (Savelyeva and Douglas 2017).

Greening the curriculum or curriculum for sustainability are other terms used for sustainability teaching. As formal education, sustainability is taught at universities on three levels, which are undergraduate, graduate, and the certificate level. Curricular innovation is becoming a popular way to prepare students to address issues of sustainability more successfully than previous generations (Barlett and Chase 2012). The emergence of interdisciplinary curriculums in sustainability allows for the integration of several disciplines, typically combining engineering with social and ecological sciences (Bacon et al. 2011). For this, universities faced several challenges because the academic structure in many universities was not prepared for this kind of overlap between areas (Coops et al. 2015).

Additionally, a challenging opportunity is the influence of technology and electronic resources that are transforming higher education (Chang and Chen 2011). These two elements have made distance learning possible, enhancing students' opportunities for independent learning and changing the traditional method of teaching (Barker and Gossman 2013; Maitaouthong et al. 2011); however, a paradoxical situation needs to be faced, those requiring the most this kind of education, the disadvantaged communities, do not have access to the proper tools and infrastructure (UNESCO 2002).

Distance education, which is a method of teaching where the student and teacher are not face-to-face during the learning process (Kentnor 2015), is also known as open and distance learning and has evolved through four main phases: from correspondence systems, followed by educational television and radio systems, continued by multimedia systems, to the current Internet-based systems (UNESCO 2002). Usually, students and teachers maintain communication by audio, video, computer, and the Internet (Roffe 2004). The Internet is without a doubt the most popular mechanism of change in the delivery of education (McPherson and Bacow 2015; Ospina-Delgado et al. 2016; Whitaker et al. 2016). Distance education courses seem to be effective for sustainability in higher education as they continue to grow in many universities around the world (Altomonte et al. 2016).

A complementary approach for formal education is informal education, which can be understood as the education that is provided mainly through family activities socialization or through daily events that tend not to be specialized by their own (Seymour 1972), like visits to museums or other fairs and exhibits, as well as listening to radio broadcasting or watching TV programs on educational or scientific themes (Melnic and Botez 2014). Sustainable universities combine both formal and informal learning to raise awareness about sustainability (Barth 2013). However, to create a linkage between formal and informal learning is an arduous task because it is necessary to match time frames, expectations, and perspectives (Biberhofer and Rammel 2017).

Research

The present trend for university researchers is to conduct multidisciplinary research projects that aligns with the UNESCO guidelines in order to foster higher-level cognitive and non-cognitive/transferable skills, such as problem-solving, critical thinking, creativity, teamwork, communication skills, and conflict resolution, which can be used across a range of occupational fields (UNESCO 2017b). Having perspectives from different disciplines allow researchers to effectively contribute to the development of innovative solutions that are in line with the three sustainability dimensions: environment, society, and economy (Can Baran 2015).

Multidisciplinary or even transdisciplinary research is necessary so that our society can critically engage in conversations about sustainability to deal with issues as complex as the ones we face (Nuhoğlu 2010). Because of this complexity, society is typically divided on what sustainability should look like and how to act according to its principles (Ratiu and Anderson 2014) which results in little progress being made. The speed of current life requires that students acquire knowledge and skills quickly to counteract convoluted situations within societies (Griffin and Care 2014; Siddiq et al. 2017) with the confidence that we can develop new ways of thinking and understanding that result in a change in our behaviors helping our society to become more sustainable.

Research allows universities to engage in community outreach projects and to form partnerships with industries, governmental agencies, educational institutions, and nongovernmental organizations to foster as well as to increase sustainable economic growth (Zilahy and Huisingh 2009). Universities aim at joining forces with communities, agencies, and organizations to improve the quality of life for the students as well as their surrounding communities by undertaking successful projects (Tamburini et al. 2014). Sustainability initiatives coordinate and improve efforts within our society by working within communities with workers and churches, for instance, to provide services and technical assistance in many instances in the form of free-volunteer programs (Chalker-Scott and Tinnemore 2009).

Climate change has also become a critical topic for sustainability researchers because its complexity demands transdisciplinary knowledge and input from faculty and from other nonacademic stakeholders (Gaziulusoy et al. 2016). This involvement triggered a great interest across the general community provoking the participation of people in grassroots movements and the creation of networks that link climate change with other societal issues such as poverty, health, environmental, and social justice.

Greening the Campus

Another strong avenue that allows universities to move toward sustainability is practicing sustainability on the campus itself in order to reduce the environmental impact of their own activities; on occasions, this strategy receives more attention than the other strategies previously mentioned above (Swearingen White 2014).

Although, there is still a lack of awareness in students about greening the campus (Disterheft et al. 2012), students have used the concept to foster additional sustainability initiatives. The students' dominant approach is toward environmental sustainability (Zeegers and Francis Clark 2014) perhaps because they fear for the future or feel it is the right thing to do (Pfautsch and Gray 2017).

Each greening the campus initiative has different targets, and universities worldwide have been committed to several projects with a range of positive outcomes. Additionally, allocation of resources varies from traditional initiatives such as energy and water conservation (Finlay and Massey 2012) to relative novel initiatives such as improving climate-friendly practices on campus (Helferty and Clarke 2009; Wachholz et al. 2014; Opel et al. 2017).

Although the international ISO 14000 series includes environmental management system (EMS) standards that have provided an effective framework to the integration of the variable "environment" into the daily operations of HEIs (Fisher 2003), the role of an EMS, specifically ISO 14001, in the transformation of HEIs into sustainable universities has been a controversial issue in regard specifically to the greening of a campus. However, even though EMS certification can be important, it is not essential to have successful sustainability projects (Spellerberg et al. 2004).

Future Directions

Within this increasingly global worldview, higher education and research are key elements to increase knowledge, adopt technologies, promote cross-border associations, and sustain complex communities (Marginson and van der Wende 2009). Hence, in the next decades, higher education will be influenced mainly by five mega trends: (1) democratization of knowledge and accessibility; (2) contestability of markets and funding, where universities need to compete for students and government funds like never; (3) digital technologies; (4) global mobility; and (5) deeper integration with industry (Ernst and Young 2012).

Under this multifaceted context, sustainable universities around the world have acquired impulse and in many now have reached maturity. In the same way that the UN Decade of Education for Sustainable Development enhanced sustainability on campus, it is expected that SDGs will further assist universities to adopt the principles of sustainable development.

The SDGs are a core guideline for addressing literacy in regard to sustainable development. In fact, this sustainability trend will trigger important changes that will define new roles for universities (Beynaghi et al. 2016). This might include the incorporation of more holistic perspectives into disciplinary curriculum (Correia et al. 2010), the implementation of transdisciplinary, solution-oriented and capacity building projects (Fukushima et al. 2017), and a more general assessment of sustainability literacy.

Additionally, ethics and morality, as it relates to sustainability, also continue to be a fundamental pillar for ensuring that we can effectively achieve the SDGs. Thus, as envisioned by Hensley (2017), in moving toward sustainability, universities keep reinventing themselves by promoting a critical thinking, providing a sense of place, and increasing ecological literacy to sort out, with resilience and hope, the growing socioecological problems that, although they could seem impossible to solve, are not necessarily so.

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Sustainable Urban Transformation

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Definition

"Sustainable Urban Transformation" refers to theoretical and applied advancements in sustainable development that focus on the central role of cities in achieving recognized sustainability goals, emphasize collaborative contributions from various stakeholders, and integrate diverse perspectives from various bodies of knowledge and expertise.

Introduction

The origins of Sustainable Urban Transformation have been largely codified in McCormick et al. (2013a) and McCormick et al. (2013b), and have been exemplified in such case studies as Hellstrom-Reimer et al. (2012), Block and Paredis (2013), Trencher et al. (2013), Mejía-Dugand et al. (2013), and Ernst et al. (2016). "Sustainable urban transformation" (SUT) builds upon historical conceptualizations of sustainable urban development that were articulated in detail in such works as the 1987 WCED Brundtland Report and the 1992 United Nations Agenda 21 Action Plan (Wheeler and Beatley 2014). However, scholars of SUT point to a distinction between this term and traditional notions of sustainability, noting that "sustainable urban development is primarily about development in urban areas while [SUT] is about development or change of urban areas" (McCormick et al. 2013b, p. 4). With that in mind, this chapter acknowledges the close relationship between these concepts and broadly addresses the historical evolution of terminology related to urban sustainability and sustainable urban development. It begins with a brief introduction to the scholarship of sustainable urban development and then traces its ongoing relationship with broader changes in economic policy and governance. Next, scholarship that critically interrogates the shortcomings of urban sustainability initiatives is reviewed. That section is followed by an examination of recent developments in urban sustainability planning, including climate mitigation and adaptation, challenges to Western notions of sustainability planning from cities in the global South, and recent applications attempted by cities seeking to achieve truly "radical" and "multidimensional" SUTs (McCormick et al. 2013b).

Context and Development of the Term "Sustainable Urban Transformation"

Background: Urban Sustainability from Brundtland to Present

The most cited source on sustainability and sustainable development remains the UN Brundtland Report, which defines sustainable development as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs" and goes on to emphasize the interconnected nature of the environment, economy, and society when engaging in any form of development, including urban development (1987, p. 43). The three dimensions or "pillars" of the Brundtland framework (i.e., environment, economy, and social equity) were further articulated 5 years later in the UN Agenda 21 Action Plan, which added an emphasis on stakeholder collaboration and a focus on cities as crucial loci for the advancement of sustainability. These documents created an important foundation for future engagements with urban sustainability and strongly influenced the development-oriented rhetoric employed by agencies such as the World Bank, UNDP, the Asian Development Bank, and others. The "three pillars" approach also influenced applied planning approaches such as New Urbanism, Transit Oriented Development, and Smart Growth, which in turn strongly influenced urban planning orthodoxy in the 1990s and early 2000s (Wheeler and Beatley 2014; Parnell and Oldfield 2014). Beginning with their popularization in North America and Western Europe, many of the common principles of what has come to be known

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broadly as "sustainable urbanism" have been adopted and applied in cities of East Asia and the Middle East, and have influenced planning policies in the cities of developing countries of the global South (Wheeler and Beatley 2014; Parnell and Oldfield 2014).

Although their application is contextually dependent on the regional economy and local political apparatus, the common principles of sustainable urbanism include: improved energy efficiency, density-oriented development, improved mobility and access to public transit, mixed-use development, careful management of local resources and ecosystems, and stakeholder collaboration (Duany et al. 2011; Calthorpe 2010; Wheeler and Beatley 2014). These have often materialized in actually existing structural changes that include the modernization of utility infrastructures, green building design, modernization of transportation networks, and the rehabilitation or establishment of parks, waterways, and green space. In terms of policy approaches, these may include such initiatives as recycling programs, waste reduction measures, tax abatements and incentives for conservation-oriented renovations and upgrades, and low carbon energy plans. In recent years, technological advancements in "intelligent" or "smart" systems such as real-time feedback mechanisms, city sensors, smart grids, and smart buildings are spurring investments and influencing policy priorities as they relate to SUTs (Luque-Ayala and Marvin 2015; Marvin et al. 2015). In industrialized cities throughout the world, the integration of data-driven networks and data-informed programs into urban transportation systems, housing, emergency response systems, and several other aspects of city management are all currently in process and remain highly relevant to conversations of SUTs (Hellstrom-Reimer et al. 2012; Trencher et al. 2013; Kitchin 2014; Aelenei et al. 2016).

It is also important to note the role that universities and other Institutions of Higher Education (IHEs) play in Sustainable Urban Transformations. IHEs have emerged as local leaders in the research, education, and practice of sustainable transformations. These institutions serve as venues for teaching students about sustainability, but they also serve as living laboratories that allow faculty, staff, and students to expand upon the current boundaries of sustainability education. Furthermore, IHEs are tasked with the development of future leaders, scientists, and other professionals that will 1 day assess current initiatives as well as create innovative sustainability initiatives of their own (Brown and Hamburger 2012; Evans et al. 2015; Marans and Callewaert 2017). With some IHEs containing populations as high as 80,000 community members (or more), campuses often act as cities within cities. As such they are uniquely positioned as promoters and practitioners of Sustainable Urban Transformations. The campus itself serves as a way to implement new strategies of energy conservation, the creation of sustainability offices and/or committees, sustainably-minded building construction and renovation, waste management, sustainable dining operations, curriculum development, and engagement with their host community (Brown and Hamburger 2012; Evans et al. 2015). As the scholarship on the social and political-economic dimensions of Sustainable Urban Transformations continues to evolve, university campuses are becoming testing grounds for these dimensions as well. Historically, IHEs have failed to address the issues of social sustainability, work equity, and social justice (Mountz et al. 2015; Rankin et al. 2010; Marshak et al. 2010; Museus et al. 2015). However, as activism and research has raised awareness about these issues, some universities have begun to consider transformative measures focused on increased budget transparency and stakeholder collaboration, retention of marginalized and unrepresented students, recognition/inclusion of diverse viewpoints, and expanding disability and mental health services (Marshak et al. 2010; Marans and Callewaert 2017; Hudler et al. 2017). A tremendous amount of work still needs to be done on these issues, but as living laboratories for transformative sustainability, IHEs are an ideal place for research, activism, and practice to advance these dimensions of sustainability.

As mentioned earlier, all of the above applications of urban sustainability must consider the broader political-economic forces at play. There has been a great deal of scholarship exploring the ways cities, municipalities, and institutions have coupled sustainability measures to popular neoliberal growth agendas and economic trends (for example, While et al. 2004; Kahn 2006; Brand 2007; Müller 2013). Since at least the 1980s, city leaders have implemented ambitious programs dedicated to ecological modernization, density-oriented development, and smart urbanism in an attempt to present "win-win" scenarios for the economy and the environment (Brand 2007; Krueger and Gibbs 2007; Hodson and Marvin 2017). As Gibbs et al. (2013, p. 103) note, in the twenty-first century, sustainability is often presented not as an "obstacle to capitalist accumulation, but rather a constituent part of it." Indeed, many of the most economically successful cities of the twenty-first century have strong reputations for environmental sustainability and have used their green image as a means to attract skilled labor and compete for desirable industries and capital investment (While et al. 2004; Krueger and Gibbs 2007). However, applied strategies to attract mobile labor and capital are often not implemented evenly throughout the urban landscape, resulting in rising inequality in cities known to embrace many of the principles of ecological sustainability, including San Francisco, Seattle, Vancouver, Toronto, Amsterdam, Copenhagen, Cape Town, Curitiba, and others. The following section reviews some of the critical scholarship on increasing inequalities appearing in cities that identify themselves as sustainable. This is a necessary exercise considering that progress toward equity and justice has been identified as an important goal of SUT but has significantly lagged behind notable success in environmental and economic sustainability initiatives (Dempsey et al. 2011; Hamann and April 2013).

Critical Scholarship on Urban Sustainability: Issues of Justice and Equity

As the principles of sustainable urbanism gained momentum in North America and Western Europe, scholars began to question the paradoxical and uneven implementation of sustainability initiatives (see for instance, Krueger and Gibbs 2007) and their tendency to exacerbate issues of environmental injustice and social inequality (Heynen et al. 2006). Two authors in particular provided an important theoretical framework that detailed the initial links between revitalization-oriented sustainable urban development and what has come to be referred to broadly as "environmental gentrification." Dooling's work (2008; 2009) on ecological gentrification noted that cities that employ an environmental ethic as justification for economic development often implement plans that result in the displacement or exclusion of vulnerable populations. Examples of this include the revitalizations of urban watersheds, the rehabilitation of degraded parks and greenbelts, or the removal of polluting industries and locally unwanted land uses in poorer – and often minority – neighborhoods. Later, Quastel (2009) expanded upon Dooling's arguments by articulating a broader political ecology of gentrification related to sustainable development initiatives. Quastel's case study of ecodistrict development in Vancouver highlighted the promotion of several forms of creative sustainable urbanism (i.e., smart growth, transit-oriented development, ecosystem protection, ecological modernization, and the attraction of educated knowledge workers) and their direct relationship with class-based gentrification and exclusionary displacement. Following these works, Checker (2011) introduced the term "environmental gentrification" as a broader term to refer to the many processes of sustainable urban development that employ an environmental justification for economic development projects that result in the displacement of vulnerable populations. At this same time, scholars throughout North America and Europe had begun to detail case studies of the widespread integration of sustainability rhetoric into city management plans, planning agendas, and the mission statements of public-private partnerships for the purpose of justifying neighborhood revitalization and ecological modernization projects. The selective employment of sustainability principles has been identified and expanded upon by such scholars as Pearsall and Pierce (2010), Curran and Hamilton (2012), Rosol (2013), Long (2016), Wolch and Dear (2013), Pearsall and Anguelovski (2016), and numerous others. As these scholars and others note, when the environmental and economic "pillars" of sustainability are implemented without consideration of social equity issues, sustainable development ultimately fails for at least three reasons. First, it elevates some populations and their ecosystems as more productive and valuable, therefore prioritizing the basic needs and lifestyle choices of those people and areas over others. Second, it reduces stakeholder collaboration and the diversity of perspectives, obfuscating insights provided by a broader knowledge base. Lastly, it creates additional challenges by displacing vulnerable populations and relocating environmental degradation to places where social and environmental problems are less visible and may be more difficult to remedy.

While many of the above scholars speak specifically about these issues on the municipal scale, they also note that this is a complex, multi-scalar problem. Not only are sustainability initiatives implemented unevenly within specific cities but the conceptualization of sustainability principles and the production of urban theory may indirectly lead to inequalities at the regional and even global scales. Since its inception, urban sustainability theory and practice has been dominated by Western and industrialized perspectives. As Parnell and Robinson (2012, p. 596) note, the global North has "overlook[ed] the rapidly growing cities of the global South where traditional authority, religion, and informality are as central to legitimate urban narratives as the vacillations in modern urban capitalist public policy." The grounding of sustainable development knowledge in a purely Western context not only ignores the sustainable practices of urban citizens and municipal leaders of the vast majority of the global population, it elevates a code of practices and principles that (a) are at times inappropriate and even counterproductive in the context of the Southern urbanization, and (b) insert the necessity of a financial investment model that reinforces problematic power structures (Parnell and Robinson 2012; Parnell and Oldfield 2014). Such problems have led some scholars to call for a (re)theorizing of urban development from the global South (Parnell and Robinson 2012); this notion carries a great deal of weight for the definition of SUT. Simply put, since SUT calls for "structural transformation processes. . .that effectively direct urban development towards ambitious sustainability goals" (McCormick et al. 2013b, p. 1), it becomes necessary to remain cognizant of the ontological origins of sustainability goals as they apply to vulnerable and marginalized populations, and to remain critical as to whether some initiatives labeled as "sustainable urban transformations" may benefit some populations while ultimately burdening others.

Issues of justice and equality are further complicated by the increasing threat of climate change. Already, scholarship that critically analyzes urban measures to address climate change have had mixed results in cities of the developed world, leading to unintended consequences such as "carbon gentrification" (Rice et al. 2019). Indeed, some have suggested that shifting focus on climate change and climate resilient infrastructure in the neoliberal era begs several questions about equitable implementation and is increasingly indicating a shift toward a less socially just mode of development dubbed "climate urbanism" (Long and Rice 2018). This is particularly concerning for cities in the global South. As numerous scholars have noted, the hazards associated with climate change already disproportionately affect citizens of the global South – in particular women and poorer populations – and these vulnerabilities are projected to worsen (Adger et al. 2013; Blaikie et al. 2014; Olson 2014). The urban populations of these regions are expected to double by 2030 and the land area covered by cities is expected to triple (UNDP 2015), suggesting that the need for SUTs is much greater in the rapidly growing cities of the global South. While the majority of case studies in sustainable urban transformations remain focused on cities of the global North, works such as Hamann and April (2013), Mejía-Dugand et al. (2013), Bhagavatula et al. (2013) explore SUTs in cities of South Africa, Latin America, and India, respectively. In the following section, applications in these cities and others will be discussed as the chapter moves beyond an overview of the theory of SUT toward current practices and future considerations.

Toward a More Complete Understanding of Sustainable Urban Transformation

More than half of the global population lives in cities and that number is expected to rise to nearly

70% by 2050 (UNDP 2015). In addition to their rapid population growth, cities are also experiencing growing economic primacy and rising political influence; there is little doubt as to why the twenty-first century is being referred to as the "urban century." As a result, cities are the logical focal points for sustainable development and intervention. Cities are responsible for at least 70% of all greenhouse gas emissions, contribute significantly to solid and toxic waste pollution, produce heat island effects that can alter surrounding temperatures and ecosystems, and contribute vast amounts of air pollutants (Kennedy et al. 2007; Benton-Short and Short 2013). In addition to having ecological footprints as much as 200 times as large as the city itself and consuming vast amounts of open space due to sprawling development, cities throughout the global south have experienced significant over-urbanization and slum development (Wigginton et al. 2016). Today, nearly 900 million slum dwellers live in cities throughout the world, revealing just one of myriad social challenges related to inequity and inadequate development that cities face in the urban century (UNDP 2015). Despite the attention focused on cities as the greatest offenders of environmental degradation and social ills, there are those who remain optimistic about their transformational potential. In recent years, the United Nations has made cities the focus of sustainability agendas while mainstream scholars, advocacy groups, and think tanks look to cities as the appropriate scale to pursue development agendas and action on climate change.

The literature on SUTs builds upon this focus by taking a multidimensional approach to sustainable urban development through theoretical advancements, urban modeling, performance assessment, bottom-up grassroots and social movements, technological advancements, and other multi-scalar sustainability projects.

While scholars and practitioners acknowledge the strong relationship between sustainable urban development and SUT, they are quick to point out their different approach: SUTs often *shift* traditional or existing development paths, focusing on the transitional change of urban areas by addressing "drivers of radical change and multi-dimensional urban structures" (McCormick et al. 2013b, p. 4). According to McCormick et al. (2013b), "drivers of change" include governance and planning, innovation and competitiveness, and lifestyle and consumption; "sustainable urban structures," on the other hand, refer to resource management, climate mitigation and adaptation, transport and accessibility, buildings, and the spatial environment and public space (see Table 1).

Sustainable urban transformations are policies, interventions, and applications that frame their actions along social, economic, and environmental interactions among these dimensions. Despite the many case studies of specific projects that explore and apply the SUT framework, scholars of SUT insist that all actions take a "programmatic rather than a single project-based approach" (McCormick 2013b, p. 7). Still relatively nascent as body of literature, the bulk of studies (n = 20) that employ this overall framework can be found in a 2013 special issue of the *Journal of Cleaner Production* (although other examples certainly exist; see for example McCormick 2013a; Hellstrom-Reimer et al. 2012; Seeliger and Turok 2015). The studies from the aforementioned special issue are geographically, thematically, and methodologically diverse. While it is beyond the scope of this chapter to describe each of them in detail, three are briefly summarized here in an attempt to reveal the unique ways in which the SUT framework may be employed. These include a new assessment tool aimed at measuring and reducing urban waste, disseminating and reproducing an innovative transportation intervention (Bus Rapid Transit), and urban preparation and planning for climate hazards.

Sustainable Urban Transformation, Table. 1 SUT: Driving Forces vs. Structures. Adapted from McCormick et al. (2013a, b)

Drivers of change	Sustainable urban structures
Governance and planning Innovation and competitiveness Lifestyle and consumption	Transportation and accessibility buildings Resource management and climate mitigation and adaption Spatial environment and public space

Zaman and Lehmann (2013) explore the concept of a “zero waste city” through the creation of an assessment tool used to measure the performance of zero waste systems. The tool, which they have called the “zero waste index,” measures the virgin materials that are offset by waste management systems and indirectly measures the resources (including water, raw materials, and energy) that can be diverted from extraction, consumption, and waste. By analyzing three case study sites (Adelaide, Australia, San Francisco, U.S.A., and Stockholm, Sweden), Zaman and Lehmann (2013, p. 123) achieved a comparative performance model that forecasted the amount of virgin materials, energy, water, and emissions that were substituted by the resources recovered from waste streams while also estimating the potential energy, emissions, and water savings that resulted from resource recovery. In this way, the authors engaged multiple topics within the SUT framework (i.e., Lifestyle and Consumption, Governance and Planning, Resource Management and Climate Mitigation and Adaptation) while also revealing the interactions among each. Their assessment tool also aims to promote radical and multidimensional change toward sustainability goals that include resource conservation, reduction of greenhouse gas emissions, and overall reduction of the urban ecological footprint.

In another example from the issue, Mejía-Dugand et al. (2013) explore the dissemination of Bus Rapid Transit Systems (BRTs) throughout Latin America. Rather than focusing purely on the environmental, economic, and social benefits of the adoption and promotion of BRTs, the authors chose to deepen their analysis by examining the ways in which BRTs overcame social barriers to gain public acceptance throughout a broad range of Latin American cities in a relatively short period of time. Mejía-Dugand et al. (2013) outline strategies, show the multidimensional effects of a sustainability innovation, and provide insight into how other sustainability innovations can be effectively disseminated. In doing so, they manage to address connections among multiple dimensions of the SUT framework while also providing the important perspective of an innovation that originated in the global South and has since influenced cities in the industrialized global North.

In the last example from this issue, Wamsler et al. (2013) identify the knowledge gaps between the theories and practices of urban climate change preparedness, specifically the ability of cities to prepare for and mitigate the risks associated with climate hazards. While theoretical in nature, the aim of this article is to contribute practical, applied knowledge for city policymakers and urban citizens who can use this knowledge to achieve the sustainable urban transformation of their city. The authors consider the full life cycle of climate-induced disasters: from initial causes, to short-term and long-term impacts, to post-disaster response and recovery (pp. 68–69). All of these are considered in the context of the complexity of the “city-disaster nexus,” which involves the various interrelationships among the urban fabric, urban society and culture, urban economy and governance system, and urban climate. They then describe the various strategies of adaptation and mitigation that either address or fail to address the city-disaster nexus. In the analysis of these issues and the presentation of their comprehensive assessment and planning framework, Wamsler et al. (2013) effectively address all of the dimensions of the SUT framework and provide multiple avenues for radical and multidimensional change.

The above three examples were chosen to show the various ways both applied and theoretical scholarship can effectively engage the SUT framework. Scholars of SUT note that this framework, coupled with the literature’s call for radical and multidimensional change, has prompted a fresh perspective on sustainability (McCormick et al. 2013b; Seeliger and Turok 2015; Zhang et al. 2016). However, SUT has inherited many of the same challenges as its conceptual cousin: sustainable urban development. As examples from Seeliger and Turok (2015) and Hamann and April (2013), both note issues related to social inequality and social injustice remain significant barriers to achieving truly sustainable urban transformations. Further, despite promising research from Radywyl et al. (2013) and Mejía-Dugand et al. (2013), challenging top-down and hegemonic approaches to sustainability and SUT remain especially difficult (although these same examples may prove as a sign that this could be shifting).

Despite criticisms, the crises posed by ongoing rampant urban growth in the global South, coupled with the looming threat of climate change, necessitate significant, persistent, and innovative interventions to advance sustainable urban development. Employing the SUT framework seems to provide a meaningful avenue for scholars and practitioners to engage and begin those transformations. In short, while Sustainable Urban Transformation remains new as a theoretical concept, it opens space for challenging some of the traditional pathways of sustainable urban development while encouraging and promoting radical and multidimensional interventions with an aim to achieve ambitious sustainability goals.

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Sustainable Waste Management Systems in Higher Institutions: Overview and Advances in Central University Miotso, Ghana

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Definitions

Sustainable waste management is defined as waste management systems' evaluation processes that incorporates feedback loops to protect the environment alongside resource and energy consumption from the most favourable to the least favourable actions per the waste hierarchy.

Introduction

It is established that HEIs can teach and demonstrate the theory and practice of sustainability by taking actions that can help to understand and reduce unsustainable practices of their own activities including waste management (Kianoosh 2015). When waste is not properly managed, it becomes a threat to health and a major social and environmental problem. Problems of waste handling have become a development issue, deeply rooted in science and technology and societal readjustment. Defining a system to regulate waste must integrate the moral and cultural reorientation of communities to invoke basic rights and obligations that will produce outcomes necessary for addressing the menace (Hoffman and Ventresca 2002). An efficient waste management system extends beyond technological needs to include social, institutional, legal, and financial aspects. According to Leonard (2005), its sustainability entails organizing and managing adequate finances, infrastructure, and workforce with the involvement of all stakeholders to sustainably deal with the problem. The relevance of this is study, on zero waste management systems in Central University, is well noted by Bailey (2015) that HEIs can play a key role in promoting sustainable development due to inherent expertise among university staff and students as well as their engagements with the wider community.

Defining Key Terms

Key terminologies, as they relate to zero waste management systems, are defined here to enhance in-depth understanding of the system.

Waste

Waste is defined as an unwanted or undesired material or substance (Hoffman and Ventresca 2002). In CUM, it consist of rubbish, trash, junk, and garbage or the unwanted materials, left over from the food plaza, lecture halls and laboratories, library facilities, students halls of residents, administrative blocks and lecturers offices, and/or effluents from same CUM community in-house activities. In other words, waste is a man-made substance, which in its actual structure and state is deemed not useful to the owner(s). Lands contaminated from improper disposal practices or chemical spills from laboratory experimentation, junk, or transport yards in HEIs are also considered as brownfields.

Solid Waste

Solid waste (SW) means any other waste material other than liquid waste (LW). SW in CUM include garbage; refuse; sludge from a wastewater treatment systems, water supply treatment systems, or air pollution control systems in facilities; and other discarded solid or semisolid materials coming from CUM communities, or contained gaseous materials, resulting from the transport yard and agricultural operations and/or from community activities.

Waste Management

Waste management (WM), according to Amoah and Kosoe (2014) and Puopiel (2010), is the administration of activities that provides for the collection, transportation, and disposal of garbage, sewage, and other waste products. WM in CUM encompasses management of disposal methods, collection, all processes and resources for proper handling of waste materials, transportation and maintenance of waste transport trucks and disposal facilities, as well as compliance with standards, health codes, and environmental regulations.

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Waste Management Systems

Waste management systems (WMS), according to Hagerty et al. (1973), refer to a specific technique (strategy), device, or systems, used to manage waste materials. This may deal with the collection, transportation, recycling, disposal, or processing of waste (Puopiel 2010; Miller 2004; Kreith 1994). WMS varies according to both the kinds of waste material to be treated and the aims of the treatment itself (Tchobanoglous et al. 1993, 1997). Supported by CUM management, the Department of Environment and Development

Studies (EDS) has evolved a system whose main goal conforms to best WM practices, to maintain a clean and healthy environment, curb health epidemics and environmental pollution, and recover materials for reuse or recycling (Momoh and Oladebeye 2010; Miller 2004; Shuebeler et al. 1996).

Waste Management Systems

An Overview in CUM

Ghana, with a total population of 29 million (GSS 2010), has over 205 accredited higher educational institutions (HEIs) contributing meaningfully to the teaching, research, and service fraternity in diverse capacities. These institutions are made of public and private tertiary institutions, technical universities, polytechnics, distance learning, colleges of education, and nursing (NAB 2017). CUM is the largest private HEI in Ghana with over 7000 students (NAB 2017). Over the past 2 decades, CUM has responded positively to the high-level manpower training needs by developing diversified academic programs in the social sciences, including law, technology, and applied sciences, including architecture, physician assistantship, pharmacy and nursing, and business management, and, thus, contributes enormously to waste generation in the Greater Accra Region (NAB 2017).

Preintegration of Environmental Concerns

The amount of waste generated by urban centers during and immediately after the colonial era and attainment of independence (*Ghana, then known as the Gold Coast was colonized by the British until She become independent on the sixth of March 1957*) was insignificant due to low population density (GSS 2010; Bremner et al. 2010), low societal levels of exploitation of natural resources, and low levels of technology characterized by simple lifestyles. Common wastes produced during these times were mainly ashes from burning hydrocarbons and human biodegradable waste which were released back into the environment with minimal impact (Al-Youssfi 2002). Prior to the integration in CUM (Pre-1990s), waste materials generated were environmentally friendly and mainly found in the form of biodegradable food leftovers and packaging materials from leaves and papers. Tools and residues from wood or metal were recycled or passed down through the academic calendars for reuse. When it became necessary for CUM to discard off large waste materials (papers, stencils, and junkyard waste), this was routinely organized and burnt in isolated controlled dumpsites on campuses.

Pro-integration of Environmental Concerns

With the onset of environmental concerns and unsustained growth of urbanization in Ghana (Benneh et al. 1993), buildup of waste, mainly from nondegradable plastics from uncollected dumpsites and opened spaces, began to stir up rapid deterioration in the levels of sanitation and the quality of urban life which eventually drifted into HEIs campuses. Streets, open spaces, and gutters became choked with filth due to inadequate waste clearance regulations, non-compliance, and the creeping in of a complex societal lifestyle. With the onset environmental concerns becoming aspects of decision-making in Ghana (Pro-1994), calls for the establishment of a responsible ministry, agencies, and municipal authorities with waste removal powers became institutionalized (Bailey 2015). Spurred by increasingly floods, partly to be blamed on plastic wastes leading to devastating cholera outbreak and public health-related issues in the urban centers, especially in the city of Accra, major legislations were promulgated after the 1972 Stockholm conference, to better manage waste; the 1992 environmental policy, EPA Act 1994 (Act 490) and the 1999 Legislative Instrument 1652 (LI 1652), which sought to manage waste using best practices (Boamah 2010; Bailey 2015).

WM in Ghana, today, is the responsibility of the Ministry of Local Government and Rural Development, which oversees the activities of Metropolitan, Municipal and District Assemblies (MMDAs). Regulatory powers are, however, vested in the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science. The MMDAs are responsible for the collection and final disposal of municipal waste through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Departments. Due to the high volumes of waste generated daily in the cities, it has become necessary to involve private waste management entities. Subscribing to best management practices, CUM has adopted a system that handles four main types, food, rubbish, special, and hazardous waste, summarily defined in this paper under section "Types and Sources of Waste."

Types and Sources of Waste

Food Waste

Food waste is any food substance, raw or cooked, which is discarded or intended or required to be discarded from the food plaza, halls of residents, and university communities. These organic residues are generated by the handling, storage, sale, and preparation, cooking, and serving of food (Miezah et al. 2015). It includes uneaten portions of meals and trimmings from food preparation activities in kitchens, restaurants, and canteens from the food plaza (Miller 2004) and the university community.

Rubbish

Includes both combustible and noncombustible solid wastes from the university community excluding food wastes or other highly putrescible materials. These fall within a category defined by Tchobanoglous et al. (1993) and EGSSAA (2009) to include all forms of paper, cardboard, plastics, textiles, rubber, leather, wood, furniture, and garden trimmings. Noncombustible rubbish consists of glass, tin cans, aluminum cans, ferrous and other nonferrous metals, and dirt.

Special Waste

Special waste is defined as any waste material which, because of its physical characteristics, chemical make-up, or biological nature, requires either special handling procedures or permitting or poses an unusual threat to human health, equipment, property, or the environment (Miller 2004). These include general hospital/clinic, laboratory and agricultural wastes, pathological waste, pharmaceutical waste, radioactive waste, infectious waste, chemicals waste, sharp objects, lithium batteries, and pressurized containers. These are segregated at source and specially disposed of in CUM.

Hazardous Waste

Hazardous waste is waste with properties that make it potentially dangerous or harmful to human health or the environment. These may exhibit any one or a number of the following characteristics: toxic, ignitable, reactive, and corrosive. They could assume the form of liquids, solids, or gases (Al-Youssfi 2002).

Municipal Waste (MW)

MW includes all type of waste generated by households and commercial establishments and managed, especially, by local government bodies. The contents of what is called municipal waste may vary from country to country and even from one municipality to the other. Waste generated in HEIs exhibits all characteristics of municipal waste. In a well-developed country with good recycling systems, municipal waste will mainly include items that cannot be recycled (Kumar et al. 2016). Those that are not able to be recycled are disposed of in landfills. In most developing economies and for that matter, Ghana, landfills are not engineered.

Advances in CUM Waste Management Systems

Waste generated in CUM consists of many different materials. Detailed understanding of the composition of solid waste is deemed necessary to inform management (Denison and Ruston 1990; Miezah et al. 2015) on how to best deal with it. The system in CUM starts with control of waste generation from the various sections of the university campus (administration, lecture halls and offices, halls of resident, food plaza, etc.), storage (maximum of 3 days), collection, transfer and transport of waste (by a cleaning company and a private waste management company called Zoomlion), processing, and disposal (by Zoomlion), in accordance with best practices and principles of public health, economics, engineering, aesthetics, and other environmental considerations responsive to public attitudes. Wastes generated are first stored either in dustbins in offices, laboratories, or in dustbins or skip containers placed at vantage points on campus. Sometimes it becomes necessary to transfer the waste from small collection equipments (dustbins) to bigger tractors, tricycles, or skip containers when the volume of waste becomes surmountable and finally to bigger trucks for disposal. There is a research project by the Department of Environment and Development Studies (EDS) on material recovery for reuse and recycling where students segregate plastics, papers, and food leftovers for further processing. This project is expected to be extended to surrounding communities after the pilot exercise.

Key Components of the System

Waste Generation

Thousands of tons of solid waste are generated daily in our cities with most of them ending up in open spaces, including gutters, dumps, and wetlands. It contaminates surface and groundwaters and poses major health hazards. Waste generation rates in urban cities vary approximately between 0.5 and 0.8 kilograms per person daily (Miezah et al. 2015). Large amounts of waste are generated beyond management capability of existing infrastructure and finances to efficiently manage them. Over 65% of urban cities do not have home collection services (Boadi and Kuitunem 2005). In HEIs however, an average of 70% across the country are served with institutional collection services. Separation at source is not a priority making sustainable WM problematic.

Waste Handling

Waste handling comprise all activities associated with managing wastes until they are placed in storage containers before collection or returned to recycling centers (Tchobanoglous et al. 1993). In CUM handling is done by the company responsible for providing cleaning services to the university. Specific activities associated with handling wastes material at the source vary depending on the types of materials that are recovered for reuse and the extent to which these materials are separated from the waste stream. Handling is also required to move the loaded waste from the collection centers to the final disposal sites depending on the type of collection services available. These services are provided by Zoomlion in CUM.

Waste Separation (Segregation)

This involves the recovery of separated materials, processing of solid wastes components, and the transformation of the solid wastes that occur, primarily, in locations away from the source of generation. Known methods used for recovery of waste materials separated at source include curbside collection, drop-off, and buyback centers. Currently there are no buyback services in CUM. The separation occurs onsite and processing of these wastes usually occurs at recovery centers, transfer stations, combustion facilities, and disposal sites. Waste components are separated by manual separation of the waste components and size reduction by shredding, separation of ferrous metals using magnets, volume reduction by compaction, and combustion (Tchobanoglous et al. 1993).

Waste Storage

This refers to all places where generated waste is stored until collected. Storage may be affected by factors such as climate, type of container, container location, and contamination of waste components. These factors have a greater bearing on the storage of perishable materials, which decompose rapidly. These are collected quickly. Those that delay in collection are stored in skip or dustbins and not thrown away indiscriminately because of health, environment, and aesthetic consideration.

Waste Collection

Collection of wastes involves gathering of the wastes materials and haulage by vehicles after collection to locations where the collection vehicles are emptied (Miezah et al. 2015; Bartone 1991). Collection are provided and supervised under various management arrangements, ranging from municipal services to franchised private service providers. Collection methods include communal collection points, curbside collection and drop-offs, setout-setback, and backyard carry.

Waste Transfer and Transport

Transfer and transportation of waste involves two steps: (1) the transfer of wastes from smaller collection bins, skips containers, and tricycles to larger transport equipments (provided by Zoomlion) and (2) the subsequent transport of the wastes, usually over long distances to the final disposal site (Baabereyir 2009). The transfer usually takes place at stations approved by Zoomlion. Although motor vehicle transport is most common, transport by rail and barges are also possible. In Ghana tricycles are used to transfer the wastes to storage containers, where they are subsequently transported to the disposal sites by skip container and tractor-trailer trucks.

Waste Dumping

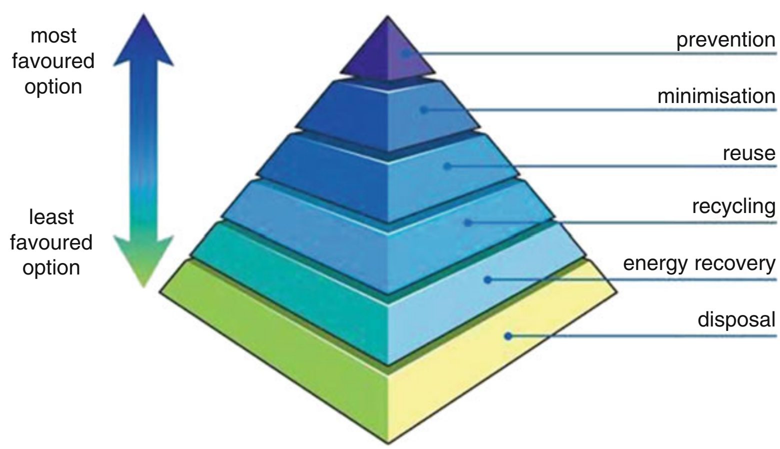
Best management practices demand that waste collected need to be dumped at engineered sites (Amoah and Kosoe 2014). This is not the case in Ghana. Landfills are not engineered posing high risk of infections through runoffs during rains and pollution of underground water. These sites are of great concern due to their threat to human health and pollution of underground water through leaching.

Zero Waste Management System

A key goal of zero waste management, according to Flintoff (1984), Shuebeler et al. (1996), Miezah et al. (2015), and Kianoosh (2015), is to protect the health of the population, promote environmental quality and sustainability, support economic productivity, and generate employment and income. To achieve the above goals, it is necessary to establish sustainable systems of waste management that meet needs of the entire population. In CUM, the system is absorbed and carried out by the university, employing and developing capacities of all stakeholders, including students and its local communities with advice from government agencies at the local regional level.

The Systems Approach

CUM approaches sustainable waste management from the perspectives of the entire cycle of material use from production, distribution, and consumption as well as waste collection and disposal. Immediate priority is given to effective collection and disposal. Waste reduction at source and recycling are relatively young novelty but equally pursued as important longer-term objectives. The systems' principles of sustainable WM strategies, in order of preference, are prevention and minimization of waste generation, maximization of waste recycling, and reuse and ensure safe and environmentally sound disposal of waste. This environmentally friendly and socially acceptable method adheres to the WM hierarchy depicted by Fig. 1.



Sustainable Waste Management Systems in Higher Institutions: Overview and Advances in Central University Miotso, Ghana, Fig. 1 Zero waste management hierarchy based on US EPA 2008

Source Reduction (Reuse)

Source reduction (prevention) is the application of best strategies and practices aimed at reducing waste at source. It takes many different forms, including reusing or donating items, buying in bulk, reducing packaging, redesigning products, and reducing toxicity. Purchasing products that incorporate these features supports source reduction. Source reduction can save natural resources, conserve energy, reduce pollution, reduce the toxicity of our waste, and save money for consumers and businesses alike.

Recycling

Recycling is a method of reducing the amount of wastes that enter disposal sites (Puopiel 2010). It converts material which will otherwise remain useless into valuable resources, capable of generating employment and bringing in economic returns. Recycling prevents the emission of many greenhouse gases and water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children's future, and reduces the need for new landfills and combustors (Bradshaw et al. 1992; Miezah et al. 2015).

Composting

Composting is the process of turning organic household waste into fertilizer through aerobic fermentation. It is a minimally used form of waste disposal in most cities and does not contribute to the danger of food pollution. Of about 1250 tons of garbage collected per day, between 10% and 15% is composted (Bradshaw et al. 1992).

Energy Recovery

Energy recovery from waste is the conversion of nonrecyclable waste materials into useable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas (LFG) recovery. Currently CUM is practicing anaerobic digestion during gasification and landfill gas in trial stages. This process is often called waste-to-energy (WTE).

Treatment and Disposal

Landfills are the most common form of waste disposal and are an important component of an integrated waste management system. They are primarily regulated by government agencies and meet stringent design, operation, and closure requirements in order to stay open. Methane gas, an end product of waste, can be collected and used as fuel to generate electricity. After a landfill is capped, the land may be used for recreation sites such as parks, golf courses, and ski slopes.

Incineration

Incineration is a controlled combustion process for burning combustible waste to gases and reducing it to a residue of noncombustible ingredients (CED 2003). During incineration, moisture in the solid waste gets vaporized and the combustible portion gets oxidized and vaporized. Carbon dioxide ($C0_2$), water vapor, ash, and noncombustible residue are the end products of incineration. Incinerators have the capacity to reduce the volume of waste drastically, up to ninefold than any other method (Kwawe 1995).

Sanitary Landfill

Sanitary land filling includes confining the waste, compacting, and covering it with soil. It not only prevents burning of garbage but also helps in reclamation of land for valuable use. The placement of solid waste in landfills is the oldest and definitely the most prevalent form of ultimate waste disposal (Chandra and Linthoingambi 2009).

Challenges and the Way Forward

In spite of these advances in WMS, a number of challenges have been identified militating against sustainable waste management in CUM. HEIs are faced with acute financial challenges resulting in inadequate service coverage and operational inefficiencies of services. This sometimes leaves wastes at dumpsites uncollected for number of days resulting in untidy environment around installations and buildings, very bad odor, and numerous flies. The system is also challenged with limited utilization of recycling activities for waste recovery for reuse, improper landfill disposal, and inadequate management of hazardous and health-related wastes due to limited knowledge on its implications on the parts of some university staff and students as well as local communities. These go a long way to compound existing public health facilities battling with municipal environmental health problems. Effective management of solid waste must therefore go beyond developing viable self-financing schemes to raising awareness of local communities on sanitation and proper hygiene, forging cooperation with local government agencies, private waste management agencies, and other higher educational institutions which may have an edge in handling such situations.

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Sustainable Water Management and Higher Education

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Definition

TVET (Technical and Vocational Education and Training) is education and training which provides knowledge and skills for employment. TVET uses formal, nonformal, and informal learning. TVET is recognized to be a crucial vehicle for social equity, inclusion, and sustainable development.

Nongovernmental organizations (NGOs) are usually nonprofit and sometimes international organizations independent of governments and international governmental organizations (though often funded by governments) that are active in humanitarian, educational, health care, public policy, social, human rights, environmental, and other areas to affect changes according to their objectives.

Introduction

Water sustainable management has a close relationship with higher education by integrating with the community. So, the main aim of this research is to show how development in higher education can improve water sustainable management. To address the world's water crisis problem, higher education is known as one of the critical aspects of the international responses, which can promote alterations in performances and to encourage more sustainable societies, in terms of economic feasibility, social equity, and environmental safety (Dyer and Dyer 2017). Education for sustainable development deals with all levels, settings, and types of educations (Komiyama et al. 2011). Therefore, it should not be perceived as a standalone action, but rather as an integral part of any education system and a capacity building strategy (Disterheft et al. 2013; Chan et al. 2017). Water education is often associated with poverty alleviation, adaptation to climate alterations, provision of basic human rights, gender equality, and native cultures, among other key issues (Leal Filho et al. 2015).

Necessary strategic objectives to achieve better water sustainable management are explained as below:

1. Promote water technicians' education and exercises
   - Set integrated values and technologies for maintaining water supply and treatment, community-based water management, and sanitation services. Also to integrate water

preservation into Technical and Vocational Education and Training (TVET) for water technicians (Marlow et al. 2012)

- Identify and promote professional development opportunities for water technicians through formal, nonformal, informal, and on-the-job training

To achieve the abovementioned objective: By the (1) reinforcement of technical and vocational education and training: Several developing countries are experiencing an increasing gap between labor market requests or demands in key sectors and lack of trained staff or high qualified professionals. Serious skill shortages have occurred in the water supply and sanitation sectors (Crow 2010). So, it is essential to address these skill gaps by taking strategies to meet labor market demands and to introduce new technologies and trades and enhance capabilities necessary for sustainable water management, supply, and sanitation systems. Moreover, enabling appropriate networks or institutions to support improving skills, and technical and organizational capacities, for instance, enhancing community's quality of life through improving access to safe drinking water and sanitation services.

2. Water education at schools
   - Improve educational capacities of primary, middle, and high schools to develop water management projects.

   How to reach: Facilitating information exchanges in schools by establishing educational institutions in developing countries, ranging from preschools, primary and secondary schools to technical and vocational, and teachers' training institutions. The overall purpose of these objectives to promote participating in quality education through raising educator's awareness regarding the impacts of water-related issues and provide information on how they can act to encourage responsible behavior towards water resources and utilization.
3. Society and stakeholder education
   - Disseminate best management practices in linking water scientists and managers, community educators, and NGOs to improve community-wide water preservation strategies as well as to develop community skills to take ownership of water resources management actions (Kharrazi et al. 2017).
4. Water education for mass media specialists
   - Provide targeted training to both water and media professionals, e.g., journalists, editors, producers of radio, television, film, and other media resources, to communicate water problems in a transparent and effectual manner.

   How to reach: The media plays a major role as a partner for sustainable development; therefore, public debates on media, for example, parliamentary broadcasts, assist to shape and mobilize public opinion and encourage their participation in sustainable management of water supplies. Establishing journalism and media training on freshwater-related issues has an important and influential role. In addition, professional media who invest and have interest in sustainable developments can help increasing the number of institutions who provide supports to the "International Water Film" events. The media can greatly assist in spreading credible knowledge on water management issues, increase public debate, promote transparency, and foster the creation of quality media programs by professional media for sustainable development purposes.
5. Advance education and proficient development of water scientists, engineers, managers, and decision makers by:
   - Increase education and training programs through strengthening the education of a new generation of water managers and decision makers to contain a holistic, integrated trans-disciplinary approaches to water management and development (Wals 2014)
   - Promote national, local, and international networks for proficient development and ready acceptance of scientific research into university curricula

Previous Works and Practices

In recent years, water education for sustainability has improved as it is an important field of exercise in higher education. This is reflected in recent international networks and workshops coordinated by UNESCO. However, some recent commentators have discussed that university courses on sustainable development and management of water resources are insufficient and so far are having minor impacts or contributions towards water sectors and development of sustainable water supplies (Karthe et al. 2016; Leendertse and Taylor 2011). The authors of this entry, as water educators who participated in this issue, want to alter this fact. Education for social alteration in one form or another which is education that will "make a difference" in the professional lives of graduates and in the water sector is compulsory. In the following argument, we raise questions such as How do we educate the evolving professionals to acquire knowledge, skills, and values to enable them to participate in conserving water supplies, and manage them sustainably? How do we educate such experts to critically and ingeniously contemplate current and future water issues, and how they will be able to contribute to new knowledge and participate in debates on sustainable development in theory and in practice? How do we improve the experiences and skills of such professionals to enable them to effectively integrate multiple disciplines and interests and to influence policy decisions and developments?

The previous studies reviewed in this entry mainly came from reflecting on educational theory and ideas, rather than research on educational training. For example, McIntosh and Taylor (2013) showed some ideas on how we can educate specially graduated students from universities in the field of water sustainable management.

Oliver and Dennison (2013) worked on the project of "Popular Education for Water Sustainability" and three lessons learnt from reflective practice are:

First, popular water educators require to identify the people who they work with, also their knowledge, experience, and ambitions. Second, they should learn from their participants and allow them to learn from each other. Third, effectual popular education has a robust emotional element that is just as important as thinking and doing.

Oliver and Dennison (2013) used some theories at the university level to develop better understanding and management of water environment for coastal zone management. They gave examples of their own teaching to motivate students.

Missingham and McIntosh (2013) continued exploring the effectiveness of popular water education principles and approaches, in this case, in the university's classroom. They briefly discussed the origins of popular education and participatory learning approaches and their growing influence in the field of environmental education. The study highlighted strategies of asset-based teaching and learning in which students' knowledge, experience, and heart-felt aspirations are turned into learning resources equally – or even more – important as the lecturer's expert knowledge. The study also discussed problem-posing education, participatory learning underpinned by effective group facilitation techniques, and student construction of knowledge and theory (rather than uncritical consumption).

Lyu et al. (2013) presented and analyzed their experience in running the Mekong Learning Initiative research exchange program, which set out to create educational linkages and collaborative learning for water sustainable management between postgraduate students at Yunnan University in China, Ubon Ratchathani University in Thailand, and the Royal University of Phnom Penh in Cambodia. An important aspect of the program is that it grew out of collaborations between academic researchers at the three universities and the University of Sydney. This collaboration had aspirations on their part to try something new in terms of cross-boundary student exchange for research and learning in the region for water sustainable management that has increasing interconnections in wider dimensions (such as trade, economic infrastructure, population movements, and politics). Lyu et al. (2013) characterize the program as cross-cultural, peer-based learning, and experiential learning. They describe in detail how they managed and facilitated the process and the main learning outcomes for water sustainable management. They draw out many useful lessons for trans-boundary and cross-cultural water pedagogy.

Camkin and Neto (2013) from academics involved in the IGERT program, funded by the US National Science Foundation (NSF). The IGERT program has aimed to encourage and fund interdepartmental and inter-institutional initiatives that develop interdisciplinary and integrative experiences and skills in postgraduate research students in the field of water sustainable management. Their paper describes how the IGERT Watershed science program at Southern Illinois University has set out to facilitate the interdisciplinary processes and integrative skills being sought by the NSF. Their approach has been based on student training in multidisciplinary watershed sciences cannot be actually multidisciplinary study without meaningful collaborations between students and advisors from different disciplines. Interestingly, they concluded in a discussion the challenges they were facing regarding resourcing issues and institutional resistance when running the program.

Liu and Yang (2012) presented a range of effective education strategies, developed in the water sciences and water management program. They were taking students into the field which was important and assigning them to work in small teams on applied research questions, required research design, application of sensor technology, and the analysis and interpretation of sensor data.

Camkin and Neto (2013) made a thoughtful conclusion to special issues facing water resources development and management. They described that multidisciplinary, interdisciplinary, and trans-disciplinary has different meanings.

Therefore, previous research did not consider professional experiences of participants and was not challenging them to consider how water decisions and actions could be improved by Integrated Water Resource Management concepts. Moreover, previous research did not analyze, discuss, and learn through practical water problems in real world contexts. So, in the next section, the novelty of this research is explained and compared with previous works.

Findings of This Study

Many previous studies on education programs failed to achieve proper role of higher education (in real world at training level) for water sustainable management (Leal Filho et al. 2017; Loucks and Van Beek 2017). One major reason is that educational programs typically do not draw on behavioral studies in the environment and sustainability sciences (Frisk and Larson 2011). Similarly, psychologists and other behavioral scholars usually do not turn their research into practical results/outcomes that can inform policy-makers and practitioners. Generally, previous research studies did not consider professional experiences of participants nor challenged them to consider how water decisions and actions can be improved through Integrated Water Resource Management. Furthermore, we cannot observe concepts and studies that analyzed, discussed, and learned through practical water problems in real world context. So, this entry addresses the difficulties of integrating and collaborating across disciplines and sectors by presenting a framework for sustainability education. For achieving effective approaches, this research first discusses three important criteria for educating for sustainable behavior change for water management: (1) informational content, (2) delivery methods, and (3) targeted audiences. Also the important factors for water sustainability management challenges which relate to education are explained.

Methodology

The entry builds on the emerging literatures on transition management and identifies three critical issues to be considered in education for sustainable behavioral changes for water management to be applied in any region or location. To indicate the value of these critical issues, exemplary challenges and opportunities of educating for sustainable behaviors in different contexts are provided.

Critical issues to be considered in educating for sustainable behavior change include:

Insights from behavioral and sustainability sciences based on prominent scholars and established literature. This study justifies three important criteria as below to be considered for education programs aimed at sustainable behavior change.

1. Information content: Incorporating diverse domains of knowledge. Several scholars have demonstrated a weak or modest influence of technical knowledge on behaviors (e.g., Berry et al. 2018; Tarannum et al. 2018). Also the knowledge can effect on water sustainable management. In a report published by the National Academy Press, Varua et al. (2017) declared that, in general: “Increasing knowledge does not translate into a change in behavior” (p. 79). Yet some significant effects have been found between knowledge and action, particularly for knowledge domains that go beyond traditional notions of “knowledge” – that is, technical “declarative” understanding of how the world works (also called systems knowledge; Sharp et al. 2017). For example, procedural knowledge about how ecology can change in a given region can be important for water management behaviors (Varua et al. 2017). Sharp et al. (2017) also found that procedural knowledge about the aspects of water sustainable management (also called “action-related” or “how to” knowledge) as well as effectiveness knowledge (about impacts or outcomes of actions) promote water management behaviors, whereas declarative, water sustainable management knowledge only had indirect effects on actions. Roczen et al. (2014) demonstrated that “action-related” (procedural) knowledge was effective in promoting conservation behaviors, along with attitudes about nature. So, this knowledge can also be important for water sustainable management. Using Kaiser and Fuhrer’s (2003) typology of four knowledge domains, a recent study by Redman (Redman 2013) further showed that procedural knowledge as well as effectiveness and social knowledge influenced water management behaviors, whereas declarative knowledge had no effect on water management behaviors analyzed. In this approach, effectiveness knowledge for water sustainable management encompasses understanding about the impacts of particular actions and social knowledge refers to customs, norms, and traditions. Also this knowledge should apply in applied education. As Sharp et al. (2017) explain, these three alternative forms of knowledge are more in line with behavioral theories about how managers and people to act for water sustainable management. For example, procedural knowledge also addresses important constraints on behaviors for water sustainable management, but people cannot engage in a particular action if they do not know how to do so.
2. Delivery methods: Using interactive approaches, educational scholars stress that one-way lectures and communications are insufficient for increasing knowledge in support of sustainable actions of water management (Frisk and Larson 2011). These didactic methods have even been found to reduce cognitive and behavioral outcomes compared to real-world, experiential approaches for water management (Redman 2013; Frisk and Larson 2011).

Simply put, one-way modes of communicating are generally less effective than two-way or more interactive pathways for translating knowledge into action for sustainable water management. Central reasons for more interactive exchanges of information are building trust and gaining legitimacy in the “knowledge” delivered through proper programs. With its significant complexities, uncertainties, and diverse stakeholders, sustainability education for sustainable water management requires new educational methods. This requires researchers and educators to step down from the podium and into more interactive projects that are problem-based, systems-oriented, and experiential, in addition to being reflexive, collaborative, and integrative of different actors, system components, and disciplines for water sustainable management. The problem-oriented and normative elements of sustainability also require attention to values and subjective beliefs, which could be brought into educational programs as effectiveness and social knowledge about water resource use or other activities.

3. Targeted audiences: Reaching people, matter most when aiming to change behaviors, it is common sense to target the individuals who are most relevant and significant for the specific actions and impacts of concern for water sustainable management (Hering et al. 2018; Al Masud et al. 2018). For water sustainability matters, critical audiences are those people or groups who have a large effect on desired outcomes compared to others (Sivapalan et al. 2014). Generally speaking, early adopters or opinion leaders (e.g., leaders of neighborhood groups) can also be engaged in programs for water sustainable management to help diffuse knowledge and information through existing social networks (Hering et al. 2018; Kisumbi and Omboto 2018).

   Therefore, in the aim of water educational efforts, all the above important aspects should be considered (Frisk and Larson 2011; Sharp et al. 2017).

Based on literature-based criteria and the application of those to water education programs, we have several suggestions on how to foster water sustainable behavior change. First, programs that incorporate diverse forms of knowledge are most likely to succeed. This entails not only objective forms of declarative knowledge for water sustainable management, but also it is important to know "how are" effective information and subjective understanding (e.g., beliefs) about social norms and the desirability of actions and outcomes which are related to water sustainable management (Frisk and Larson 2011). By addressing subjective knowledge, we do not mean that certain beliefs should be forced upon participants for water sustainable management; rather, exploring peoples' beliefs and expectations can lead to social learning and realizations about how individuals themselves can act in ways that result in favorable outcomes for better water sustainable management.

Procedural, social, and effectiveness knowledge in water sustainable management (which explained before) can also lead to empowerment and a sense of control or efficacy, both of which are key factors in individual's decisions to undertake particular actions in water sustainable management (Sivapalan et al. 2014). For water sustainable management education to support water supply conservation, the conveyance of information should go beyond providing facts about water sources, the hydrologic cycle, and other technical matters. Social knowledge can be incorporated for water sustainable management, for example, as descriptive information about who uses the most water and for what purposes (Redman 2013).

Procedural information can also be combined with effectiveness knowledge for water sustainable management – perhaps through bill inserts and workshops targeted to high water-use neighborhoods – in order to know how best to conserve water. In other cases, the use of water bills has proved effective for proper water sustainable management particularly when descriptive information about consumption rates is combined with injunctive messages that present high usage as bad (e.g., with a frowning face or thumbs down) and low as good (e.g., with smiley face or thumps up) to invoke social norms (Missingham and McIntosh 2013; Greenland et al. 2018). Of course, procedural information about how to actually save water is essential as well for water sustainable management. Alternative pedagogical tools could also enhance the effectiveness of educating for sustainability. Novel methods entail interactive, real-world, and experiential activities to ground knowledge and education in actual situations and practices (Frisk and Larson 2011). In the case of water education, such activities could be incorporated into informational booths, community events, or classrooms. At booths oriented toward adults, for instance, people could engage in a trivia game that gauges their social and effectiveness knowledge regarding the biggest uses of water and how to save the most water through various practices, which are important for better water sustainable management. Students could use field trips, school gardens, as outlets for learning for sustainable water management, particularly since nature play and outdoor experiences are strong predictors of participation in environmental behaviors (Berry et al. 2018). Finally, successful approaches to sustainable behavior change for water sustainable management involve targeting appropriate audiences. Consequently, programs with goals such as conserving water outdoors should focus on the biggest users or uses (Marchese et al. 2018).

Challenges and Limitations

Following discussion in previous section, obstacles to educate for behavior alteration for better water sustainable management are important and must overcome. One challenge is how to overcome the traditional attitude and standards embedded in education institutions. Despite codified standards, any programs linked to education must address education necessities, such as teaching content areas or "strands" per disciplinary subjects. Professional and organizational cultures display extra institutionalized challenges for water sustainable management, especially given the established customs of emphasizing declarative expertise and one-way modes of teaching and communicating. Cultural or political biases which can effect on water sustainable management will likely ascend from involving with more subjective beliefs and norms pertaining to effectiveness and social knowledge, specifically, yet such topics are related to social studies, history, and other subjects that address cultural traditions.

Another key challenge to new or alternative programs for education is their resource-intensive nature. Dissimilar places or programs may not have the information necessary to improve such an approach and thus, may need to conduct studies and gather data to develop a targeted program for water sustainable management. In such cases, we recommend Community Based Social Marketing (CBSM; http://www.cbsm.com/) for better water sustainable management. CBSM is both grounded in behavioral research and tailored to real world settings. This situational approach involves identifying motivations and barriers (which can effect on water sustainable management) and understands significance behaviors which effect on program objectives for a given area (e.g., reducing outdoor water use). Then, a strategy should design and evaluate to remove barriers and/or enhance motivations through a variety of tools, tailored to a specific situation (Gricelda et al. 2018; Frisk and Larson 2011). Lastly, knowledge and behavior can be complex and highly contextual for water sustainable management. So this is important to understand what motivates or constrains actions and how to most effectively change individual behaviors for collective goals affecting water sustainability management (Redman 2013; Kisumbi and Omboto 2018). Therefore, this entry has provided some guidance for fostering sustainable behavior change through educational approaches for water sustainable management, and the criteria and recommendations should be tested and explored in other contexts (Jenkins 2018).

Conclusion

This research indicated a number of ways to develop education for sustainable behavior alteration. Even though education alone cannot resolve sustainability problems, this research have offered suggestions to improve their transformative capacity by focusing on three criteria: information content, communication methods, and target audience. Drawing from behavioral research, in addition to real-world experiences, this research especially recommend that educational programs aimed at sustainability: (1) incorporate diverse types of knowledge that are (2) delivered in interactive and experiential ways, to (3) specific actors that hold the greatest potential for behavior change, conservation, and sustainability. Also learning is not a one-way process and seriously connect to other important networks to transform university learning into a force for positive and effective changes across the water sectors.

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Systemic Inquiry

► Reflective Practice for Sustainable Development
► Service-Learning and Sustainability Education
► Work-Integrated Learning for Sustainability Education

Systems Thinking and Sustainable Development

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Definition

Sustainability can be defined as the long-term maintenance of the earth's resources and environment for the future benefit of all forms of life.

Introduction

The issues of sustainability and sustainable development have become increasingly part of everyday life, to the point where international policies and agreements have cascaded into practices that somehow address the cradle-to-grave life of the artifacts we use. Sustainable development has been defined in *Our Common Future* (WCED 1987) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Following the "Earth Summit" in Rio de Janeiro (1992), there has been a succession of UN conferences about sustainable development. However, it was with the Bali Road Map (COP13 2007) that the notion of a holistic approach to sustainable development was presented then reinforced at Rio+20 (UN 2012). Sustainable development is thus acknowledged to be inherently complex (Garcia et al. 2006; Lozano et al. 2013; Lozano et al. 2015). Such situations have been described as "fuzzy" (Zadeh 1965; Bellman and Zadeh 1970), "wicked" (Churchman 1967; Rittel and Webber 1973), and "messy" (Ackoff 1974; Eden et al. 1983) problems.

Within higher education there is also much discussion about sustainability, with effort to engage in sustainability-related practices. Moreover, it also calls for holistic approaches. This is exemplified in the 2009 G8 University Summit Torino Declaration on Education and Research for Sustainable and Responsible Development (Turin Declaration). It calls for "an integrated holistic approach to decision making and problem-solving. Disciplinary thinking has to be supplemented by systems thinking" (G8 2009). The concept of a holistic approach to sustainable development invokes the need for any approach to be underpinned by systems thinking or holistic thinking, which is arguably the same (Wiek et al. 2011).

Systems thinking has been defined by Espejo (1994: 210) as "learning how to manage situational complexity." It involves the conceptualizations of situations as systems (i.e., "mental constructs"). Mingers and White (2010) succinctly capture what this implies:

- Viewing the situation holistically, as opposed to reductionistically, as a set of diverse interacting elements within an environment.
- Recognising that the relationships or interactions between elements are more important than the elements themselves in determining the behaviour of the system.
- Recognising a hierarchy of levels of systems and the consequent ideas of properties emerging at different levels, and mutual causality both within and between levels.
- Accepting, especially in social systems, that people will act in accordance with differing purposes or rationalities. (ibid: 1148)

However, Ackoff (2006) draws attention to lack of uptake of systems thinking explaining that this is due to the vagueness and ambiguity of the language used as well as disengagement with potential beneficiaries of systems thinking.

This is reflected in the paucity of literature about sustainable development from a systems thinking perspective, especially with regard to higher education. A recent systematic literature review by Williams et al. (2017) of publication relating to systems thinking and sustainability management between 1990 and 2015 revealed only 96 papers, of which only 10 are related to education in general. Further, these related primarily to how sustainable development was incorporated into teaching.

Within Higher Education?

There are primarily two aspects of sustainable development within higher education which might benefit from systems thinking. The first relates to how universities incorporate sustainable development within their operations. The second relates to the embedding of sustainable development into the curricula.

Sustainable Development Within Operations

The notion that sustainable development should adopt a systemic transdisciplinary approach is one that was given explicit university presidential support at the UN Turin Declaration in May 2009. This called for the:

> Restructuring of education and research to incorporate and integrate cutting-edge knowledge, in order to move towards integrated holistic approaches, problem solving, and systems thinking. (Lozano et al. 2013: 7)

It is grounded in the view that reductionist approaches are inadequate for dealing with the complexity of the multidisciplinary nature of sustainable development (Garcia et al. 2006; Lozano et al. 2013; Lozano et al. 2015). Tarrant and Thiele (2016) explain that systems thinking is relevant to sustainable development since it is relational and co-ordinatory, this allowing complex situations to be understood as adaptive processes.

A systemic view of what a sustainable university might look like was developed by Velazquez et al. (2006), grounded in general systems theory. This draws attention to the importance of governance structures, embracing vision, mission, and a university-wide committee that sets policies and targets as well as coordinates initiatives and secures funding. It also identifies four strategies addressing education, research, outreach, and the campus operations, respectively. Posner and Stuart (2013) illustrate how systems thinking can create a deep understanding of the complexity of universities. This allows attention to shift from "piecemeal approaches" addressing individual issues to more effective coordinated action focusing upon identified "leverage points" that have most impact. While this is illustrated using examples from a university campus, it is unclear what the mechanism is enabling leverage points to be identified.

Indeed, there is limited evidence of the use of systems thinking applied to the development of sustainable university operations. One unique case that illustrates the use of systems thinking to "green" a campus is presented by Koester et al. (2006). This reveals an evolving learning process manifesting in a variety of university initiatives, underpinned by a "whole-systems approach." The first initiative was Green-1, which is related to the university's educational mandate. Then, in 1999, the university's president signed the Talloires Declaration, underpinning the university's commitment to environmental stewardship. This resulted in a renewed second initiative – Green-2. Other initiatives have included conferences, workshops, and outreach programs. Moreover, this commitment to environmental stewardship has transferred into campus planning and faculty practices. Underpinning the success of this are leadership and participation.

The importance of signing a declaration like the Talloires Declaration was examined by Lozano et al. (2015). They found that those institutions that sign a declarations, charters, and initiatives tend to be highly committed to the implementation of sustainable development.

An alternative approach that might be expected to incorporate systems thinking is to embed an Environmental Management System (ISO 14001) in the university (e.g., Van Weenen 2000; Ferreira et al. 2006). However, this does not imply that that systems thinking underpins an implementation. For example, Zenchanka and Malchenka (2017) offer a "holistic" approach to sustainable development to a university campus. Their approach (3Gs) addresses the issues of good governance (G1), campus greening (G2), and social responsibility (G3), based upon the ISO standards, ISO 9001, ISO 14001/ISO 5001, and ISO 26000, respectively. However, it is unclear what are the underlying systems' concepts as suggested by Mingers and White (2010) of this holistic approach.

From an operations perspective, while holistic or systemic approaches to sustainable development can be declared, in practice where is the evidence? Indeed, Lozano et al. (2015) reveal in a study involving 70 worldwide institutions that while universities are engaging in sustainable development, activity is compartmentalized and lacks holistic integration.

Sustainable Development Within the Curricula

The growing significance of sustainable development has resulted in recognition of the need to incorporate sustainability into university curricula. Sustainable development can be incorporated in four ways:

- Some coverage within an existing course.
- A dedicated course.
- Is appropriately embedded as a concept within mainstream courses.
- Is offered as specialization within a programme.

(Lozano 2010)

However, barriers include at the staff level, perceived irrelevance and limited awareness/expertise, at the curriculum level, overcrowding, and at the institutional level, lack of drive/commitment (Dawe et al. 2005).

In an audit of the courses of one university in 2005–2006, Lozano (2010) revealed how integrative was the incorporation of sustainable development. Courses were evaluated on four dimensions: economic, environmental, social and that which "crosscuts" the former three. It was found that, while most courses were innovators with regard to one dimension, they were laggards in the other dimensions. In other words, they are "compartmentalized" and "overspecialized." It was concluded that:

> These results indicate that intertwining SD as a concept, in and among the different disciplines and schools, and tailored to their specific nature, could help universities move towards a more balanced, synergistic, trans-disciplinary, and holistic academic system, thus helping graduates to better contribute to making societies more sustainable. (ibid: 643)

Nevertheless, irrespective of how sustainability is incorporated, one of the core features for developing "sustainable development literacy" (Dale and Newman 2005) is systems thinking. Underpinning this is literacy to be able to deal with unpredictable and changing complex problematic situations. However, while Warburton (2003) acknowledges the call that systems thinking, along with interdisciplinarity, is essential in sustainable development education, it is unclear how this is to be achieved:

> How then do we provide students with the conceptual tools to move across disciplines to recognise patterns and causal relationships between economic, environmental and equity issues? (ibid: 45)

Warburton proposes approaches that support deep learning and the development of analytical skills and independent thinking. These include drawing upon personal experience, clarifying key concepts and frameworks, and engaging in participative and problem-based activity. Dieleman and Huisingh (2006) also propose systems thinking as a means to integrate different disciplines in sustainable development education but draw attention to the fundamental challenge of how to adopt systems thinking approaches, raising the need to develop a "systems thinking language." In response, they propose the use of systems games to create an experiential learning environment in which to understand the complexity of systems as well as explore possibilities. Dawe et al. (2005) also identifies "holistic thinking" as core to the teaching of sustainability but alongside experiential learning. For Svanström et al. (2008), the learning outcomes that one might expect from a sustainable development course include the ability to think systemically as well as the development of both interpersonal and intrapersonal skills and change agent skills.

A more comprehensive evaluation of the competencies required for literacy in sustainable development is that of Wiek et al. (2011). They identified systems thinking is one of five key competences in sustainability, together with the "anticipatory competence, normative competence, strategic competence, and interpersonal competence" (Wiek et al. 2011: 205). These competences are defined as:

- systems thinking: ability to analyse and make sense of complex systems
- anticipatory (futures) competence: ability to create/construct possible futures (scenarios) related to sustainability
- normative (values) competence: ability to establish appropriate 'values, principles, goals, and targets'
- strategic (action-orientated) competence: ability to design and implement interventions and governance strategies
- interpersonal (collaborative) competence: ability to mobilise others and facilitate participatory collaborative activity.

(Wiek et al. 2011, 2015)

This has been examined and developed by Remington-Doucette et al. (2013), Remington-Doucette and Musgrove (2015), and Caniglia et al. (2016).

One issue is the apparent conflation of holistic or systems thinking with "transdisciplinarity" and the differences in how systems thinking is conceptualized. This is evident in an editorial published in 2013, which states that:

> these articles provide an encouraging, holistic and trans-disciplinary perspective on higher education for sustainable development via articles that provide critical reflections on methodological perspectives where 'the sciences meet the arts'. (Lozano et al. 2013: 3)

While there is a clear transdisciplinary contribution, it is unclear what systems thinking underpins this holistic perspective. Moreover, the interpretation of what constitutes open and closed systems raises questions about how endemic is the variance in the understanding of systems concepts:

> Although... considered universities to be open systems they are neither open nor closed-systems. They are better described as semi-open (or semi-closed) systems. (Lozano et al. 2013: 4)

An alternative view would describe that systems are informationally open and operationally closed (Espejo 1992).

A rich insight into what is implied in terms of systems thinking is provided by Martin (2002), who reports on a 1-day foundational course on sustainable development that is grounded in systems thinking – practice. Underpinning this is the notion of the earth as a system, providing a top-down perspective. It utilizes the concepts of rich pictures (Checkland 1981) to facilitate debate and scenarios, based upon backcasting, and to explore future possibilities.

Habron et al. (2012) provides a rich insight to the pilot of an undergraduate specialized course in sustainability. This was delivered by both faculty (40%) and expert guest speakers (60%). Engagement was enhanced with online reflective posts and an online discussion. Expected competence development included self-awareness, civic engagement, and systems thinking. Systems thinking was in a 1-h lecture, introducing the language and key concepts. A magazine article was used to allow students to develop systems models, drawing upon such concept as boundaries, relationships, and feedback loops. Moreover, feedback about a mid-term exam questioned the validity of the exam:

> While the pedagogy focused on learner-centered, collaborative learning within a learning community with an emphasis on fostering dialogue and shared understanding, the exam relied on individual student performance in isolation from the learning community. (ibid, 2012: 386)

Instead, an interactive dialogical assessment was developed which evaluated individual participation in a group conversation, thereby allowing students to demonstrate their learning with the support of appropriate drawings. The different assessments allowed different competencies to be assessed (e.g., interaction, problem-solving, and systems thinking). The systems thinking aspect of the course was one of the areas that was perceived to need more development.

Despite the examples of Martin (2002) and Habron et al. (2012) into the use of systems thinking to frame a course on sustainable development, these are perhaps relatively unique examples of how systems thinking is embedded in the teaching of sustainable development.

Conclusion

Sustainable development requires systems thinking if it is to be effective. Within higher education, this is equally so in both the development and uptake of related practices in its institutions and also in the delivery of learning experiences to students. However, the response to the call for systems thinking and holistic approaches for sustainable development appears to be limited in terms of the use of systems concepts. Despite the claims of holistic approaches, few explicitly reveal what systems thinking techniques are used, which are exemplified by Peter Checkland's (1981) Soft Systems Methodology, Colin Eden's (1988) "Strategic Options Development and Analysis" (SODA), and Raul Espejo's (1992) VIPLAN Methodology. Moreover, rather than be systemic and interdisciplinary, approaches tend to be compartmentalized. Further, the desire for trans-/cross-disciplinarity can imply a systems perspective, though again it is questionable whether there is a systems perspective as it is unclear what systems thinking techniques are used. Moreover, there is the danger that where systems thinking is espoused, there is misunderstanding.

The demise of systems thinking as a subject in university curricula over the last few decades appears to have resulted in a demise in its general understanding. This is specifically relevant for sustainable development, since without a good understanding of systems thinking techniques, then any call for systemic thinking or holistic approaches to sustainable development will lead to less than effective interventions. This raises the question of how competence in systems thinking is developed and invites the setting out of what such a program should embrace. The danger is that incompetence in systems thinking may discredit sustainable development.

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