Introduction to the *Handbook on Teaching and Learning for Sustainable Development*

Walter Leal Filho and Amanda Lange Salvia

The present *Handbook on Teaching and Learning for Sustainable Development* offers a wide range of perspectives, and a comprehensive overview of innovative teaching methods and innovative approaches (e.g., technological, non-technological, social and governance) that show how sustainability teaching may be practised. It contributes to a further understanding of:

- the role of sustainable development in different teaching realities;
- the contribution of sustainable development to citizenship;
- future perspectives in the curriculum;
- the means to reorient education for a sustainable future;
- the various challenges in implementing the principles of sustainable development in practice.

In this context, the contributions of the authors play a key role and outline the many ramifications of a broader understanding of sustainability.

PART I TEACHING PRACTICES

In Chapter 1, María Olga Bernaldo and Gonzalo Fernández-Sánchez describe how the acquisition of skills related to the field of sustainability from universities may be considered one of the most significant challenges of higher education institutions (HEIs). They describe the work undertaken at the European University of Madrid (EU), a private Spanish university. Results obtained in the last three years from an international volunteer programme are evaluated from two perspectives: (1) service: analysing the perspectives of the local population concerning what objectively has been done in their community and how much it has subjectively impacted their lives; and (2) learning: studying the experience of students who have been working in this programme, assessing the acquisition of skills and values from their education in sustainable development.

In Chapter 2, Marli Dias de Souza Pinto and Genilson Geraldo discuss the inclusion of the discipline of ‘informational sustainability’ in graduate programmes, as a way of placing information science in the context of the dimensions of sustainable development. Informational sustainability is evidenced as an informational mechanism of access, dissemination and use of sustainable information, aiming at institutionalization, organization and awareness of the information society, with a goal to provide a present quality of life without compromising that of future generations. This methodology may allow students to obtain information about the context of sustainable development and

provide informational support for global objectives through participation in seminars, socialization of readings and discussion of the topic, and through the development of scientific studies.

In Chapter 3, Diane Boyd and Naomi McLeod demonstrate the transformative power of reflexive teaching approaches and creative hermeneutics with final year undergraduate students in a university in the United Kingdom. Initially, whilst they demonstrated knowledge of environmental aspects, there was a distinct lack of understanding of political and socio-cultural influences in the form of relational ethics (praxeology). Students were not making interconnections between the three pillars of sustainability (namely political-economical, environmental and socio-cultural) as an embodied, natural, instinctive phenomenon. Creating a relaxed collaborative, open environment was important for encouraging the students to engage reflexively.

In Chapter 4, Elisabete Linhares and Bento Cavadas discuss the fact that oceans are experiencing a reduction in biodiversity due to both overexploitation and various forms of pollution – that is, plastic waste – and that raising the awareness of higher education students about this environmental problem is important. They report on an educational resource entitled ‘Bad Plastics – Oceans Free of Plastic’. The resource was structured on the 7E teaching model and focused on UNESCO’s Sustainable Development Goal 14 – Life Below Water.

In Chapter 5, focusing on sustainable higher education institutions promoting a holistic approach, Usha Iyer-Raniga and Karishma Kashyap use secondary literature to focus on campus awareness about sustainability through all functions of a higher education institution. The chapter draws on relevant gaps in the literature and suggests a holistic approach be adopted by HEIs in terms of managing indoor and outdoor spaces on campus while also using such institutions to push the boundaries for green building and green campus performance practices. A leadership model is suggested that brings a commitment to education and demonstrating these on campus where possible, while also engaging internal and external stakeholders in the process.

In Chapter 6, Claudia Mac-lean, Isabella Villanueva and Jean Hugé investigate the scope of student-led actions at higher education institutions in Latin America. The University Students Sustainability Congress student initiative at the University of Chile is presented as an in-depth case study followed by an explorative review of four student-led sustainability initiatives at universities in Argentina, Bolivia, Mexico and Peru. The chapter concludes by indicating that higher education institutions show a medium to high level of student involvement in the process of transformation towards sustainability. Additionally, the dominant activities are outreach oriented and their scope can be at the university or at the city level.

In Chapter 7, aiming to identify the main variables associated with recycling behaviour and motivations for waste separation of students at Universidad de La Frontera in Chile, Rodrigo Vargas-Gaete, Paula Guarda-Saavedra and Javiera Eskuche collect and analyse descriptive, behaviour and motivational variables through an online survey. It was identified that students over 21 years of age, who have resided in rural environments and regularly practise physical activity, were the most likely to carry out waste separation for recycling. Environmental education was considered the highest motivation factor to separate waste to recycle, probably linked with increased information/education. The authors indicate how local empirical evidence could support recycling promotion plans.

In Chapter 8, Niina Väänänen and Sinikka Pöllänen present some examples of how to teach sustainability through craft in a Finnish context in light of recent theories of sustainable craft and the United Nations Sustainable Development Goals of Agenda 2030. Craft refers to a standard school subject in which learning by doing has been the distinctive feature of the implementation of the core curriculum since the school system was established in Finland. In crafts, sustainability begins from materials and environment but can ultimately turn into a holistic understanding of crafting as a lifestyle and a viable alternative for a sustainable future.

In Chapter 9, Carmel Roofe, Therese Ferguson, Carol Hordatt Gentles, Sharon Bramwell-Lalor, Loraine D. Cook, Aldrin E. Sweeney, Canute Thompson and Everton Cummings undertook a collaborative action research project to infuse education for sustainable development (ESD) into the courses of the University of the West Indies (Jamaica). Qualitative data in the form of self-reflections along with action plans for infusion were analysed. Self-critique and openness to new ideas, creation of opportunities for students' feedback, flexible application of the process and collaboration with colleagues were presented as four key strategies for infusing ESD. The findings offer a useful platform that other universities can learn from as they seek to infuse ESD into courses and programmes.

In Chapter 10, R. Bruce Hull, David P. Robertson and Michael Mortimer argue that leadership competencies should be included in the education of sustainability professionals, since advancing any of the Sustainable Development Goals requires mobilizing and influencing people. By focusing on leadership for wicked situations, the authors describe a programme that teaches these leadership skills to inspire sustainability professionals using a hybrid of in-person and online pedagogies that include self-guided reflection, problem-based learning, transdisciplinarity and peer-to-peer learning.

In Chapter 11, based on more than two decades of analysis of processes of urbanization and industrialization with deep socio-environmental reflections, Sonia Regina da Cal Seixas and João Luiz de Moraes Hoeffel address the implications of this with regard to violence and the mental health of the population of specific regions in the state of São Paulo, Brazil. This chapter presents how the Sustainable Development Goals of the 2030 Agenda are present in the analyses that aim to improve both socio-environmental and life quality of the population of these study areas, especially concerning mental health and violence reduction.

In Chapter 12, Luan Santos, Victória Fernandes da Silva, Isabella Arlochi de Oliveira and Bruno Neves Amado analyse the Federal University of Rio de Janeiro (UFRJ), Macaé campus, as a case study for developing sustainable extension projects in engineering courses, especially in the context of the Sustainable Development Goals and the 2030 Agenda. Such projects represent a great potential in environmental and sustainable issues and in the internalization of the SDGs at UFRJ. The results mapped some gaps and proposed some actions to better align the assessed projects with the SDGs, inspiring new attitudes both within the university environment and beyond that sphere.

In Chapter 13, Marina Alves Novaes e Cruz, Ana Claudia Campuzano Martinez, Cecilia Maria Marafelli, Katherine Cilae Benedict, Maria Inês Rocha de Sá, Leonardo Esteves de Freitas and Edmundo Gallo present a Brazilian project that is expected to be developed over the next four years in partnership with the Universidade Federal Fluminense, Fundação Oswaldo Cruz, local government and the Forum of Traditional

Communities. The project relates to the training of about 30 teachers from public schools located in *caíçara* communities, in the coastal region of Paraty, Brazil, aiming to strengthen the way of life of these groups and favour processes of adaptation to climatic change. The first part of the training encompasses teachers' awareness, socio-cultural diagnoses of schools and communities diagnosis and the theoretical basis of a differentiated educational proposal.

In Chapter 14, Diana Watts discusses the challenge of engaging environmental science graduate-level students to examine sustainable business as a more dynamic interplay involving business, government and civil society. The chapter describes integrative course projects that serve to challenge key assumptions and encourage reformulation of basic premises preparing environmental students to become co-collaborators in developing future sustainable solutions.

PART II INNOVATION AND NEW TECHNOLOGIES

In Chapter 15, based on the aspirations of the United Nations Decade of Education for Sustainable Development (DESD 2005–14) and on the need for an educational paradigm shift to integrate socio-cultural and economic dimensions with ethical and aesthetical values, Hock Lye Koh and Su Yean Teh provide critical reflections and useful suggestions on innovations in curriculum and pedagogy. These innovations are considered essential to education for sustainable development in achieving the UN Sustainable Development Goals. Sustainably solving global issues such as climate change, acute water shortages and rapid loss of biodiversity is supported by pedagogy through living examples and experiences at the local, regional and international levels.

In Chapter 16, Daniel Otto draws on the pedagogical approach of digital storytelling – a combination of the ancient tradition of storytelling and the use of digital media – to present the benefits of open educational resources (OER) in an international university teaching project about climate change. The chapter argues that digital storytelling is even more powerful as well as sustainable if implemented in conjunction with concepts related to OER and open pedagogy. A re-examination of the case study through the lens of OER-enabled pedagogy reveals that it secures the students' recognition as the creators of their stories and that their products are made publicly available, ensuring further use and carrying value to others.

In Chapter 17, Wendy Stubbs, Susie S.Y. Ho, Jessica K. Abbonizio, Stathi Paxinos and Joannette J. (Annette) Bos argue that traditional monodisciplinary educational approaches do not adequately prepare students to develop innovative solutions to address the Sustainable Development Goals, as sustainability demands knowledge, skills and perspectives from different disciplines, industries and cultures. To address this, a multidisciplinary team of educators from Monash University, Australia, co-designed an integrated sustainability course to prepare students to address the complex issues underlying the SDGs, drawing upon the Research Skills Development framework. The chapter describes the collaborative model used to design and develop the Master of Environment and Sustainability course and concludes with personal reflections from academics and students.

In Chapter 18, Elizabeth Sidiropoulos demonstrates a novel application of an augmented Learning Activities Survey instrument to assess sustainability education in

higher education. Using an online post-test survey administered to students undertaking introductory sustainability education units at two Australian universities, the chapter provides insights on key influences, experiences and types of learning outcomes. The main influences on transformative learning were indicated as personal support, educational resources/activities enabling independent research, engaging in reflection and trying new roles. The use of an augmented Learning Activities Survey instrument has been suggested as a useful first step to evaluate sustainability education in higher education.

In Chapter 19, based on the need to take time in building the concept of environment so that educators can access the concept of sustainability and of the Sustainable Development Goals, Rocío Jiménez-Fontana, Esther García-González and Antonio Navarrete present an educational process developed over 11 years as part of the Andalusian Interuniversity Master's Degree in Environmental Education. The chapter examines to what extent SDGs are present in the prospective environmental teachers' conceptions about the environment, and how this varies throughout the process. Even though the goals are present from the beginning, the results indicate increased richness and representativeness in approaching the SDGs towards the end of the process. Additionally, the results indicate that the greatest increase at the end corresponds to the SDGs comprising economic sustainable development in combination with social and natural aspects.

In Chapter 20, Osvaldo Luiz Gonçalves Quelhas, Sergio Luiz Braga França, Marcelo Jasmim Meiriño, Gilson Brito Alves Lima, Luís Perez Zotes and Nicholas Van-Erven Ludolf present a case study of the Post-graduation Program in Management Systems (PPSIG) at Fluminense Federal University, in Rio de Janeiro, Brazil. The PPSIG database was investigated through a data mining process to analyse its performance and results, including scientific production, technical reports, research projects, teaching activities, official documents, among others. The promotion of interdisciplinary courses, social actions, internationalization and interinstitutional integration are indicated as contributors to the promotion of education for sustainable development, qualifying the programme for the implementation of sustainability in the region.

In Chapter 21, Gert-Olof Boström, Katarina Winka and Katarzyna Wolanik Boström present two different cases from Umeå School of Business, Economics and Statistics, Sweden, to discuss the potential of extra-curricular activities (ECAs) in providing opportunities for a multidimensional learning experience in education for sustainable development. The cases suggest that ECAs can serve as a source of deeper interest by offering an up-to-date, nuanced knowledge of sustainability practices in research, work life and society at large, in addition to motivating students to think critically and creatively about the practices they are going to encounter in their future work life.

In Chapter 22, Sonia Massari, Francesca Allievi and Francesca Recanati investigate the principles needed to develop a new pedagogy for sustainability, accounting for the role of empathy. The teaching approach is developed through the use of the Food Sustainability Index (FSI) as an educational tool for teaching food sustainability in higher education settings, taking into consideration a systematic approach and the complexity of food sustainability issues. The chapter describes two experiments based on the use of the tool at the Bachelor and Master degree levels. Based on these experiments, an educational model to foster the empathic process for sustainability teaching in higher education is presented.

In Chapter 23, Madhavi Venkatesan highlights how the teaching of economics can enable the tangibility of the discipline, considering the importance of how teaching is

provided and how freedom is given to question and critically assess the social construction of the economic framework. The chapter establishes the opportunity for the economics discipline to foster sustainability and promote its adoption through addressing the role of conscious consumption and responsible participation in consumer, investor and government decision making. The role of culture in sustainability and the relationship between economic measurement and cultural convergence, resource utilization and climate change are also discussed.

In Chapter 24, Dzintra Iliško reinforces the role of universities in creating spaces to envision sustainable futures and the need to change students' lifestyles and habits to involve them in the process of imagining sustainable futures and allowing experiential and applied learning modes. Based on the importance of viewing sustainability as a multidimensional issue involving multiple actors and allowing the space for profound agreements and respectful disagreements among all of them, the author presents initiatives undertaken in the regional university by engaging students in the process of changing their perspectives and identifying core values in a sensemaking mode towards more sustainable futures.

In Chapter 25, Cahyono Agus, Nur Aini Iswati Hasanah, Aqmal Nur Jihad, Pita Asih Bakti Cahyanti, Muhammad Sulaiman and Suratman discuss the initiative and strategy taken by Universitas Gadjah Mada in planning and developing a sustainable campus. The Sustainable Blue Campus works as a programme to implement education for sustainable development and the Sustainable Development Goals and promote both academic and non-academic atmospheres to support the integrated education, research and community service processes. Principles of win-win solutions, co-creation, co-finance, flexibility and sustainability are integrated and a network collaboration between the university and the regional government, industry, community and professional associations is proposed.

In Chapter 26, Rudi W. Pretorius critically reflects on the value and challenges of interdisciplinary settings in higher education as intellectual spaces for sustainability learning. The chapter uses the undergraduate curricula of 19 geography departments at universities in South Africa (2016–17) and feedback from interviews and focus groups conducted at a selection of these departments. The chapter presents the trends towards interdisciplinarity in undergraduate geography curricula in South Africa and discusses the need for a balance in the undergraduate geography curricula regarding aspects such as the discipline's integrity, vocational requirements and twenty-first-century sustainability challenges.

In Chapter 27, Michael-Anne Noble, Hilary Leighton and Ann Dale address prevailing dualisms between humans and nature and subject and object through a curriculum designed to invite students to step into experiential outdoor spaces with time enough to develop an affective connection to the place and a greater conscious awareness of belonging. Through the development of critical knowledge and practices related to ecosystem structure and function, biodiversity and sustainability, examples from Royal Roads University faculty illuminate how natural and social sciences, when choreographed together for learning, are critical to establishing a primary motive of 'relatedness' as it pertains to an indissoluble unity between people and place. The chapter suggests that while moving from nature as a mere backdrop to co-implicating themselves in a continual process of being in place, students deepen their identification with place and might develop willingness to protect what has become part of their own sense of identity.

In Chapter 28, Monica Dantas, Sherif Goubran and Nadra Wagdy investigate the evolution of sustainability-related projects and initiatives at universities, moving beyond simple participation formats to include innovative collaborative and communal forms, claiming varied levels of contribution to community building and resilience, and narrowing the knowledge-to-action gap. The chapter uses Season Jars, a student-led project at Concordia University (Montreal, Quebec), to examine how innovative approaches to education combined with the innate interdisciplinary of food can provide innovative experiential learning platforms for sustainable development. The significance of the shifting roles of organizers and participants in building capacity for transformative action within participatory learning environments is discussed and a universal framework that can be replicated in other universities has been proposed.

In Chapter 29, María Fernanda Acosta Altamirano, Verónica Gabriela Tacuri Albarracín and Erika Gabriela Araujo Pérez explore and gather information regarding the agricultural and festival calendar of the rural parish San Andrés Taday located within the province of Cañar, Ecuador, and the methodology they used to get this information. Ancestral knowledge is transmitted over generations through the Agrofest calendar, which seeks to implement and harvest family orchards for self-consumption while balancing agricultural activities and caring for the environment. In research by the National University of Education to reconstruct and recognize the 'Agricultural and festive calendar', information on the oral ancestral knowledge of people has been compiled through participatory workshops with families that own the orchards. This experience reflects the importance of building an educational establishment focused on the dialogue between knowledge and the preservation of the environment.

In Chapter 30, María Alló, Carmen Gago-Cortés, Ángeles Longarela-Ares and Estefanía Mourelle present a pioneer project carried out by the Universidade da Coruña, Spain, to incorporate sustainable development in the criteria of future professionals. The sustainability and Big Data massive open online course (MOOC) emerged as a space to raise awareness and promote sustainability in the environmental, social and economic dimensions. The MOOC is presented as a project for exploring new educational tools, as well as serving as a means to publicize and increase the visibility of sustainable development.

In Chapter 31, after summarizing previous research on the social psychology of sustainability, Dennis Nigbur, Ana Fernández, Sharon Coen, Anke Franz and Ian Hocking report on a survey of 118 university staff measuring attitudes, social norms, perceived control, self-identity and intentions relating to office waste recycling, energy saving and transport choice. The chapter discusses how universities can cultivate sustainability through norms and self-identities.

In the final chapter, Chapter 32, Walter Leal Filho provides an overview of some of the challenges seen in sustainable development teaching and outlines ways to maximize its impacts, including students' engagement, variety of methods and balanced global-local focus. After several cases exploring strategies and tools to successfully contribute to sustainability teaching, this chapter calls attention to the need to unlock the transformative power of the teaching process and therefore better engage learners and promote a positive effect on their own lives, both personal and professional.

In summary, the contributions provided in this *Handbook* offer an overview of the many ways in which sustainability can be integrated into both institutional practice and in

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all areas of the curriculum, in particular into cross-curriculum themes such as citizenship, health and consumer education. The experience and knowledge shared by the authors means that some advice may be provided to those interesting in developing or deploying new teaching and learning strategies, which may foster the cause of embedding sustainable development as a core part of teaching and learning processes.