Handbook of Research on

Pedagogical Innovations for Sustainable Development

Ken D. Thomas and Helen E. Muga

IGI GLOBAL
DISSEMINATOR OF KNOWLEDGE

Handbook of Research on Pedagogical Innovations for Sustainable Development

Ken D. Thomas
Auburn University, USA

Helen E. Muga
University of Mount Union, USA

常州大学山书馆
藏书章

A volume in the Practice, Progress, and Proficiency in Sustainability (PPPS) Book Series

Information Science REFERENCE
An Imprint of IGI Global

Managing Director: Lindsay Johnston
Production Editor: Jennifer Yoder
Development Editor: Austin DeMarco
Acquisitions Editor: Kayla Wolfe
Typesetter: Michael Brehm
Cover Design: Jason Mull

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Copyright © 2014 by IGI Global. All rights reserved. No part of this publication may be reproduced, stored or distributed in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher. Product or company names used in this set are for identification purposes only. Inclusion of the names of the products or companies does not indicate a claim of ownership by IGI Global of the trademark or registered trademark.

Library of Congress Cataloging-in-Publication Data

Handbook of research on pedagogical innovations for sustainable development / Ken D. Thomas and Helen E. Muga, editors.

pagea cm

Includes bibliographical references and index.

Summary: "This book brings together case study examples in the fields of sustainability, sustainable development, and education for sustainable development"-- Provided by publisher.

ISBN 978-1-4666-5856-1 (hardcover) -- ISBN 978-1-4666-5857-8 (ebook) -- ISBN 978-1-4666-5859-2 (print & perpetual access) 1. Sustainable development--Study and teaching. I. Thomas, Ken D., 1982- II. Muga, Helen E., 1977-

HC79.E5C3743 2014

338.9'27071--dc23

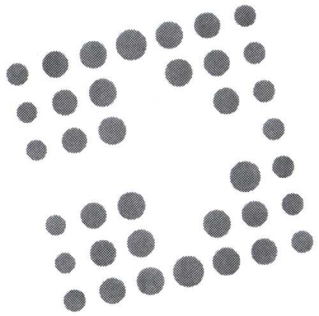
2014000907

This book is published in the IGI Global book series Practice, Progress, and Proficiency in Sustainability (PPPS) (ISSN: 2330-3271; eISSN: 2330-328X)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

For electronic access to this publication, please contact: eresources@igi-global.com.



Practice, Progress, and Proficiency in Sustainability (PPPS) Book Series

Ayman Batisha
International Sustainability Institute, Cairo

ISSN: 2330-3271
EISSN: 2330-328X

Mission

In a world where traditional business practices are reconsidered and economic activity is performed in a global context, new areas of economic developments are recognized as the key enablers of wealth and income production. This knowledge of information technologies provides infrastructures, systems, and services towards sustainable development.

The **Practices, Progress, and Proficiency in Sustainability (PPPS) Book Series** focuses on the local and global challenges, business opportunities, and societal needs surrounding international collaboration and sustainable development of technology. This series brings together academics, researchers, entrepreneurs, policy makers and government officers aiming to contribute to the progress and proficiency in sustainability.

Coverage

- Eco-Innovation
- Environmental Informatics
- Global Business
- Global Content and Knowledge Repositories
- Green Technology
- ICT and Knowledge for Development
- Knowledge Clusters
- Strategic Management of IT
- Sustainable Development
- Technological Learning

IGI Global is currently accepting manuscripts for publication within this series. To submit a proposal for a volume in this series, please contact our Acquisition Editors at Acquisitions@igi-global.com or visit: http://www.igi-global.com/publish/.

The Practice, Progress, and Proficiency in Sustainability (PPPS) Book Series (ISSN 2330-3271) is published by IGI Global, 701 E. Chocolate Avenue, Hershey, PA 17033-1240, USA, www.igi-global.com. This series is composed of titles available for purchase individually; each title is edited to be contextually exclusive from any other title within the series. For pricing and ordering information please visit http://www.igi-global.com/book-series/practice-progress-proficiency-sustainability/73810. Postmaster: Send all address changes to above address.
Copyright © 2014 IGI Global. All rights, including translation in other languages reserved by the publisher. No part of this series may be reproduced or used in any form or by any means – graphics, electronic, or mechanical, including photocopying, recording, taping, or information and retrieval systems – without written permission from the publisher, except for non commercial, educational use, including classroom teaching purposes. The views expressed in this series are those of the authors, but not necessarily of IGI Global.

Titles in this Series

For a list of additional titles in this series, please visit: www.igi-global.com

Handbook of Research on Pedagogical Innovations for Sustainable Development
Ken D. Thomas (Auburn University, USA) and Helen E. Muga (University of Mount Union, USA)
Information Science Reference • copyright 2014 • 743pp • H/C (ISBN: 9781466658561) • US $345.00 (our price)

Sustainability Science for Social, Economic, and Environmental Development
Nilanjan Ghosh (Multi Commodity Exchange of India Limited, India) and Anandajit Goswami (The Energy and Resources Institute, India)
Information Science Reference • copyright 2014 • 324pp • H/C (ISBN: 9781466649958) • US $195.00 (our price)

E-Innovation for Sustainable Development of Rural Resources During Global Economic Crisis
Zacharoula Andreopoulou (Aristotle University of Thessaloniki, Greece) Vagis Samathrakis (Alexander Technological Educational Institute of Thessaloniki, Greece) Soulla Louca (University of Nicosia, Cyprus) and Maro Vlachopoulou (University of Macedonia, Greece)
Business Science Reference • copyright 2014 • 317pp • H/C (ISBN: 9781466645509) • US $185.00 (our price)

Sustainability Integration for Effective Project Management
Gilbert Silvius (HU University of Applied Sciences Utrecht, The Netherlands & Van Aetsveld, The Netherlands) and Jennifer Tharp (Mastodon Consulting, USA)
Business Science Reference • copyright 2013 • 482pp • H/C (ISBN: 9781466641778) • US $185.00 (our price)

IGI GLOBAL
DISSEMINATOR OF KNOWLEDGE
www.igi-global.com

701 E. Chocolate Ave., Hershey, PA 17033
Order online at www.igi-global.com or call 717-533-8845 x100
To place a standing order for titles released in this series, contact: cust@igi-global.com
Mon-Fri 8:00 am - 5:00 pm (est) or fax 24 hours a day 717-533-8661

此为试读,需要完整PDF请访问: www.ertongbook.com

To our parents and grandparents for their belief in us before we even knew our own potential.
Gone but never forgotten.
Love always.

–Helen E. Muga & Ken D. Thomas

Editorial Advisory Board

Chandra Y. Austin, *Auburn University, USA*
Amy T. Campion, *Capella University, USA*
Shigeko N. Fukai, *Chiba University & Okayama University, Japan*
Monica A. Gray, *Arcadia University, USA*
Cynthia Hall, *West Chester University, USA*
Joniqua A. Howard, *University of Puerto Rico – Mayaguez, Puerto Rico*
Nekesha B. Williams, *City University of New York, USA*

List of Reviewers

Naailah A. Ali, *University of the West Indies, Trinidad & Tobago*
Dunja Anđić, *University of Rijeka, Croatia*
Elizabeth B. Brite, *Auburn University, USA*
John Buchanan, *University of Technology – Sydney, Australia*
Ana M. Capelo, *University of Aveiro, Portugal*
Diana Chalil, *University of Sumatra Utara, Indonesia*
Tolecia Clark, *Atlanta Technical College, USA*
Allison Cotgrave, *Liverpool John Moores University, UK*
Margaret Crocco, *Michigan State University, USA*
Adam de Eyto, *University of Limerick, Ireland*
Nathan Hensley, *Auburn University, USA*
Renate Hübner, *Alpen-Adria University, Austria*
Tehmina Khan, *RMIT University, Australia*
Yuto Kitamura, *The University of Tokyo, Japan*
Noora Kokkarinen, *Liverpool John Moores University, UK*
Nelly Kostoulas-Makrakis, *University of Crete, Greece*
Fernando Lourenço, *Manchester Metropolitan University, UK*
Vassillos Makrakis, *University of Crete, Greece*
Alex Mayer, *Michigan Technological University, USA*
Robert Nagel, *James Madison University, USA*
Elisa K. Pokral, *Monroe County Waste Management District, USA*
Franz Rauch, *Alpen-Adria University, Austria*

Arezou Sadoughi, *University of Science and Technology, Iran*
Susan Salter, *University of Tasmania, Australia*
Sandra Schuck, *University of Technology – Sydney, Australia*
Rowena Scott, *Edith Cowan University, Australia*
Madoc Sheehan, *James Cook University, Australia*
Jay Shuttleworth, *Columbia University, USA*
Angus Stewart, *Edith Cowan University, Australia*
Axel Eric Timm, *Karlsruhe Institute of Technology, Germany*
Sanja Tatalović Vorkapić, *University of Rijeka, Croatia*

Foreword

Can education be virtue for sustainable development, a source of knowledge, moralization and vector for long-term societal transformations?

Sustainable development is about having a common sense: if we do not maintain our house, it will ultimately collapse. In actual fact, the metaphor of "the house is burning" is recurrent since the 1970s in environmental writings[1], campaigns and at various international conferences. The intent of this has been to dramatize the urgent need for sustainable thinking and practice, evidently with certain success. Governments around the world now acknowledge the precept of sustainable development, often by creating formal agencies and allocating of important amounts of human and financial resources towards environmental protection goals. On the other hand, many local societies have continued to demonstrate considerable sagacity in safeguarding a balanced eco-system for the use of present and future generations[2]. Over the recent decades, certain philosophers have gone as far as calling for creating a "natural contract" (Serres, 1992)[3] with all living things, including the cosmos.

While an extensive and positive notion of sustainable development espousing certain rationality, principles and even exigency is deeply satisfying, the past experience suggests that simple moral prescriptions are never sufficient to bring about significant societal changes. Here a distinction should be made between the concepts of morals and ethics, the latter being more imperative as it is embedded frequently in sanctioned, legal regulatory structures. Even so, this tells little about the power of the powerful. To privileged social groups, populations and spatial zones (rich and political elites worldwide, urban middle classes, industrialized countries), sustainable development is about preserving their quality of life, protecting convenient recreational zones or demonstrating of certain civility. A considerable degree of ambiguity is evident in their attitudes and actions, given that, while the general principle of sustainable development may be admitted (certain environmental values are even idealized), but, in reality, few are willing to give up the comforts and privileges that they enjoy by virtue of being a part of the existing patterns of unequal resource distributions at various levels. Their engagements are frequently purely discursive. Nevertheless, they are most inclined towards technocratic prescriptions, interpretations of universality and experiences of modernity that essentially reflects a certain historical trajectory, thereby serving the interests of a small part of the world populations or territories. This case exemplifies a situation something very similar to what Plato (1956) had described: privileged individuals would never hesitate to presenting themselves as being "just", while taking a great deal of advantages by forming the part of unjust power relations and inequalities.

Naturally, short-term profit makers do not lack - and this is so in poorer societies as well. The *mantras* of economic growth and greater utilization of market mechanisms, on the one hand, and vanishing of grand political projects and utopias, on the other, incite everyone to develop a mentality that can be

described as "grab all you can." This while the poorer groups are unable to see the fruits of modernization and squeezed between an extreme desire for increased consumption and few means to satisfy them, may have no other viable alternatives than to continuously utilize locally available common resources, at times beyond their regenerating capacities. Clearly, in the absence of broader social changes, a mere idealistic conception of sustainable development has little sense in these kinds of circumstances.

The vital question is therefore: who can change the course of the history, middle classes, poorer communities, governments, international organizations, technological innovations, market forces, and popular and forceful mobilizations by social organizations? In this context, specifically what should be the role of education, recognizing that education too is subject to considerable influence by the existing (and previous) social norms, values and dominant power structures? Education is, for good or bad, an intellectual construct. Educational reforms can easily fall into the trap of being too confident, similar to the experiences in many branches of natural and social sciences, in using certain notions, available statistics, references to socio-historical evolutions and anticipated outcomes. Time and again, they may also fall into the trap of near evangelic oversimplifications in carving solutions and future lines of action. Above all, education is subject to manipulations by the ruling elites.

Various chapters making this sizeable volume fully recognize many of these complexities. The strengths and shortcomings of the existing pedagogical theories and conceptual framework are examined in order to address the question of sustainable development, and the reader is provided with plentiful useful references for further reading. The main concern remains: how do we understand the issue of sustainability in education in its entirety in consideration of its contradictions and multifaceted nature?

But the strength of this book is distinctly on its capacity to assemble and analyze a wide variety of contemporary themes and issues dealing with pedagogical innovations for sustainable development. The topics covered include the development of sustainability in education programs in such varied areas as watershed literary, energy saving, construction projects, green chemistry and electronic textbooks. Considerable attention is paid to highlighting the importance of generating social awareness among diverse production and consumer groups in rural to urban areas, as well as from developed to developing countries. The prime focus of this collected work is undoubtedly the issue of appropriate curriculum development for the elementary to high schools going up to the university courses specialized in diverse disciplines such as engineering, business, and social studies. A fresh and rigorous investigation of localized contexts makes the book empirically highly valuable. Finally, the book opens up new research perspectives for continued theoritizations, analyses, public discussions and policy formulation in this very important area of social engineering, stressing in particular the need to fully comprehending the linkages between local and wider dynamics, including the role of rapidly evolving technologies and communication channels - induced in part by the current processes of globalization and prevailing structures of worldwide power relations.

A book of this nature is surely very timely for university students and teachers, public libraries, social and campaign organizations, government agencies as well as regional bodies and international organizations.

Kléber Ghimire
University of Stendhal, France

REFERENCES

Meadows, D. et al. (1972). *The Limits of Growth*. London: Earth Island.

Plato, . (1956). *The Republic (Book 2)*. New York: Oxford University Press.

Serres, M. (1992). *Le contrat naturel*. Paris: Flammarion.

ENDNOTES

1 One of the legendary initiatives: the report of the Club of Rome established in 1968 warned that, "If the present growth trends in world population, industrialization, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years," (Meadows et. al., 1972, p. 23).

2 The notion of "future generations" is surely not the first invention of the Brundtland report on sustainable development in the late 1980s.

3 Obviously, the term "natural contract" makes direct reference to that of Rousseau's "social contract", in that an individual renounces natural liberty (the freedom to do anything s/he desires) in exchange for broad civil rights and protection.

Kléber Ghimire *was a Research Program Director and Research Coordinator at the United Nations Research Institute for Social Development (UNRISD) from 1990 to 2007. He led the Institute's programme on Civil Society and Social Movements, particularly implying co-ordination of thematic and country studies under the following projects: Social and Policy Responses to North-South Inequality; The UN World Summits and Civil Society Engagement and Global Civil Society Movements; and Dynamics in International Campaigns and National Implementation. Throughout the 1990s, he coordinated research on the socio-political dimensions of the environment and sustainable development. Currently he is Professeur associé, and former head of the department of social sciences, faculty of languages, literatures and foreign civilizations, at the University of Stendhal, Grenoble, France.*

此为试读,需要完整PDF请访问: www.ertongbook.com

Preface

THE ROLE OF EDUCATION IN ADVANCING SUSTAINABLE DEVELOPMENT

Education is an important component for progress in the developed and developing world. The access to education, the quality of education, and education that strives to incorporate aspects of sustainability are key factors in addressing current global challenges such as poverty.

There are clear links between global challenges observed in the 21st century. An example of this is the link between water, energy, improved health, and sanitation. Energy and water are two of the most important resources for economic and social prosperity. They are inherently linked to one another in that water is used, for example, in hydroelectric power generation, fuel production, and thermoelectric conversion. Energy, on the other hand, is required for water withdrawal, conveyance, treatment, and distribution. Infrastructures of the built environment that support economic, environmental, and societal advancement also require tremendous amounts of resources including water, energy, and other scarce, non-renewable resources.

Sustainable development, or sustainability, has been defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Because of the interconnectedness of various global challenges facing society today, a population that is educated in systems thinking is able to make better decisions concerning issues that affect them and the world around them. Further, interdisciplinary and multidisciplinary approaches to problem solving are necessary, whether it be in the composition of a project team, the types of integrated assessment methods used, or collaborative research. As an example, the evaluation of the feasibility of algal biofuel as an energy source requires a collaborative, multi-disciplinary team from the fields of biology, engineering, and sociology.

To arrive at a multidisciplinary, collaborative, systems thinking method of problem solving, there needs to be to a paradigm shift in education towards sustainability. "Education for sustainability is the continual refinement of the knowledge and skills that lead to an informed citizenry that is committed to responsible individual and collaborative actions that will result in an ecologically sound, economically prosperous, and equitable society for present and future generations. The principles underlying education for sustainability include, but are not limited to, strong core academics, understanding the relationships between disciplines, systems thinking, lifelong learning, hands-on experiential learning, community-based learning, technology, partnerships, family involvement, and personal responsibility" (President's Council on Sustainable Development, 1996).

Objectives of the Book

The overall goal of this book is to provide case study examples for educators, administrators, researchers, and practitioners in the fields of sustainability, sustainable development, and education for sustainable development as a fitting culmination to the United Nations Decade of Education for Sustainable Development (DESD) (2005-2014). The editors of the book are of the view that having exemplary case studies that infuse sustainable development into formal and informal education will allow for the quicker proliferation of education for sustainable development at every level of education (pre K-12 through adult). This aligns with the mission of the DESD, as it directly benefits the following priority areas: promoting basic education, reorienting and revising education programs, developing public understanding and awareness, and providing practical training. These priority areas align with the following UNESCO c/5 major progammes, lines of action (MLA), and thematic areas:

Major Programme I – Education

- **MLA 2:** Building effective education systems from early childhood care and education to higher education and furthering lifelong learning (01033)
  - **Thematic area 1:** Early childcare and education (01034)
  - **Thematic area 3:** Secondary education (01037)
  - **Thematic area 4:** Higher education (010380
- **MLA 3:** Sector-wide frameworks: helping governments to plan and manage the education sector (01039 & 01040)
  - **Thematic area 1:** Education sector policy analysis, planning, and management (01043)
  - **Thematic area 2:** Integrating education for sustainable development in sector-wide frameworks (01045, 01046 & 01047)
- **MLA 4:** Leading the international education agenda, including education for sustainable development (ESD), and tracking trends (01049 &01050)
  - **Thematic area 2:** GMR and possibly other education reports (01052 & 01053)
  - **Thematic area 3:** DESD coordination (01054 & 01055)
  - **Thematic area 4:** Promotion and monitoring of normative and standard-setting instruments in education (01056)

The details were attained from the UNESCO 2010-2011 35 c/5: Approved Programme and Budget document (UNESCO, 2010).

Scholarly Value and Impact of Book

To achieve a paradigm shift in education for sustainability, there is a need for (i) a formal education reform, (ii) integration of sustainability in non-formal education setting and outreach, and (iii) strengthened education for sustainability (President's Council on Sustainable Development, 1996). The dissemination of successful education practices that incorporate sustainability across the globe would allow individuals, educational institutions (formal and non-formal), organizations, industry, and practitioners to assess, modify, and/or integrate these practices into their particular settings. The diffusion and adoption of best

educational practices for sustainability is critical to addressing global challenges that current and future society will face.

The materials covered in the book expand on the fields of the social sciences, engineering, sciences, education, and business. Some aspects that the chapters in this book attempt to expand on include:

- Infusion of sustainable development into both formal and informal education. Sustainable development in kindergarten, primary, secondary, postsecondary/vocational, college/university, graduate school, informal education.
- Challenges of integrating sustainable development—Details of what they were and how were they were chosen. Details of the assessment of challenges and how they were overcome or why challenges were not addressed.
- Successes of integrating sustainable development—Measures of success: What was carried out to have a declaration of success.
- Peda- or Andragogy—Analysis of both the teaching and learning techniques utilized to bring about sustainable development education. Details on why certain teaching and learning techniques were chosen would be expected.
- Interdisciplinary and multidisciplinary approaches to teaching sustainable development
- Institutional frameworks/organizational (re)structuring to promote sustainability/sustainable development education

Target Audience

This book is relevant to a diverse audience inclusive of educators/teachers/trainers at all levels of education, sustainable development practitioners, the public at large, and education policy makers, with the main target audience being educators/teachers/trainers at all levels of education inclusive of education administrators. The book is timely as professionals, researchers, educators, and leaders pursue innovative solutions to climate change, population growth, resource scarcity, water scarcity, food scarcity, poverty reduction, improved health, universal education, sustainable infrastructure, environmental health, and disaster planning and management. Addressing these challenges through education in sustainability is key. Since sustainability is a multidisciplinary subject, the information contained in this book is useful to practitioners, researchers, and educators in the various disciplines of the social sciences, sciences, and engineering. The book provides insights into the sustainability concepts, theories, mechanisms and strategies that the audience can incorporate into formal and informal teaching. The book serves as an excellent reference guide for persons working in the areas of curriculum studies as well as sustainability/sustainable development.

Book Structure and Chapters Synopsis

The book consists of thirty six (36) chapters among five (5) major sections pertaining to sustainability. These sections are:

Section 1: Pedagogical Theories and Conceptual Frameworks to Address the Issues of Sustainability Education

Section 2: Development and Transformation of Sustainable Development Programs: Elementary and Secondary Education
Section 3: Approaches in Higher Education to Teaching and Learning Sustainability and Sustainable Development Concepts
Section 4: Contemporary Approaches to Adult Education for Sustainable Development
Section 5: Education for Sustainable Development: Problems, Prospects and Promise

Section 1: Pedagogical Theories and Conceptual Frameworks to Address the Issues of Sustainability Education

In Chapter 1, *Muireann McMahon and Tracy Bhamra* present their study entitled: "Sharing the Load: Developing Capacity for Social Sustainability in Design through Collaboration". This study describes three projects involving collaborations between groups of undergraduate design students from different geographical locations. A brief description of the projects and logistics is followed by an analysis of the outcomes and experiences of participants. Transforming the rhetoric surrounding sustainability into action is where designers often struggle. The results attained here show that designers need to be introduced to a set of competencies that go beyond traditional design skills along with successful approaches for transformation.

Nathan Hensley of Auburn University explores the theoretical underpinnings and practical application of Watershed Education in Chapter 2. His study: "Incorporating Place-Based Education to Cultivate Watershed Literacy: A Case Study", describes an experiential approach to teaching about stormwater and sustainable stormwater management while working to advance the "watershed literacy" of college students. The case study culminates by explaining a model that educators in both formal and non-formal environments can use to help their students learn about watersheds and stormwater.

Photography has been used to encourage Australians to recognize and value natural landscapes. Photography contributed significantly to the impact of campaigns to save rivers and vast wilderness areas in the south-west of Tasmania. In Chapter 3: "Sustainability in Photography Can Change the World", *Rowena H. Scott* aims to elevate the reader's appreciation, not only of photography, but of artistic endeavor in the quest for sustainability and as an education tool. It describes a case study of an environmental sustainability photography competition in a university that stimulated curiosity, imagination and enthusiasm in the natural environment.

Education for sustainable development (ESD) is inextricably linked to processes of cooperation between countries in order to better perform a curricular innovation and development. These cooperation processes are even more acute in countries that recently came out of situations of serious conflicts. East Timor is an example of a post-conflict country where currently is there is secondary school reform in the framework of a cooperation protocol between Portuguese Institutions and East Timor's Government. In Chapter 4: "Integration of Education for Sustainable Development into Formal Secondary Curricula of East Timor", *Ana Capelo* highlights this cooperation in line with the production of new curricular materials for secondary school according to ESD purposes and Millennium Development Goals attainment.

Chapter 5 presents a case study entitled: "Interdisciplinary Approaches to Sustainable Development in Higher Education: Case Study from Croatia" by *Dunja Anđić and Sanja Tatalović Vorkapić*. This chapter presents and discusses the infusion of education for sustainable development into formal higher education trough interdisciplinary approaches and its relationship with positive psychology. Sustainable behavior is presented, described and measured, including its use as the predictor of converged forms of

knowledge/effects of subject Pedagogy of sustainable development. In other words, the specific case study from Croatia is described with the aim of testing the positive change in students' sustainable behavior that is expected to be found under the influence of relevant subject. Also, the relationship between students' optimism, life satisfaction and sustainable behavior has been analyzed and discussed. That includes the specific interdisciplinary approach in teaching and learning as the basis for further research and future development of similar courses.

In Chapter 6, *Fernando Lourenço, Natalie Sappleton, Weng Si Lei, and Ranis Cheng* present their case study entitled: "Sustainable Development in Business Education: The Role of Entrepreneurship as Pedagogy". This chapter provides a discussion of whether it is better to flow with the dominant economic-driven values as prescribed by conventional business education or to challenge it in order to nurture sustainability-driven values among students. These options are explored and the suggestion that entrepreneurship has a role to play as a pedagogical tool to support the teaching of sustainable development is offered.

Engineers are no longer constrained to disciplinary boundaries, and instead, must work across disciplines as members of global communities and multidisciplinary teams. *Robert L. Nagel, Kyle G. Gipson, and Adebayo Ogundipe* in their Chapter 7 case study entitled: "Integrating Sustainable Design and Systems Thinking throughout an Engineering Curriculum" attempt to address this. Since the inaugural class started in 2008, the faculty of the Madison Engineering Department have strived to integrate environmental, social, economic, and technical contexts of sustainable design and systems thinking as common curricular threads. This case discusses curricular threads to illustrate how content integration, developmental instruction, and a problem-based learning framework are used to train students to understand systems holistically, describe and analyze tradeoffs, understand resultant perturbations, and design effective, sustainable solutions.

In Chapter 8: "Learning about the Different Dimensions of Sustainability by Applying the Product Test Method in Science Classes", *Mareike Burmeister, Janine von Döhlen, and Ingo Eilks* report on an initiative that combines curriculum development in the fields of 'Sustainable Development' and 'Chemistry' with informal education and teacher professional development. This combination is operated by the development of innovative out-of-school laboratory activities dealing with selected sustainable development issues in conjunction with the high school chemistry curriculum. Teaching modules developed to be operated in formal secondary school chemistry and science teaching. Development of such modules is discussed and illustrated in this chapter.

In Chapter 9, *Sandra Murray and Susan Salter* explore a case study entitled: "Communities of Practice (CoP) as a Model for Integrating Sustainability into Higher Education". In this study, the authors discuss in depth the Education for Sustainability (EfS) Community of Practice (CoP) model. The EfS CoP is a University of Tasmania initiative. It was established to overcome challenges to the integration of sustainability across the university including curriculum, operations and research. These challenges included the importance of establishing greater collaboration across disciplinary boundaries, between academic and professional staff members, as well as engaging with students and the wider community. The journey of the EfS CoP has also suggested that teaching and learning for sustainability in higher education requires support from senior positional leaders and all partnerships involved in the process.

Section 2: Development and Transformation of Sustainable Development Programs: Elementary and Secondary Education

Project-based learning (PBL) formed the framework for teaching sustainability concepts to elementary students by an informal educator. In Chapter 10, "Using Project-Based Learning to Teach Sustainability Issues to Elementary Students", *Ingrid Weiland, Elisa Pokral, and Kristin Cook* highlight how assessment was done by the use of pre and posttests as well as focus group interviews to statistically measure the impact of the informal educator on the students' learning of sustainability issues/concepts. The actual PBL curriculum that was created is elaborated upon from conception through to post-implementation.

In Chapter 11, *Elizabeth Spence, Tarah Wright, and Heather Castleden* explored Nova Scotia's sixth grade curriculum outcomes for the subjects of science, social studies, and health education. They analyzed the curriculum for the integration of the fundamentals of environmental education (EE). The importance of environmentally focused education (EE, ESD, EfS) is explored, with a focus on how educating about the environment is approached in terms of knowledge, skill, and attitude centered curriculum outcomes. Current limitations to the breadth of environmentally focused education and potential solutions are revealed and discussed.

Chapter 12, entitled: "Learning about Sustainability in a Non-Formal Laboratory Context for Secondary Level Students: A Module on Climate Change, the Ozone Hole, and Summer Smog", by *Nicole Garner, Maria de Lourdes Lischke, Antje Siol, and Ingo Eilks*, illustrates the application of the Consumer Test Method to develop the Product Test Method. The Product Test Method is intimately linked to ecological, economic and societal sustainability. Thus the application of the modified method allows more focused learning about sustainability. The chapter presents a case of applying the method to a lesson plan on the evaluation of plastic types where the results show the lesson plan's potential to contribute to higher levels of student motivation and perception of issues of sustainable development.

Educating children about environmental sustainability can begin with their immediate vicinities. In Australia, the New South Wales Department of Education and Communities embarked on a structured, four-year, state-wide Program in which teams of students between the ages of eight and sixteen were financed to create projects that would conserve energy and thereby reduce electricity costs in their schools. These authentic, student-directed projects were linked to syllabus-based outcomes and content. Chapter 13, entitled: "A System-Wide School-Based Program for Sustainability: Climate Clever Energy Savers", by *John Buchanan, Peter Aubusson, and Sandy Schuck,* describes the Program in the context of the importance of sustainability development, and the centrality of education in achieving three of the projects evaluated.

Chapter 14, "Teaching Sustainability Competencies to High School Students using Small-Scale Community-Based Construction Project" by *Mehmet E. Ozbek and Caroline M. Clevenger,* provides case studies for teaching sustainability concepts to high school students, by implementing the service-learning model by way of small-scale, sustainable hands-on construction projects that can be built in a high school shop class. It presents two curriculum tools to assist high school shop teachers develop similar projects. These curriculum tools contain general instructions, as well as suggested "discussion points", to highlight the inherent complexity of sustainability and engage high school students in discussions surrounding sustainability. It is important to note that the focus of the case studies is on providing a general model for teaching concepts related to sustainability through construction activities rather than providing 100% error free instructions on how to build such projects.

此为试读,需要完整PDF请访问: www.ertongbook.com