



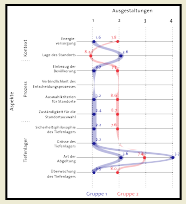
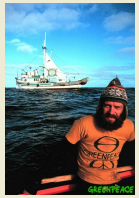

Core Competencies in Sustainability

Arnim Wiek

School of Sustainability, Arizona State University

ITdNet Meeting

Leuphana, March 2, 2012

Disaster Relief: A UN helicopter responding to a disaster.

Transformational Vision

"Imagine what might happen if students were regularly assigned actual sustainability problems that were brought to higher education by cities, businesses, nonprofit organizations, and other institutions. ..."

"Most of our higher education institutions include somewhere in their mission statements goals for preparing students to help create a better society, yet this ideal is often not fully implemented."

POLICY FORUM

SUSTAINABILITY

Education for a Sustainable Future

Sustainability is being integrated into higher-education institutions' mission and planning, curricula, research, student life, and operations.

Debra Rowe

Sustainability is a lens through which increasing numbers of individual colleges and universities, as well as national organizations, are collectively examining and acting upon our shared world's systems (1, 2). In the United States, a national trend has begun, but much more needs to be done.

College and University Actions

Sustainability is being integrated into U.S. institutions' mission and planning, curricula, research, student life, operations and purchasing, and community partnerships. Students and staff at hundreds of campuses are engaged in sustainability committees and actions, including the following: learning to focus on acquiring sustainability knowledge and application skills; sustainability-oriented film festivals, speakers, and other campus events; socially and environmentally responsible criteria for purchasing and endowments; infusion of sustainability into the general education core requirements, courses, disciplines, whole colleges, and specialized degrees; and regional and global approaches to sustainability in collaboration with businesses, government, nongovernmental organizations (NGOs), and kindergarten through high school (K–12) education.

Core requirements at many universities and colleges (e.g., Portland State University, Miami Dade Community College, University of Minnesota) include the components of sustainability education, even if the word sustainability is not specifically used. Degrees in sustainability have sprouted up at dozens of institutions [see (3) for a listing]. In the Campus Climate Challenge, students on over 400 campuses are working with administrators and staff to measure and reduce greenhouse gas emissions (4) and are voluntarily raising student fees and changing energy policies to move to renewable sources.

U.S. business, architecture, and engineering schools are in the forefront of sustainability education. Architecture and engineering schools have criteria for accreditation that require students to be able to understand and implement sustainable design. Nonprofit organizations such as Engineers for a Sustainable World and Engineers without Borders have developed. The World Resources Institute and the Aspen Institute have worked with business schools to develop case studies and business curricula that include sustainability principles and practices (5). Increasingly, interdisciplinary learning experiences focus on our sustainability challenges.

The purchasing power alone of colleges and universities, as they demand more environmentally and socially responsible products and processes, can help move sustainability from its present niche markets to become the standard in product and process design. This can be expressed through commitments to sustainable behaviors and policies in institutional mission and planning; more energy-efficient and greener buildings and operations; substantial purchases and installations of renewable energies and commitments to carbon emissions reductions and neutrality; sustainability audits and reporting; and sustainable living campaigns in the residential halls. For example, over 300 presidents have signed commitments and taken action to move toward carbon neutrality and to eliminate greenhouse gas emissions. Michigan State University, NYU (New York University), University of California at Berkeley, the Pennsylvania State University, and others have conducted sustainability audits and reports. Sustainability-oriented residential living practices are in place at Bowdoin, Carnegie Mellon, Dartmouth, Harvard, Tufts, University of Vermont, and Yale. Rutgers and the National Association for Educational Procurement have focused on developing resources for the purchasing side of sustainability (6, 7). Stanford University has developed both environmental and social screens for their endowments.

A statement drafted by the Business Sector Team of the U.S. Partnership calls upon higher education to make sustainability education a requirement for all undergraduates. Participating members came from both small and large corporations—from media conglomerates to energy companies such as Duke Energy and consumer products such as Burt's Bees. "All students need to learn, through an interdisciplinary approach, not only the specifics of our sustainability challenges and the possible solutions, but also the interpersonal skills, the systems thinking skills, and the change agent skills to effectively help to create a more sustainable future. We are looking for these sustainability educated students as future business people, as employees, as consumers, innovators, government leaders and investors" (8).

Activities of National Organizations

After the United Nations declared a Decade of Education for Sustainable Development (2005–14), a grassroots effort from higher education developed in the United States in the absence of a federal government response. The National Council for Science and the Environment hosted its annual conference in 2003 on Education for a Sustainable and Secure Future. Out of that meeting, the U.S. Partnership for Education for Sustainable Development (9) was created to catalyze a U.S. response for this decade and beyond. This national network of over 300 organizations has sector teams in Faith, Business, Communities,

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Rowe, 2007, *Science*, 292, 641-642

Why are we interested in core competencies?

Core Competencies define a reference framework

- for developing academic programs and courses
- for transparently evaluating learning progress and effectiveness of teaching approaches
- for shaping *visible* profiles of our students as future "problem-solvers," "change-agents," "transition managers," etc.

What is a core competence in sustainability?

Competence is a functionally linked complex of knowledge, skills, and attitudes that enable successful task performance and problem solving (cf. Spady, 1994; Baartman et al., 2007).

Competencies **in sustainability**, these are complexes of knowledge, skills, and attitudes that enable successful task performance and problem solving *with respect to real-world sustainability problems, challenges, and opportunities* (cf. Dale & Newman, 2005; Rowe, 2007; Barth et al., 2007).

Competencies and **core** competencies

Sources

1. ASU-SOS faculty meetings and workshops
2. Literature review
   - Journal articles, books
   - White papers, NGO websites
   - Websites, curricula, mission statements
3. International survey
4. International workshops (AASHE, AAAS)

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Developing key competencies for sustainable development in higher education

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Abstract

Purpose – To date, little attention has been given to the circumstances in which the process of developing key competencies for sustainable development may take place. The purpose of this paper is to consider, the possibilities both of formal and informal learning and their relationship to competence development within higher education.

Design/methodology/approach – An explorative, qualitative study based on focus groups was designed using different groups from formal and informal learning settings.

Findings – The development of key competencies is based both on cognitive and non-cognitive dispositions and asks for multiple contexts. 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.

Research limitations/implications – While aspects of both formal and informal learning settings could be identified, the interdependences between them remain elusive.

Practical implications – Based on the findings, some main aspects for acquiring competencies can be pointed out that may be crucial in higher education settings.

Originality/value – The paper analyses the implications for both formal and informal learning settings of new ways of developing key competencies within higher education. Particular attention is given to interdisciplinarity and students' self-responsibility.

Keywords Sustainable development, Higher education, Competences, Learning

Paper type Research paper

Introduction

Science and technology are the crucial structural driving forces in all societal spheres. Sustainable development is the ethically founded response to a worldwide process in which not only research is increasingly carried out on the basis of private and economic interests but where these interests are also shaping the profile of academically educated young people (Altner and Michelsen, 2006).

Against the background of globalisation and increasing complexity, higher education for sustainable development (ESD) aims at enabling people to not only acquire and generate knowledge, but also to reflect on further effects and the complexity of behaviour and decisions in a future-oriented and global perspective of responsibility. Higher ESD has to participate in the discussion about sustainable ways of living and working. Acquiring relevant competencies within and by academic work cannot be a private concern of faculty, staff or administration. Absolutely essential is a new learning culture which does not confirm academic tradition but examines its potential for a sustainable future, in an open-minded and participative process. It has to be related to one's own sphere of influence and desires. On the other hand, individual

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International Survey (cond. ASU, AAAS)

- What do you consider to be *core* competencies in sustainability (title, definition, justification)?
- Unifying framework for these competencies?
- To what degree does your program convey these competencies to students?
- What do you use core competencies for?

Sample

Number of Responses: 31

Universities

UC Davis | Harvard University | Northern Arizona University | University of Colorado at Boulder | University of Pittsburgh | Maastricht University, NL | Utrecht University, NL | Lund University, Sweden

Academic Programs

Sustainability Science | Sustainable Development | Environmental Management and Policy | Chemical Engineering | Agroecoystem Management

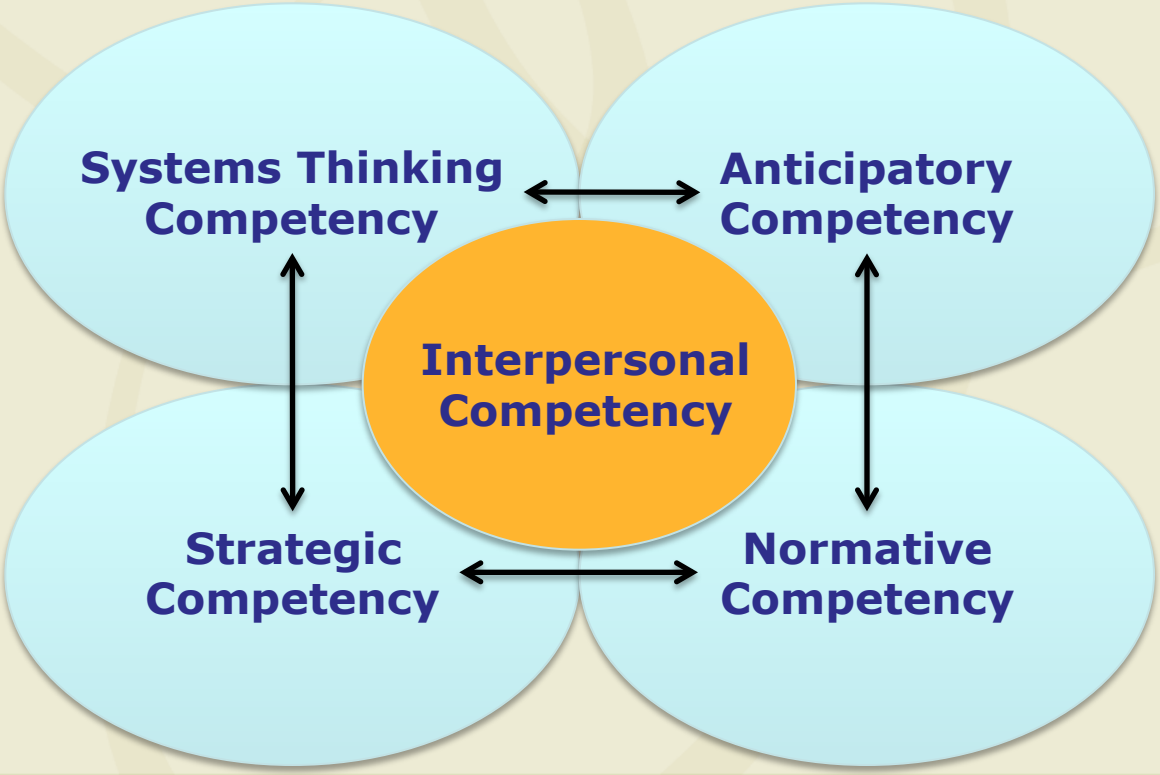
Proposed Unifying Frameworks

- Gestaltungskompetenz (de Haan 2006; Barth et al., 2007; van Dam-Mieras et al., 2008)
- Heads, Hands, and Heart (Sipos et al., 2008)
- Values, Knowing, Skills, Understanding (Parkin et al., 2004; Sterling & Thomas, 2006; Segalas et al., 2009)
- "SPADE - Stakeholders, Problem-Definition, Analysis, Decision-making, Evaluation" (PS12)
- "Analyze, explore and solve sustainability issues" (PS10)
- "Consciousness of the oneness of humankind" (PS4)

→ Sustainability research and problem solving competence

Conceptual Framework

Sustainability Research and Problem-Solving Competence



"Linking knowledge to action"

Survey – Distribution of Responses

	Systems Thinking	Anticipatory	Normative	Strategic	Interpersonal
1	PS2 Understanding and knowledge of natural processes and resources	PS11 Participatory elicitation competence; "desirable future states"	PS3 Concern for justice	PS18 Adaptation	PS1 Civic engagement
2	PS4 Integrated Assessment	PS16 Fairness and equity; "future generations"	PS16 Fairness and equity	PS19 Green materials design	PS6 Integrate across disciplinary lines
3	PS6 integrate across disciplinary lines	PS13 Ability to use triple bottom line concepts consider "future"	PS30 Diversity of knowing and learning; "problems based on worldviews"	PS22 Community development	PS16 Interdisciplinarity
4	PS11 Resilience competence	PS16 Decisionmaking under uncertainty	PS30 Awareness of values	PS13 Ability to use triple bottom line concepts effectively	PS30 Interdisciplinary collaborative inquiry
5	PS13 Life cycle competency	PS11 Resilience competence; "long range planning"	PS7 Measuring and modeling sustainability	PS19 Green infrastructure design	PS10 Communication about sustainability
6	PS14 Resilience competency		PS30 Analysis; "assessing sustainability"	PS13 Ability to apply the principles of green chemistry and green	PS21 Humility
7	PS16 Interdisciplinarity and interconnectivity			PS9 Practical skills	PS11 Participatory elicitation competence
8	PS1 Ecological resilience			PS30 Synthesize information on alternatives and draw implications	PS9 Communicative skills
9	PS11 Systems thinking competence				PS9 Social teamwork
10	PS25 Theory of complexity				PS9 Networking and convincing
11	PS25 System dynamics modeling				PS9 Interdisciplinary attitude
12	PS26 Systems thinking				
13	PS26 Temporal and spatial scaling				
14	PS28 Systemic thinking				
15	PS31 Land change, human dimensions				
16	PS7 Measuring and modeling sustainability				
17	PS17 Ecological footprint, biocapacity, resource accounting				
18	PS24 Competence in harnessing and integrating knowledge to address				
19	PS21 Inerpreting social systems as information processing systems				
20	PS16 Understanding of legal structures				

Literature Review – Systems Thinking Competence

Conceptual components

- Concepts of feedback loops, cascading effects, inertia
- Across scales (local to global)
- Across sectors (society, environment, economy)

Methodological components

- Qualitative and quantitative modeling, 'thick' description

Sustainability is

- Related to *complex* problems and *complex* solutions

Sources: Crofton, 2000; Sipos et al., 2007; Sterling & Thomas, 2006

Survey –
Systems Thinking Competence

Competence titles

- "Systems thinking" (PS11,PS26)
- "Theory of complexity" (PS25)

Components

- "To analyze and synthesize system complexity" (PS25)
- "Understanding the nature of interfaces, interactions and feedback cycles" (PS11)

Justification

"It is not possible to manage human systems interacting with physical and biological systems without understanding human interactions with each other and the environment." (PS21)

Anticipatory Competence

Conceptual components

- concepts of time and future
- concept of intergenerational justice
- prominent scenarios and foresights

Methodological components

- Scenario methodology, simulations, backcasting

Sustainability requires

- Long-term (future) orientated (sustaining)
- Intergenerational justice (future generations)

Sources: de Haan 2006; Grunwald 2004; Kelly 2006

Normative Competence

Conceptual components

- (Un-)sustainability of current or future states
- Sustainability principles, concepts of justice, goals, targets

Methodological components

- Assessment, appraisal, evaluation; Envisioning

Sustainability is

- a highly normative concept (justice, balance, integrity)

Sources: Grunwald 2004, 2007; Segalas 2008; Sterling and Thomas 2006

Strategic Competence

Conceptual components

- Concepts of transitions, governance, strategies
- Obstacles (path dependency, habits) and synergies

Methodological components

- Designing governance arrangements, policies, institutions
- Supporting behavioral change

Sustainability requires

- ‘linking knowledge to action’ (transformative change)

Sources: Bearth et al., 2007; Rowe, 2007; Greenheart (www)

Interpersonal Competence

The skills necessary to motivate and facilitate sustainability research and problem solving

Teamwork, Communication, Negotiation, Leadership, Empathy

Sustainability requires

- Collaboration across/beyond disciplines
- Involvement of stakeholders
- Commitment to justice and equity

Sources: Crofton 2000; Sipos et al. 2007; Svanstrom et al. 2008

STUDENT SUSTAINABILITY ATTRIBUTES

Holistic Systems Thinking	Sustainability Knowledge	Awareness & Integration	Acting for Positive Change
Sustainability depends on, and aspires to, a purposeful, equitable and harmonious integration of human and natural systems. Holistic, ecological or synergistic thinking provides means and methods to see, articulate and qualitatively and quantitatively measure how human and natural systems work and interact. Holistic systems thinking also requires a capacity for synthesis and for negotiating solutions to complex problems.	Sustainability depends on comprehensive knowledge within one's area of study. In addition, sustainability knowledge requires students to gain proficiency in the underlying ideas and principles of sustainability, and in the evaluation of different sustainability models and paradigms. Sustainability knowledge also requires students to understand contemporary sustainability issues, particularly those which relate to their own area of study.	Sustainability requires students to be aware of their own constructing patterns and processes: how their context informs their personal perspectives and their integration of new information. Sustainability also requires students to think and act in new ways to solve complex, integrative problems through collaboration between disciplines. Collaboration demands an awareness of, and respect for, different disciplinary values, perspectives and knowledge.	A sustainability graduate has a personal value system that inspires action and recognizes and embraces the individual's capacity to create change. A sustainability graduate is committed to acting on personal beliefs but is flexible and open to critical assessment and modification of those beliefs through self-evaluation. They also appreciate that collaborative and active engagement with communities leads to enriched creative problem solving, as well as and the ongoing development of change agent skills.
Example Learning Outcomes:	**Example Learning Outcomes:**	**Example Learning Outcomes:**	**Example Learning Outcomes:**
1. Demonstrate a capacity to appreciate that all actions have consequences within, between and among systems	1. Demonstrate an ability to critically evaluate competing sustainability models and paradigms	1. Appreciate that sustainability demands participation from all disciplines and contributions from society	1. Demonstrate skills and strategies to enter into dialog and create persuasive arguments relating to sustainability
2. Comprehend systemic limits and the ways humans can and do impact ecological systems	2. Understand the complexity of land use and the changing relationship between humans and nature over time	2. Empathize with intercultural perspectives and recognize their value to illuminate environmental and social issues	2. Advocate for positive change through collaboration, mediation and consensus building strategies
3. Demonstrate the ability to integrate knowledge of social and ecological systems to assess effects of human activities	3. Understand contemporary sustainability issues such as climate change, and resource depletion as well as proposed solutions	3. Demonstrate empathy for others and be able to weigh multiple perspectives	3. Apply skills and knowledge in service to one's community

Bringing them all together ...

City of Phoenix
Sustainability Studio
Visioning Workshop
March 6, 2010
150 people involved

Conveying Core Competencies

n=14

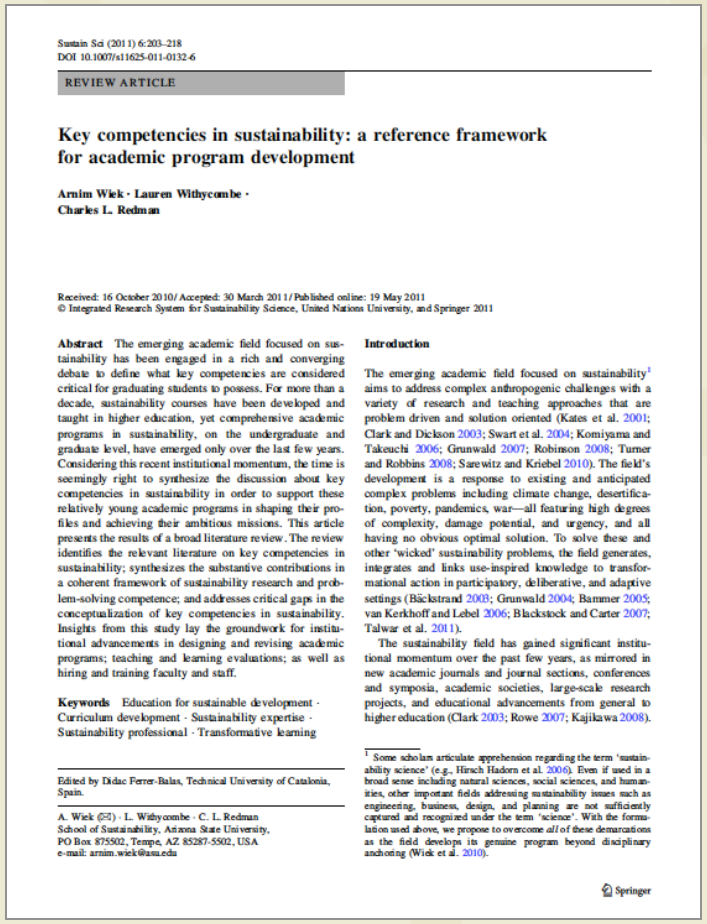
Our program conveys:

1. All of the competencies (n=2 / 14%)
2. A majority of the competencies (n=5 / 36%)
3. **A minority of the competencies (n=6 / 43%)**
4. None of the competencies (n=1 / 7%)

Conclusions

- **Convergence** – relevance and content
- **Methodological competence** – under-developed, under-valued
- **Frameworks** – Absence of unifying frameworks for competences (mainly lists), not inspired by *sustainability* thinking
- **Justification** – Lack of rigor *why* these competences are important for sustainability
- **Implementation** – Lack of putting them into practice

Publications



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REVIEW ARTICLE

Key competencies in sustainability: a reference framework for academic program development

Arnim Wiek · Lauren Withycombe · Charles L. Redman

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Abstract The emerging academic field focused on sustainability has been engaged in a rich and converging debate to define what key competencies are considered critical for graduating students to possess. For more than a decade, sustainability courses have been developed and taught in higher education, yet comprehensive academic programs in sustainability, on the undergraduate and graduate level, have emerged only over the last few years. Considering this recent institutional momentum, the time is seemingly right to synthesize the discussion about key competencies in sustainability in order to support these relatively young academic programs in shaping their profiles and achieving their ambitious missions. This article presents the results of a broad literature review. The review identifies the relevant literature on key competencies in sustainability; synthesizes the substantive contributions in a coherent framework of sustainability research and problem-solving competence; and addresses critical gaps in the conceptualization of key competencies in sustainability. Insights from this study lay the groundwork for institutional advancements in designing and revising academic programs; teaching and learning evaluations; as well as hiring and training faculty and staff.

Keywords Education for sustainable development · Curriculum development · Sustainability expertise · Sustainability professional · Transformative learning

Introduction

The emerging academic field focused on sustainability[1] aims to address complex anthropogenic challenges with a variety of research and teaching approaches that are problem driven and solution oriented (Kates et al. 2001; Clark and Dickson 2003; Swart et al. 2004; Komiyama and Takeuchi 2006; Grunwald 2007; Robinson 2008; Turner and Robbins 2008; Sarewitz and Kriebel 2010). The field's development is a response to existing and anticipated complex problems including climate change, desertification, poverty, pandemics, war—all featuring high degrees of complexity, damage potential, and urgency, and all having no obvious optimal solution. To solve these and other 'wicked' sustainability problems, the field generates, integrates and links use-inspired knowledge to transformational action in participatory, deliberative, and adaptive settings (Bäckstrand 2003; Grunwald 2004; Bammer 2005; van Kerkhoff and Lebel 2006; Blackstock and Carter 2007; Talwar et al. 2011).

The sustainability field has gained significant institutional momentum over the past few years, as mirrored in new academic journals and journal sections, conferences and symposia, academic societies, large-scale research projects, and educational advancements from general to higher education (Clark 2003; Rowe 2007; Kajikawa 2008).

Edited by Didac Ferrer-Balas, Technical University of Catalonia, Spain.

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[1] Some scholars articulate apprehension regarding the term 'sustainability science' (e.g., Hirsch Hadorn et al. 2006). Even if used in a broad sense including natural sciences, social sciences, and humanities, other important fields addressing sustainability issues such as engineering, business, design, and planning are not sufficiently captured and recognized under the term 'science'. With the formulation used above, we propose to overcome *all* of these demarcations as the field develops its genuine program beyond disciplinary anchoring (Wiek et al. 2010).

Open Questions

- **Competence** – which ones, why
- **Teaching/Learning Approaches** – which ones, why, experiences
- **Evaluation** – how, what, type