Core Competencies in Sustainability

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ITdNet Meeting
Leuphana, March 2, 2012
Disaster Relief: A UN helicopter responding to a disaster.
“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.”

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)
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 | Agroecosystem 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

"Linking knowledge to action"

Sustainability Research and Problem-Solving Competence
### Survey – Distribution of Responses

<table>
<thead>
<tr>
<th><strong>Systems Thinking</strong></th>
<th><strong>Anticipatory</strong></th>
<th><strong>Normative</strong></th>
<th><strong>Strategic</strong></th>
<th><strong>Interpersonal</strong></th>
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</thead>
<tbody>
<tr>
<td>PS2 Understanding and knowledge of natural processes and resources</td>
<td>PS11 Participatory elicitation competence; &quot;desirable future states&quot;</td>
<td>PS3 Concern for justice</td>
<td>PS18 Adaptation</td>
<td>PS1 Civic engagement</td>
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<td>PS4 Integrated Assessment</td>
<td>PS16 Fairness and equity; &quot;future generations&quot;</td>
<td>PS16 Fairness and equity</td>
<td>PS19 Green materials design</td>
<td>PS8 Integrate across disciplinary lines</td>
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<tr>
<td>PS6 Integrate across disciplinary lines</td>
<td>PS13 Ability to use triple bottom line concepts consider &quot;future&quot;</td>
<td>PS30 Diversity of knowing and learning; &quot;problems based on worldviews&quot;</td>
<td>PS22 Community development</td>
<td>PS16 Interdisciplinarity</td>
</tr>
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<td>PS11 Resilience competence</td>
<td>PS16 Decisionmaking under uncertainty</td>
<td>PS30 Awareness of values</td>
<td>PS13 Ability to use triple bottom line concepts effectively</td>
<td>PS30 Interdisciplinary collaborative inquiry</td>
</tr>
<tr>
<td>PS13 Life cycle competency</td>
<td>PS11 Resilience competence; &quot;long range planning&quot;</td>
<td>PS7 Measuring and modeling sustainability</td>
<td>PS19 Green infrastructure design</td>
<td>PS10 Communication about sustainability</td>
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<td>PS14 Resilience competency</td>
<td>PS30 Analysis; &quot;assessing sustainability&quot;</td>
<td>PS30 Analysis; &quot;assessing sustainability&quot;</td>
<td>PS13 Ability to apply the principles of green chemistry and green</td>
<td>PS21 Humility</td>
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<td>PS16 Interdisciplinarity and interconnectivity</td>
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<td>PS9 Practical skills</td>
<td>PS11 Participatory elicitation competence</td>
</tr>
<tr>
<td>PS1 Ecological resilience</td>
<td></td>
<td></td>
<td>PS30 Synthesize information on alternatives and draw implications</td>
<td>PS9 Communicative skills</td>
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<tr>
<td>PS11 Systems thinking competence</td>
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<td></td>
<td>PS9 Social teamwork</td>
<td>PS9 Networking and convincing</td>
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<tr>
<td>PS25 Theory of complexity</td>
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<td>PS9 Interdisciplinary attitude</td>
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<td>PS25 System dynamics modeling</td>
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<tr>
<td>PS26 Systems thinking</td>
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<td>PS26 Temporal and spatial scaling</td>
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<tr>
<td>PS28 Systemic thinking</td>
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<tr>
<td>PS31 Land change, human dimensions</td>
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<tr>
<td>PS7 Measuring and modeling sustainability</td>
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<tr>
<td>PS17 Ecological footprint, biocapacity, resource accounting</td>
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<tr>
<td>PS24 Competence in harnessing and integrating knowledge to address</td>
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<tr>
<td>PS21 Interpreting social systems as information processing systems</td>
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<td>PS16 Understanting of legal structures</td>
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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

<table>
<thead>
<tr>
<th>Holistic Systems Thinking</th>
<th>Sustainability Knowledge</th>
<th>Awareness &amp; Integration</th>
<th>Acting for Positive Change</th>
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<tbody>
<tr>
<td>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.</td>
<td>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.</td>
<td>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.</td>
<td>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.</td>
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### 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 dialogue 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 ...
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
Key competencies in sustainability: a reference framework for academic program development

Asa H. Wik, Lauren Y. Withycombe, Charlene L. Redman

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 the recent institutional momentum, the time is seemingly right to synthesize the discussion about key competencies in sustainability in order to support those 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 substantial 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 evaluation, as well as hiring and retaining faculty and staff.

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

Introduction

The emerging academic field focused on sustainability aims to address complex anthropogenic challenges with a variety of research and teaching approaches that are problem driven and solution oriented (Kazan et al. 2011; Clark and Dickson 2001; Swart et al. 2004; Komjathy and Takacs 2004; Gunawardana 2007; Robinson 2008; Turner and Robinson 2008; Saywitz and Kulab 2010). The field’s development is a response to existing and anticipated complex problems including climate change, deforestation, poverty, pandemics, war—all featuring high degrees of complexity, damage potential, and urgency, and all having an obvious optimal solution. To solve these and other “wicked” sustainability problems, the field generates, interprets and links new knowledge to transformative action in policy, skills/culture, and adaptive settings (Rickinson 2000; Grensand 2004; Burman 2003; van Kerkhoff and Lebel 2006; Blackstock and Carter 2005; Tabara et al. 2011).

The sustainability field has gained significant institutional momentum over the past few years, as mirrored in new academic journals and teaching programs, conferences and symposia, academic societies, large-scale research projects, and educational advancements from general to higher education (Clark 2005; Rowe 2007; Kaján 2009).

**Sustainability** problem constellations related to sea-level rise, desertification, poverty, lack of education, pandemics, or military conflicts result from complex, dynamic cause-effect chains. Elements of the problem constellation exist at different scales (local to global) and interact with one another across these scales. Inherent and reinforcing feedbacks are likely to aggravate these problems. Threatening the integrity and stability of socio-ecological systems in the long term. Public discourse largely focuses on the adverse effects of these constellations, such as catastrophes and accidents. When we focus on isolated outcomes, we avoid dealing with their root causes, namely, human factors such as motives, actions, practices, and habits. Sustainability challenges emerge from “normal” systemic failures caused by an imbalance between limited cognitive, emotional, and organizational capacities of societies and institutions on the one hand, and costly complex and high-stakes technologies and production systems on the other hand. A recent example of systemic failure that is part of a larger sustainability challenge is the oil spill in the Gulf of Mexico. While media and public attention center on an “ecological catastrophe” and whether government or corporate executives are to be blamed, the systemic character of the disaster gets neglected. Ever-increasing energy demand (that is, the complex extraction technologies, oil-drilling oil selection, and safety standards...
Open Questions

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