US higher education environmental program managers’ perspectives on curriculum design and core competencies

Implications for sustainability as a guiding framework

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Abstract
Purpose – This study is the first of a five-phase research project sponsored by the Council of Environmental Deans and Directors (CEDD), an organization of environmental program managers operating under the umbrella of the National Council for Science and the Environment. The purpose of the project is to determine if a consensus on core competencies for environmental program graduates is achievable, and if so, to make recommendations for consideration by program managers.

Design/methodology/approach – Q methodology was used to discern the perspectives of program managers at 42 CEDD member institutions on environmental curriculum design. An online survey preceded the Q sort exercise to elicit managers’ curricular views and program characteristics. Survey responses were analyzed to select statements for the Q-sorting exercise and categorized according to emergent themes. Multiple regression analysis was used to explore the relationship between perspectives (factor loadings) and host institution Carnegie classifications.

Findings – Three distinct, but not opposing, perspectives were identified from the initial Q-factor rotation, which suggests the possibility of agreement on core competencies. The perspectives differ in their views of curriculum orientation (professional training versus liberal arts), curriculum breadth versus depth, and flexible versus fixed core competencies. Host institution classification (Carnegie) is a small but significant predictor for two of the three perspectives. A second Q-factor rotation reveals a consensus perspective that accommodates most respondents and aligns well with principles of sustainability, thus suggesting that sustainability may serve as a guiding paradigm for defining areas of core competence.

Originality/value – No national study of program managers’ views of curriculum design and the identification of core competencies has been conducted in the USA.

Keywords Education, Sustainability development, Environmental management, Competencies, Higher education, Curriculum development, United States of America

Paper type Research paper

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Introduction
The environmental program identity challenge

Most interdisciplinary environmental programs in the United States were established at higher educational institutions over the last four decades (for a discussion of program origins see Schoenfeld, 1979, Weis, 1990, Soule and Press, 1998). Despite this forty-year history and the large and growing number of programs, no consensus has emerged on program identity, core principles, or interdisciplinary structure. Key questions remain concerning environmental programs’ educational mission, scope and content, core competencies for graduates, and assessment criteria (Caldwell, 1983; Soule and Press, 1998; Blockstein and Greene, 2003; McGowan, 2004).

It is not surprising, therefore, that interdisciplinary environmental degree-granting programs exhibit extensive variability in disciplinary focus, educational goals, curricular design and content, and administrative locations within the institutional hierarchy. Program variability is shaped, in part, by the traditions, missions, and cultures of their host institutions as well as their participating faculty.

Multiple program naming conventions adds to the ambiguity surrounding program identity. While it is generally believed that “environmental science” programs focus more on natural sciences and “environmental studies” programs focus more on social sciences and the humanities, this distinction is not always discernable (Maniates and Whissel, 2000). Many other titles are also used to name interdisciplinary environmental programs, particularly those at larger institutions (Romero and Silveri, 2006).

Moreover, the definition of what constitutes an “interdisciplinary” curriculum also remains unresolved. In practice, terms such as multidisciplinary, interdisciplinary, and transdisciplinary are often used interchangeably, although they represent very different approaches for integrating knowledge from disparate disciplines (Lozano, 2006; Focht, 2008).

Environmental studies and science seems to be an unbounded field of study, as reflected in the wide variety of environmental programs. Despite Schoenfeld’s (1979) claim that diversity assures a “healthy environmental studies ecosystem,” such diversity contributes to professional confusion about the expertise of environmental program graduates, and sustains vigorous debate among program directors about program design and assessment criteria.

Not only are environmental programs diverse, however; but also dynamic. Programs change in response to societal needs, shifting political and social environments, and rapid advances in technology and knowledge. Environmental programs, perhaps more than any other area of higher education, are constantly evolving to address emerging issues and prepare graduates for newly defined careers.

Despite the obvious value of program diversity and adaptability, the lack of consensus on an environmental canon and core principles poses a threat to the legitimacy of environmental programs. Caldwell (1983, p. 249) argues that “if environmental studies are to be accorded a status commensurate with their significance for mankind and the biosphere,” scholars must determine what constitutes the environmental studies “metadiscipline.” The lack of a shared identity fuels perceptions by some critics that interdisciplinary environmental programs lack rigor. Soule and Press (1998) contend that the lack of a distinct identity is needed to avert “crises of vision and curricular development” that lead to “planning paralysis,” “hyper-diverse and shallow curricula,”
and “multidisciplinary illiteracy.” Likewise, Sherren (2007) contends that programs may easily be perceived as “anything goes,” further eroding their legitimacy. Similar criticisms have been expressed by others. These include:

- Confusion, misperceptions, and lack of awareness among the public, students, and employers about what to expect from environmental programs (Weis, 1992; Braddock et al., 1994; Romero, 2003).
- Negative perceptions within university and college administrations that reduce support for interdisciplinary environmental programs (Hornig, 1996; O'Reilly et al., 1996; Fridgen, 2005).
- Reduced visibility and credibility among decision-makers and funding entities that negatively impact research and funding opportunities (Weis, 1992; Soule and Press, 1998; González et al., 2003).
- Limitations on professional careers due to the absence of program accreditation standards and myriad professional certifications (Silverman, 1992; Wright, 1992; Braddock et al., 1994; Lemons, 1994).
- Hindrance of an urgent response to recent efforts by Congress to implement federal rules on college performance, including standardized criteria for measuring academic success as a requirement for institutions to maintain student eligibility for federal financial aid (Basken, 2008; Millett et al., 2008).

Extant research on environmental and sustainability education does not provide program managers with adequate consensus-based guidance on how to develop interdisciplinary programs and what to include in them (Reid and Scott, 2006; Sherren, 2007). In the United Kingdom, a group of experts defined “benchmark” recommendations for undergraduate environmental degree programs (Eastwood and Blumhof, 2002). Their recommendations include key skills as well as subject-specific and generic knowledge for undergraduate programs in earth science, environmental science, and environmental studies (Quality Assurance Agency for Higher Education, 2000).

**Addressing the challenge**

In 2003, CEDD established a Curriculum Committee to explore the potential for core competency (essential knowledge and skills) recommendations to guide environmental program curriculum design. CEDD believes that reaching a consensus on core competencies will reduce conflict within program planning committees, strengthen program identity, and ensure that program graduates have the requisite knowledge, skills, and experience to address complex environmental challenges.

Initial discussions among CEDD members made it clear, however, that easy consensus on the identity and relative emphasis of core competencies would not be reached – at least not directly. The committee decided to broaden its inquiry to include explorations into curricular perspectives, existing program characteristics, and institutional parameters to determine if a consensus on these features was possible, and if so, offer recommendations for core competencies based on these findings. Thus, we proposed a five-phase research project, beginning with an investigation of CEDD members’ perspectives on curriculum design. In this paper, we present the results of this first research phase.
Q methodology
Q methodology is a technique for systematically revealing the subjective, lived experiences of individuals. It is widely used as a research tool, especially in psychology and the social sciences (Brown, 1980, Durning, 1999, Watts and Stenner, 2005). It is used to identify perspectives about a particular topic, provide insight into the attributes of these perspectives, explicitly outline areas of consensus and conflict, and assist in developing shared views (for examples see Steelman and Maguire, 1999; Popovich and Popovich, 2000; Webler et al., 2001; Focht, 2002). Q methodology is recognized for its value in combining quantitative and qualitative research, providing a bridge between the two research traditions.

William Stephenson, a British physicist-psychologist, developed Q methodology and first proposed that conventional factor analysis could be “inverted” to correlate people instead of traits in an paper published in Nature in 1935 (Stephenson, 1935). In other words, individuals (the P-sample) are correlated across a sample of statements (the Q-sample) that they rank (sort) in a defined order according to their view on a particular topic. Thus, the unit of analysis is the individual rather than a population, and thus reveals patterns of responses of individuals to a particular topic (the condition of instruction). The Q sorts are factor analyzed using centroid extraction and manual rotation to explore shared perspectives revealed by the sorts. (For an excellent primer on Q methodology, see Brown, 1993).

Q methodology (so named to distinguish it from traditional R methods of statistical analysis) was thus preferred by us to learn how program managers view curriculum design because of its value in revealing perspectival insights unattainable through other statistical methods.

The Q-sample
The statements sorted by the program managers (the Q-sample) were drawn from responses to an online survey of 61 CEDD members (environmental program administrators) representing programs at 58 institutions of higher education. Forty-seven statements were selected from those responses to survey questions about curriculum design, such as the need for core competencies and the nature of such competencies, how curricula should be structured, what disciplinary content should be included, the role that constituencies (such as students, donors, and employers) should play in curriculum development, the importance of defining boundaries for the environmental profession, the importance of developing guidelines for professional certification, and differences in graduate and undergraduate curricula.

We used structured sampling to select the Q-sample statements to assure that they covered the full range of views expressed by the respondents and avoid biases that could result from over-sampling or under-sampling particular areas (McKeown and Thomas, 1988, pp. 28-29). Some statements were edited to enhance clarity.

The P-sample
All program managers who participated in the online survey were asked to complete the Q sorting exercise. Forty-four CEDD members representing 42 institutions completed the exercise.
The Q-sort exercise

The Q-sort is the process through which an individual models her/his own point of view about a subject by rank-ordering the statements (Q-sample) along a continuum from “most like my view” to “most unlike my view,” typically with fewer statements allowed at the ends and more statements allowed in the middle. Statements placed in the middle of the forced distribution represent those about which the sorter feels less strongly and therefore are less salient.

In our exercise, program managers were asked to sort the 47 statements on curriculum design based on the condition of instruction: “What is your view of how environmental program curricula should be designed?” To accomplish the sort, they entered the numbers of the statements on a score sheet with 11 columns (numbered to 5, with the positive end representing “most like my view”) with rows arranged in a triangular distribution as follows: 2-3-4-5-6-7-6-5-4-3-2.

The Q-sort protocol and detailed instructions were provided to CEDD members via email. Members were given the option of completing the Q sort online or mailing completed sorts to the authors.

Q-factor analysis

Statement placements (−5 to +5) for each individual’s Q sort were analyzed using PQMethod, the PC version of QMethod, a Q-factor analysis program originally developed by John Atkinson at Kent State University in 1992 and now maintained by Peter Schmolk at the Leibniz Supercomputing Centre of the Bavarian Academy of Sciences and Humanities in Germany. Eight centroid factors were extracted initially and examined for the number of sorts that significantly loaded on them (p < 0.001). Based on this examination, we retained three factors (A, B, and C) for rotation, which accounted for 40 of the 44 sorts.

In the first rotation, we sought to avoid bipolar loadings. That is to say, we rotated factors so that no pair of sorts significantly loaded on opposite ends of the three factors. We found that Factor C was most unique (least correlated with the other factors).

Because of the uniqueness of Factor C, we chose to rotate only Factors A and B in the second rotation to produce two new factors, A’ and B’. In this rotation, we sought to explore the possibility of consensus by rotating Factor A − 44 degrees to the middle of the group of sorts originally bounded by Factors A and B. Factor A’ accounted for all but seven of these 34 sorts as well as 2 sorts that had also loaded on Factor C. (We do not discuss our interpretation of the bipolar perspective revealed by Factor B’ since only three sorts loaded on this factor).

Q-factor interpretation

The sort corresponding to each factor was interpreted by studying how the 47 statements are arranged, which is understood to represent the perspective shared by those program managers whose sorts loaded significantly on it. The initial interpretation is developed by paying particular attention to high salience statements ranked at the extremes of the sort. This interpretation is refined first by examining statements judged as less salient and then through a comparison against the common sorts revealed by the other two factors. Finally, our interpretation is validated by re-examining the survey responses of those program managers whose sorts significantly loaded on the factor.
Results – perspectives on curriculum design and program objectives

The perspectives revealed by the factors were given descriptive names that refer to educational objectives. From the first rotation, the Factor A perspective was labeled *Environmental Citizen*, Factor B was labeled *Environmental Problem Solver*, and Factor C was labeled *Environmental Scientist*. From the second rotation, the Factor A' perspective was labeled *Environmental Integrator*.

Table I presents the common Q-sort placements of those statements that best discriminate these perspectives from each other.

Three themes differentiate these perspectives:

1. orientation to curriculum design (liberal arts versus professional training);
2. curriculum breadth versus depth; and
3. fixed versus flexible core competencies.

Environmental citizen perspective (Factor A)

*Orientation to curriculum design – liberal arts*

The Environmental Citizen perspective, popular in baccalaureate liberal arts institutions, focuses on training students to be environmentally aware citizens who can be effective environmental advocates in whatever career they choose (Items 2, 25). Environmental citizens disfavor a professional orientation – a stance reinforced by their wariness or opposition to the involvement of constituencies outside the academy (Items 22, 35, 38). One program manager offered this comment: “I would argue that the students are important, but the curriculum must belong to the faculty and not be dictated by external groups.”

*Curriculum breadth versus depth – breadth with emphasis on the social sciences*

Environmental Citizens favor curricular breadth that includes the natural sciences (Item 6), the humanities (Item 5), and political and social aspects of environmental problems (Item 40). This perspective, while supporting an interdisciplinary curriculum (Item 3), is more neutral (or ambiguous) about the need for depth in a specific discipline or specialization area (Item 1). In contrast, the other two perspectives strongly reject (Factor B) or affirm (Factor C) the need for depth. Environmental Citizens view the social sciences as particularly important for environmental curricula, especially policy, law, and economics. A program manager holding this perspective opined, “Of particular relevance are the fields of political science, law, and economics; these disciplines, along with sociology, are keys to understanding the human dimensions of environmental challenges.”

*Core competencies – flexible and tailored*

Environmental Citizens are opposed to placing overly prescriptive limitations on programs via strictly defined core curricula and are wary of establishing environmental program boundaries (Items 8, 14, 43). In their comments, they indicated that they want core competencies to be flexible enough to adapt to the rapidly evolving environmental field, permit responsive program design, and ensure programs remain broad and inclusive. They also believe that programs should be tailored to institutional strengths (Item 4) and that core competencies should “not prevent different institutions from designing their programs to take advantage of different strengths and to emphasize particular aspects of environmental education.”
1. Deep strength in a given discipline is required for a student to make original, creative, and important contributions to any field.

2. The most important thing is for students to understand environmental issues from a broad perspective rather than training them for a specific professional career.

3. Environmental issues inherently transcend traditional disciplinary boundaries; therefore, environmental education should address problems in a way that goes beyond disciplinary thinking.

4. Programs need to be somewhat tailored to the strengths of a given institution.

5. Students must understand the human contexts—cultural, historical, philosophical, and ethical—of environmental issues.

6. All environmental students must be comfortable with interpreting scientific information and engaging in scientific discourse.

7. Traditional disciplinary programs have developed core competencies; environmental programs should do the same.

8. There is a foundation of knowledge and skills that are central to understanding and solving environmental problems. These need to be incorporated into all programs.

9. Academics need the reality checks that can be provided by people outside the academy. Those who are the consumers of the talent pool, who seek a valuable educational experience, and who invest in the enterprise of education all have valuable insights.

10. Undergraduate programs should have a research-based graduate school preparation track and a practical applications-based professional track.

11. Systems understanding, recognition of emergent properties, synthesized knowledge, and “thinking outside the box” are important goals of environmental education.

12. Program boundaries will establish the environmental profession as a respected and legitimate profession, and clarify expectations for students and employers.

13. One needs to understand that environmental problems are also social/political problems in order to arrive at socially relevant, politically real, and economically viable solutions.

14. It is important to include various clients in program development and planning to stay connected with market employment needs and evolving environmental concerns.

15. Because of the youth of the field and its interdisciplinary nature, core competencies for environmental programs should be sufficiently broad to encompass a variety of different approaches.

16. Defining a core curriculum will legitimize the environmental profession, define program boundaries for students, and clarify expectations for employers.

17. The environmental field is constantly changing. Flexibility is the key to keep environmental programs responsive and relevant.

Table I: Selected Q-sample statements that best discriminate factors A, B, C, and A'

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
<td>1</td>
<td>Deep strength in a given discipline is required for a student to make</td>
<td>0</td>
<td>-4</td>
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<td>make original, creative, and important contributions to any field.</td>
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<td>2</td>
<td>The most important thing is for students to understand environmental</td>
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<td>issues from a broad perspective rather than training them for a specific</td>
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<td>professional career.</td>
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<td>3</td>
<td>Environmental issues inherently transcend traditional disciplinary</td>
<td>5</td>
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<td>boundaries; therefore, environmental education should address problems in</td>
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<td>a way that goes beyond disciplinary thinking.</td>
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<td>Programs need to be somewhat tailored to the strengths of a given</td>
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<td>institution.</td>
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<td>5</td>
<td>Students must understand the human contexts—cultural, historical,</td>
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<td>philosophical, and ethical—of environmental issues.</td>
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<td>6</td>
<td>All environmental students must be comfortable with interpreting</td>
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<td>scientific information and engaging in scientific discourse.</td>
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<td>7</td>
<td>Traditional disciplinary programs have developed core competencies;</td>
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<td>environmental programs should do the same.</td>
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<td>8</td>
<td>There is a foundation of knowledge and skills that are central to</td>
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<td>understanding and solving environmental problems. These need to be</td>
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<td>incorporated into all programs.</td>
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<td>9</td>
<td>Academics need the reality checks that can be provided by people</td>
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<td>outside the academy. Those who are the consumers of the talent pool,</td>
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<td>who seek a valuable educational experience, and who invest in the</td>
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<td>enterprise of education all have valuable insights.</td>
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<td>10</td>
<td>Undergraduate programs should have a research-based graduate school</td>
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<td>preparation track and a practical applications-based professional track</td>
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<td>11</td>
<td>Systems understanding, recognition of emergent properties, synthesized</td>
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<td>knowledge, and “thinking outside the box” are important goals of</td>
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<td>environmental education.</td>
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<td>12</td>
<td>Program boundaries will establish the environmental profession as a</td>
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<td>respected and legitimate profession, and clarify expectations for</td>
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<td>students and employers.</td>
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<td>13</td>
<td>One needs to understand that environmental problems are also</td>
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<td>social/political problems in order to arrive at socially relevant,</td>
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<td>politically real, and economically viable solutions.</td>
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<td>14</td>
<td>Because of the youth of the field and its interdisciplinary nature, core</td>
<td>-2</td>
<td>2</td>
<td>0</td>
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<td>competencies for environmental programs should be sufficiently broad to</td>
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<td>encompass a variety of different approaches.</td>
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<tr>
<td>15</td>
<td>Defining a core curriculum will legitimize the environmental profession,</td>
<td>0</td>
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<td>-1</td>
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<td>define program boundaries for students, and clarify expectations for</td>
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<td>employers.</td>
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<td>16</td>
<td>The environmental field is constantly changing. Flexibility is the key</td>
<td>-4</td>
<td>-3</td>
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<td>-4</td>
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<td>to keep environmental programs responsive and relevant.</td>
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(continued)
Environmental problem solver perspective (Factor B)

Orientation to curriculum design – professional training

The Environmental Problem Solver’s orientation to curriculum design is educating environmental professionals to solve environmental problems. Those holding this perspective believe that environmental programs should focus on training environmental professionals who can utilize systems-focused approaches and draw upon insights and tools from all relevant disciplines to address complex environmental issues (Items 3, 12). One Environmental Problem Solver stated that “Systems understanding, recognition of emergent properties, synthesized knowledge, and “thinking outside the box” are important goals of environmental professional training.”

Other distinctive characteristics are strong support for external constituency involvement in curriculum design (Items 9, 22, 35, 38) and program flexibility (Item 26) to allow programs to respond to changing marketplace conditions and evolving environmental problems. Several Environmental Problem Solvers commented on the benefits of students working directly with constituencies (such as employers and non-governmental organizations) via internships, service learning, and other types of collaboration.

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>A'</th>
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</thead>
<tbody>
<tr>
<td>33</td>
<td>Environmental decisions should be made rationally. Students should learn decision theory techniques such as benefit/cost analysis, risk analysis or other optimization strategies</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>1</td>
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<tr>
<td>34</td>
<td>It is essential for students to understand the interface between nature and social systems – how societies impact the environment and how the environment impacts societies</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
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<tr>
<td>35</td>
<td>Client involvement is important for program support and overall success</td>
<td>-3</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>37</td>
<td>Undergraduate preparation for graduate school or an immediate career should be the same to prepare students for life-long learning and critical thinking</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>38</td>
<td>Client interests are not always compatible with academic goals. It’s the faculty’s prerogative to develop curricula, not the clients</td>
<td>3</td>
<td>-3</td>
<td>-2</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>Students need to understand the limits of scientific studies and learn to appreciate, quantify, and accurately report uncertainties</td>
<td>2</td>
<td>3</td>
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<td>3</td>
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<tr>
<td>40</td>
<td>It is important for students to gain an understanding of environmental conflicts between competing interests, such as utilitarian versus preservationist, individual versus public, local versus global, and current versus future generations</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
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<tr>
<td>41</td>
<td>It is important that all students have exposure to a broad range of subjects, including the humanities and the natural, social, and applied sciences</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>43</td>
<td>Hard boundaries limit the perspectives that can be brought to bear on environmental problems, which require interdisciplinary solutions</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table I.
This perspective strongly favors breadth over depth with an emphasis on interdisciplinary skills (Items 1, 3, 12). Environmental Problem Solvers stress the importance of all relevant disciplinary areas, especially the sociopolitical aspects of environmental issues and the humanities (Items 5, 19, 34). In their comments, they emphasize the importance of understanding differing epistemological approaches, as well as the ethical, historical, and cultural contexts of environmental issues. Environmental Problem Solvers also view business, engineering, and decision sciences (Item 33) as important components of environmental curricula. They place less importance on science literacy than the other two perspectives (Item 6).

Core competencies – flexible and dynamic
Congruent with the Environmental Citizen perspective, those holding the Environmental Problem Solver perspective are wary of overly prescriptive program boundaries (Item 14) and core competencies. They reject the idea that a foundation of knowledge and skills central to understanding and solving environmental problems should be applied to all programs (Item 8). However, they support defining core competencies as long as they are flexible and dynamic enough to adapt to the constantly evolving environmental field (Items 24, 26).

Environmental scientist perspective (factor c)
Orientation to curriculum design – professional scientist training
This perspective focuses on training specialists, especially scientists and engineers, who can devise practical solutions to environmental problems. Less emphasis is placed on the importance of the human contexts of environmental problems (Items 5, 40) and more emphasis is placed on decision science, engineering, and business (Items 33, 41).

Environmental Scientists are less committed to constituency involvement in curriculum design but their comments indicate they support training that meets employers’ expectations (Items 9, 22, 35, 38).

Curricular breadth versus depth – deep strength in a discipline required
Environmental Scientists support an interdisciplinary curriculum, but emphasize depth over breadth (Items 1, 2, 3, 12). They favor deep strength in a disciplinary area with branches reaching out to allied disciplines.

Core competencies – universal core grounded in natural science
Another distinctive characteristic is its staunch support for establishing a universal core (Items 7, 25) grounded in the natural sciences (Item 6). In contrast to the other two perspectives, Environmental Scientists assert that a common foundation of knowledge and skills is essential to understanding and solving environmental problems (Item 8).

Environmental Integrator Perspective (Factor A’)
Orientation to curriculum design – disciplinary synthesis
This perspective’s orientation to curriculum design is focused on disciplinary synthesis – ensuring that environmental programs provide students with the breadth of knowledge and critical thinking/synthesis skills required to understand the
complexity of environmental issues and effectively devise and initiate innovative solutions for solving environmental problems (Items 3, 12).

They oppose undergraduate tracking that would limit future options, believing that no curricular distinction should be made between students planning immediate professional careers versus graduate school (Items 11, 37).

The position of Environmental Integrators is neutral regarding the involvement of constituencies outside of the academy (Items 9, 22, 35, 38).

Curricular breadth versus depth – breadth with emphasis on human contexts
Environmental Integrators support curricular breadth with an emphasis on disciplinary synthesis and the human dimensions of environmental issues (Items 5, 19, 34). Humanities and social sciences are as important as natural sciences (Items 40, 41). Less emphasis, however, is placed on business and engineering. Science literacy, including the ability to understand the limits of scientific studies and accurately report uncertainties, is moderately important (Items 6, 39).

Core competencies – flexible, dynamic and tailored
Environmental Integrators do not view defined boundaries for environmental programs favorably because boundaries can limit the perspectives that can be brought to bear on environmental issues (Items 14, 43). They favor a flexible, dynamic set of core competencies as long as they are adaptable enough to allow for program evolution and creativity (Items 24, 26) and flexible enough to be tailored to individual institutions and programs (Item 4).

Discussion – parallels to ideologies regarding program objectives
The three first-rotation perspectives revealed by the Q analysis manifest different – but not opposing – views of the appropriate objectives for environmental programs and orientations to curriculum design. They closely parallel ideologies advocated in environmental education literature: citizen awareness, environmental managerialism, and environmental specialization.

Proponents of citizen awareness support a broad liberal arts approach and reject career-focused training (Weis, 1992; Strauss 1995, Hornig, 1996; Romero, 2003). They believe students in all fields need to develop environmental literacy to become “caring and competent stewards of the environment” (Strauss 1995, p. ix).and that environmental/sustainability education should be infused into all higher education disciplines (Weis, 1992; Orr, 1995). “The best measure of the success of environmental programs [is] the number of physicians, lawyers, businessmen, or politicians who reflect the values and worldview of an interdisciplinary environmental studies program” (Hornig, 1996, p. 3).

Advocates of the managerialist ideology prefer that environmental programs train environmental managers and scholars in the use of interdisciplinary approaches to solve environmental problems and effectively influence environmental management decisions and policy. In this view, holistic disciplinary synthesis is more important than depth in training graduates for environmental careers (Lynch and Hutchinson, 1992; Thomas, 1992; Andersen, Worthen and Polkinghorn 2001). Competence requires the “integration of knowledge . . . with problem-solving and ways of dealing with people and complex organizations” (Thomas, 1992, p. 261). Lynch and Hutchinson (1992, p. 864) contend that
environmental challenges require “authoritative environmental managership in the form of dedicated practitioners across the organizational landscape” and that a new environmental profession is needed to synthesize the diverse branches of environmental knowledge and research into a whole, define a suitable environmental ethic relative to the environment, develop competent practice of environmental management in government and industry, and maintain vigorous, independent research efforts focused on emerging problems. Andersen et al. (2001, p. 202) argue that solutions to environmental problems are not developed by scientists, but by “politicians, economists, theologians, philosophers, engineers and society as a whole – each with different epistemologies, methods, and value systems” and that environmental programs should train environmental professionals who can evaluate environmental problems in their cultural and social contexts. Therefore, environmental programs should train broad, holistic, and systemic thinkers who can fulfill roles akin to that of a conductor. In a collaborative setting involving disciplinary experts, environmental professionals should serve to bridge the gaps, orchestrate the collaboration, and provide an overarching vision.

Contrary to the awareness and managerialist ideologies, the specialist ideology advocates curricular depth in a specific discipline as a requirement for professional employment (Braddock, Fein and Rickson 1994; Soule and Press, 1998). Environmental programs should train professional specialists to apply disciplinary tools to solve environmental problems. Strength in a traditional discipline is required to combat “multidisciplinary illiteracy” and contribute to solving environmental problems (Soule and Press, 1998). They contend that “without curricular depth and coherence [environmental] programs can fail by any standard of academic excellence” (Soule and Press, 1998, p. 404). Instead of breadth, they recommend that environmental study be combined with another field of study, preferably as a double major. Braddock et al. (1994) suggest environmental program graduates do not fare as well as traditional graduates in finding employment because most entry-level positions in government and industry require a specific disciplinary background. They argue that people making hiring and promotion decisions are more likely to hire a graduate from a traditional discipline; while graduates without strong disciplinary training are often hired into positions handling communications with government agencies or community groups or in low-status departments within organizational hierarchies.

In summary, the specialist ideology sees curriculum breadth as important primarily for effective communication of scientific knowledge to team members, decision-makers, and the public.

**Perspectives on curriculum design related to institution type**

Linear regression analysis was used to explore the relationship between program managers’ institutional Carnegie classification and their curriculum perspectives.[1] The results confirm this relationship for managers loading on Factor A – Environmental Citizen perspective \( F_{(2,41)} = 3.643; p < 0.05 \) and Factor C – Environmental Scientist perspective \( F_{(2,41)} = 4.894; p < 0.05 \). Those managers loading on Factor B – Environmental Problem Solver perspective \( F_{(2,41)} = 2.752; \) ns are not predicted by their host institutions’ Carnegie classification due to the mix of Environmental Problem Solvers and Environmental Citizens located at doctoral institutions (Table II).

Though a statistically significant relationship exists between Carnegie classification and curriculum perspective for two of the three perspectives, the
Regression coefficients prove that the magnitude of the influence of institution class on perspectives is relatively low. Only 15 percent of the variance in factor loadings on Factor A and 19 percent on Factor C were predicted by the Carnegie classification of the program managers’ institutions.[2]

Consensus perspective on program identity and majority consensus on curriculum design
The statements in Table III reveal a consensus view among the three first-rotation perspectives on interdisciplinarity, as confirmed by the Environmental Integrator perspective (Factor A') obtained from the second rotation.

Program managers agree that environmental problems lie at the interface between human and natural systems; therefore, environmental programs should provide students with an understanding of both the sociopolitical and natural aspects of environmental problems (Items 19, 34). There is also agreement that the complexity of
environmental issues requires that programs employ an interdisciplinary educational approach (Items 3, 20) and that analytic skills should include systems thinking and synthesis in order to devise innovative solutions for pressing environmental problems (Item 12). Managers also agree that students should receive exposure to a range of disciplines, including those in the humanities and the social/natural sciences, and should understand the limitations of science and the relevancy of uncertainty (Items 39, 41). Finally, all agree that the environmental profession has matured enough to identify some sort of boundaries (Item 45).

The environmental education literature supports our finding that environmental programs provide an interdisciplinary focus on the interface of social and natural systems (Caldwell, 1983; Sacks and Davis, 1983; Fletcher, 1992; Orr, 1995; Andersen et al., 2001). There is also broad consensus that solving environmental problems requires a holistic approach and that environmental scholars, professionals, and scientists should be trained to be systematic, process-oriented thinkers capable of understanding complex nature-society relationships (Thomas, 1992; Hornig, 1996; Foster, 1999; Pfirman and AC-ERE, 2003).

Caldwell (1983) argues that it is the process of integrating and synthesizing knowledge that distinguishes the environmental field from traditional disciplines and environmental studies is best described as a metadiscipline because it focuses on an integrating concept: the interactions of humans and their environment. He explains that in a metadisciplinary approach, derivative knowledge from relevant disciplines is “synthesized to form new information and insights not directly deducible from any one of the disciplines.” The challenge for environmental

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>A’</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>One needs to understand that environmental problems are also social/political problems in order to arrive at socially relevant, politically real, and economically viable solutions</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>34</td>
<td>It is essential for students to understand the interface between nature and social systems -- how societies impact the environment and how the environment impacts societies</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Environmental issues inherently transcend disciplinary boundaries; therefore, environmental education should address problems in a way that goes beyond disciplinary thinking</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>41</td>
<td>It is important that all students have exposure to a broad range of subjects, including the humanities and the natural, social, and applied sciences</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Systems understanding, recognition of emergent properties, synthesized knowledge, and “thinking outside the box” are important goals of environmental education</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>39</td>
<td>Students need to understand the limits of scientific studies and learn to appreciate, quantify, and accurately report uncertainties</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>Environmental education should continue to follow its traditional focus on a providing depth in a single discipline</td>
<td>−4</td>
<td>−5</td>
<td>−2</td>
<td>−5</td>
</tr>
<tr>
<td>45</td>
<td>The environmental profession is still evolving and it’s too early to develop highly defined boundaries</td>
<td>−1</td>
<td>−1</td>
<td>−3</td>
<td>−1</td>
</tr>
</tbody>
</table>

Table III. Consensus Q sample statements
programs is to develop a metadisciplinary curriculum that “transcend multi- or interdisciplinary approaches to arrive at a metadiscipline which rest[s] upon a coherent body of theory regarding environmental relationships” (Caldwell, 1983, p. 257). Thomas (1992) supports this process-oriented view of the environmental field and argues that interdisciplinary programs should not aim for coverage of a huge range of subjects, but instead should emphasize the process of synthesis, integration, and analysis across disciplines.

Table IV presents a summary of the salient features of the four perspectives.

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**Sustainability as a guiding framework**

Interdisciplinary higher education environmental degree programs in the United States evolved in response to internal influences within the universities and colleges hosting the programs and external forces such as societal changes and the economy. Today, climate change and other complex global environmental problems are driving a movement toward sustainable development and creating significant demand for both existing and new types of sustainability and environmental professionals.

Brand and Karvonen (2007) assert that new forms of expertise are needed to effect the transformation to a sustainable future. They identify four new areas of professional expertise required for sustainable development: outreach experts who communicate effectively to non-experts, interdisciplinary experts who understand overlaps of neighboring disciplines, meta-experts who broker the multiple claims of relevance between different forms of expertise, and civic experts who engage in democratic discourse with experts and non-experts (Brand and Karvonen, 2007, p. 21). Sustainability careers as sustainability officers, wind resource assessors, and bio-mimicry engineers are experiencing rapid growth (Doyle, 2008; AASHE, 2008). Traditional environmental careers in industry and government are also experiencing strong growth while simultaneously facing the need to replace large numbers of employees expected to begin retiring in the next few years (Environmental Business Journal, 2008). In addition, environmental professionals are seeking continuing education programs to develop new competencies in working on sustainability projects (Jørgensen and Lauridsen, 2005).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Environmental Citizen</th>
<th>Environmental Problem Solver</th>
<th>Environmental Scientist</th>
<th>Environmental Integrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation – educational goal</td>
<td>Liberal arts education</td>
<td>Professional training</td>
<td>Professional training of disciplinary specialists</td>
<td>Creative thinkers</td>
</tr>
<tr>
<td>Constituency involvement</td>
<td>Student oriented</td>
<td>Employer oriented</td>
<td>Employer oriented</td>
<td>Neutral</td>
</tr>
<tr>
<td>Educational approach</td>
<td>Curricular breadth, emphasize social science</td>
<td>Curricular breadth, emphasize humanities, social science, management</td>
<td>Curricular depth, emphasize natural and applied sciences</td>
<td>Curricular breadth, emphasize humanities and social science</td>
</tr>
<tr>
<td>Core competencies</td>
<td>Broad and flexible</td>
<td>Broad and flexible</td>
<td>Defined and universal</td>
<td>Broad and flexible</td>
</tr>
</tbody>
</table>

Table IV. Perspective characteristics
Sustainability is already emerging as a new framework in many higher education programs. Despite ambiguity surrounding the definition of sustainability and tensions between varying concepts of environmental education and sustainability education, a consensus is forming that environmental education should be oriented toward sustainability (Cortese, 1992; Bonnett, 1999; Rest, 2002; McKeown and Hopkins, 2003; Mihelcic et al., 2003; Smyth, 2006). Discussions that we held at Environmental Studies Summits held in Syracuse, NY (2007) and Jonesboro, AR (2008), and the summer 2008 meeting of CEDD, indicated widespread support among program managers for adopting sustainability as an overarching paradigm.

**Conclusion**

After the idea of sustainable development entered the public lexicon in 1987, a new wave of rapid environmental program proliferation began (Manning, 2000; Maniates and Whissel, 2000; Romero and Jones, 2003). The renewed interest in environmental programs is tied to increasing awareness of the complex challenges posed by global environmental issues and achieving sustainable futures. These newly created programs (as well as many realigned existing programs) have focused their attention on the social, political, and ecological contexts of environmental issues combined with a new emphasis on complexity, systems understanding, and the relevance of temporal and spatial scales (Rest, 2002). The evolution of the concept of sustainability, rapid growth of ecosystem and social system knowledge, expanding internet technologies, and the emergence of new interdisciplinary research approaches are sustaining the momentum toward systems-oriented approaches to the examination of environmental issues. Concomitantly, the recognition of the importance of cultural, social, and political aspects of environmental problems in education and research has also increased dramatically (Bonnett, 1999; Romero, 2003; Ginsberg et al., 2004).

A new term, sustainability science has been coined to describe an emerging field of research dealing with the interactions between natural and social systems, and how those interactions affect sustainability. Sustainability science is described as science dedicated to improving the human condition. It is place-based and integrative and bridges:

1. the natural, social, and applied sciences;
2. multiple sectors of human activity;
3. geographic and temporal scales; and
4. various communities engaged in promoting ecological and human health, conservation and economic development.

It addresses the fundamental questions regarding the interrelationships of scale, non-linear processes, and complexity, as well as the unity of nature and society (Kates et al., 2001). There is clear alignment of this emerging view of science for sustainability and environmental programs' renewed focus on all aspects — social, political, cultural, ecological, and technological — of environmental problems, as well as the importance of temporal and spatial scales and systems-oriented thinking.

The results of this Q analysis of program managers’ perspectives on curriculum design suggests that CEDD members may support the development of core competencies for interdisciplinary environmental programs and that sustainability
may serve as a paradigm to guide their development. The consensus view on the core identity of environmental programs as a holistic, interdisciplinary focus on the interface between societal systems and natural systems is congruent with a focus on the ecological, societal, and economic aspects of sustainability.

The results also demonstrate tension between programs managers’ preferences for fixed versus flexible standards. Environmental Citizens and Problem Solvers are wary of overly prescriptive core competencies and prefer standards that are broad and flexible while Environmental Scientists prefer a universal set of fixed standards. This disagreement on the nature of core competence recommendations will need to be resolved.

While the similarity between CEDD members’ views of environmental program identity and concepts of sustainability is apparent, and the emerging trend toward the adoption of sustainability as a framework for environmental program curriculum design is accelerating, further research and deliberation is required to determine if sustainability can form a unifying paradigm for the articulation of core principles for all interdisciplinary environmental programs. Three additional studies are planned. A broad survey of all US higher education environmental programs is currently underway. A study of mature programs to determine whether program curricula are converging or diverging on one or more curricula designs will be immediately after the national survey is completed. A study of successful curriculum models will follow in 2009. The results of these studies will then be used to inform subsequent discussions about core competencies among program managers and other interested parties with the goal of exploring the possibility of consensus.

Notes

1. The regression was performed with institution type as the categorical independent variable coded as (baccalaureate, masters, and doctoral) and (factor loading) as the interval dependent variable. Effect coding was used to adjust results due to unequal institution sample sizes: 11 baccalaureate, 8 masters, and 23 doctoral (total = 44). Three regressions were conducted, one for each of the factors, utilizing SPSS 12.0 software.

2. Scheffe post hoc tests of institutional class differences confirm that significant differential effects exist when contrasting baccalaureate and masters institutions on Factors A and C ($p < 0.05$) and masters and doctoral institutions on Factor C ($p < 0.05$).

References


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