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Theory in, theory out: NCSE and the ESS curriculum

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Abstract The National Council for Science and the Environment (NCSE) has played a prominent role performing empirical research on the environmental studies and sciences (ESS) curriculum over the last 10 years and in significant ways has helped define the "new normal" of the ESS curriculum—for instance, in foregrounding sustainability as its core theme. Greater attention to the conceptual assumptions and implications of this effort—i.e., how theory informs and follows from NCSE's empirical research—may help us better interrogate this "new normal" as we collectively chart the ESS curriculum of the future. In this paper, I examine one key recent NCSE report, titled "Interdisciplinary Environmental and Sustainability Education on the Nation's Campuses 2012: Curriculum Design." Its theoretical dimensions are summarized via three key steps: (a) the ideal ESS curriculum builds on diverse forms of knowledge, (b) this diverse knowledge can be organized into major curricular models, and (c) sustainability integrates these curricular models. The final step, presented without empirical justification, appears to derive both from earlier NCSE-related publications and theoretical assumptions from the first two steps. I conclude by rephrasing these three steps as questions for continued discussion and debate. Ultimately, theory and empirical research both matter in discussions over the ESS curriculum, which would ideally be informed but not constrained by NCSE's contributions.

Keywords Theory · ESS curriculum · NCSE · Sustainability

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Theory and the NCSE curriculum study

The environmental studies and sciences (ESS) curriculum has been the topic of published empirical studies and opinions for at least the last 15 years (e.g., Soule and Press 1998; Maniates and Whissel 2000; Romero and Silveri 2006; Clark et al 2011a, 2011b; Gosselin et al 2013; Cooke and Vermaire 2015). Recent discussions over the ESS curriculum, however, have featured one actor in particular: the National Council for Science and the Environment (NCSE), dedicated to "improving the scientific basis for environmental decision making." NCSE, located in Washington D.C., was originally launched in 1990 as the Committee for the National Institute for the Environment, then renamed in 2000. As part of its University Affiliate Program, including roughly 200 US institutions of higher education, NCSE facilitates the Council of Environmental Deans and Directors (CEDD), "an association of institutional representatives who come together to improve the quality, stature, and effectiveness of academic environmental programs at US universities and colleges." NCSE CEDD staff and members have played a central role in the formation of the Association for Environmental Studies & Sciences (AESS), and NCSE currently provides administrative support for AESS; the two organizations have thus been closely linked.[1]

The ESS curriculum has been an important focus of NCSE, from the founding of a CEDD curriculum committee in 2003 to a multi-phased curriculum study culminating in the 2013

[1] For more information on NCSE and CEDD, see www.ncseonline.org. For a summary of the relationship between AESS and NCSE/CEDD, see the About page at aess.info.

report highlighted in this essay.[2] Curriculum discussions have been prominent features of CEDD meetings, and scholars and staff associated with NCSE have shared empirical findings and perspectives in a variety of publications, as well as featured plenary addresses at AESS national meetings. Via NCSE's Center for Environmental Education Research (CEER), NCSE has consulted with ESS program clients to help them define their curricular trajectories based in large part on NCSE's empirical results—what CEER describes as its "exclusive, nationally representative data sets."[3] NCSE and its ESS curriculum study, in short, have played a key role informing and guiding ESS curriculum discussions at the institutional and national scale.

These NCSE contributions provide rich points of departure for further discussion. My aim here is to call attention to the important, debatable, and generally neglected theoretical dimensions of the NCSE curriculum study. Empirically-based studies will play a valuable role in ESS curriculum discussions, but theory is always present in these studies as well. Theory is commonly thought of as a specific explanatory hypothesis (as in "I have a theory about x"); but theory can also be understood as broad conceptual frameworks that ground the assumptions and implications of scholarly work—often implicitly, thus demanding our concerted attention. In the case of ESS, theory is particularly important given its diverse range of contributing disciplines and related conceptual frameworks, set against an understandably practical, applied identity that tends to deemphasize conceptual analysis (Proctor et al 2013).

Theory has, in this broader sense, informed a wide range of ESS curriculum actors: it has accompanied the NCSE curriculum study, as well as the many contributions ESS practitioners have made to the NCSE study by filling out NCSE surveys, participating in CEDD discussions, and implementing NCSE guidance at their institutions of higher education. Yet theories are conceptual choices, not inevitabilities. If there is any "new normal" (i.e., settled structure) to the current ESS curriculum, we can and must continue to interrogate it, both empirically and theoretically, as we collectively chart the ESS curriculum of the future.

This paper addresses publications released as part of the NCSE curriculum study, focusing primarily on the culminating 2013 report, published internally via hardcopy report to CEDD members as "Interdisciplinary Environmental and Sustainability Education on the Nation's Campuses 2012: Curriculum Design" (Vincent et al 2013).[4] The 2013 report included analysis of both knowledge and skills components in undergraduate and graduate curricula; due to the paper's brevity, I focus only on knowledge components of undergraduate curricula. I summarize related elements of theory as three successive steps I derive from the 2013 report:

1. The ideal ESS curriculum builds on diverse forms of knowledge.
2. This diverse knowledge can be organized into major curricular models.
3. Sustainability integrates these curricular models.

The ESS curriculum has long prided itself on #1, and #3 has arguably become key to the "new normal" of the recent ESS curriculum, with #2 bridging knowledge diversity to integrative sustainability. I will review the methodologies by which these steps were carried out in order to point out their theoretical assumptions and implications.[5] Theoretical commitments expand with each of these three steps, ultimately placing sustainability at the center of the ESS curriculum, thus theoretical choices occur at and link each step.

The theoretical issues that arise here, such as the relations between humanities, social science, and natural science contributions, or the scope and relevance of sustainability across this broad spectrum of knowledge areas, have each witnessed vast amounts of scholarly ink deployed across a wide range of journals, book-length publications, and opinion pieces; these important digressions and elaborations will not be covered. My intent is simply to remind us that, as we engage in empirically-based conversations around the ESS curriculum of the future, theory remains deeply relevant and worthy of our continued attention. One often hears that theory and data are separable realms; my intent is to suggest otherwise and to support a more theoretically informed interpretation of empirical data than we find in the 2013 NCSE report.

Theory step 1: the ideal ESS curriculum builds on diverse forms of knowledge

The 2012 survey analyzed in the 2013 report focused on what NCSE calls "interdisciplinary environmental and sustainability" (IES) programs. The survey resulted in the data from 242 US undergraduate IES degree programs. One key set of

[2] See www.ncseonline.org/programs/education-careers/cedd/projects/environmental-programs-curriculum-study.

[3] For more information on CEER, see www.ncseonline.org/about-center-environmental-education-research-ceer. These consultative services have routinely been promoted at CEDD meetings. One publicly available report, with significant emphasis placed on NCSE data, was prepared for James Madison University; see www.jmu.edu/environment/ncse_report.shtml.

[4] The report was, at the time of submission of this article, available online at ncseonline.org/2013-interdisciplinary-environmental-and-sustainability-education-nations-campuses-2012-curriculum-d but has since been removed from public access; please contact NCSE to obtain a copy.

[5] See pp. 38-41 for a comprehensive summary of the report's methodology.

questions asked representatives of these programs for input on knowledge area contributions to "ideal" curricula defined in the instrument as "…the importance of knowledge…competencies for degree programs graduates" (Vincent et al 2013, 53). The survey instrument included 41 knowledge areas, organized into six categories—natural sciences (7 items), social sciences (4 items), humanities (6 items), applied/professional (10 items), interdisciplinary (8 items), and sustainability (6 items). Respondents rated each on a four-point Likert scale, from "minimum/none" to "high." Knowledge and skills items were the fundamental data upon which the study's factor analysis and other data reduction/aggregation techniques eventually derived its models for ideal curriculum design.

The basic theoretical question here is "Which knowledge areas ought to be considered for the ideal ESS curriculum, and how should they be organized?" The report addressed this question in part by stating that "The knowledge…areas were vetted by a number of experts" (p. 10) and in a footnote mentions a wide range of organizations from which experts were drawn, including CEDD, AESS, and others. Though their methodology for finalizing knowledge areas was not presented, it is apparent that NCSE relied at least in part on the ESS community. Yet, assuming a similar methodology was deployed for their 2008 NCSE curriculum survey (Vincent and Focht 2011), somehow the list of knowledge areas expanded tremendously, as only 16 knowledge areas were included in 2008 as compared to 41 in 2012.

Knowledge, of course, is not handily organized even into 41 areas; theoretical choices had to be made. One important choice is evident in the fact that some items comprise individual scholarly fields or research topics, while others comprise aggregates. For instance, the social sciences category includes an aggregate item "Behavioral Social Sciences (e.g., sociology, anthropology, psychology, organization development, cultural studies)"— though for some reason political science is retained as an independent item—whereas the natural sciences category includes more individual fields, such as chemistry, physics, and biology. For the ensuing statistical analysis to draw valid results from responses to these items, one must assume that each item is relatively homogeneous. This may indeed be the case with responses to, say, chemistry, but it is hard to imagine in the case of "Behavioral Social Sciences," as several of the listed fields (e.g., sociology and cultural studies) would generally not be classified as behavioral sciences, at least via the US National Science Foundation's Directorate for Social, Behavioral, and Economic Sciences.[6] Admittedly, there are no perfect choices when one must divide all potentially relevant ESS knowledge into a finite number of individual items, but a close inspection of the 41 items suggests a number of similarly debatable assumptions.

In addition to theoretical choices made at the scale of specific knowledge items, important choices were made concerning the composition of general knowledge categories. For instance, the interdisciplinary category was primarily exemplified via a number of "systems" items—"Systems Analysis," "Energy Systems," "Water Systems," and "Food Systems"—such that this category may have implicitly measured respondents' predispositions regarding systems language as much as their prioritization of interdisciplinarity. Additionally, a new knowledge area category, sustainability, was introduced for the 2012 survey relative to the 2008 survey and populated in part by separating arguably interrelated components of sustainability into separate items, including "Environmental," "Business/Economic," and "Social" sustainability. Choices made regarding knowledge categories would not seem to constrain the ensuing factor analysis, which involves items, not categories; yet populating a category such as sustainability with a sufficient number of items would be necessary for this category to eventually surface as a factor, as will be suggested below.

In short, the inclusion of 41 knowledge areas suggests a theoretical position of epistemological pluralism. This is a laudable position; yet the study's empirical data indicate that the ESS curriculum also embodies conflicts between these knowledge areas and that priority knowledge areas fall along a narrower spectrum. Based on the resultant factor analysis, correlations point to conflicts in respondent preference for the social sciences vs. physical or life sciences and no relation between the latter and sustainability (p. 13). And based on descriptive statistical results (pp. 57–8), a rank ordering of knowledge areas given highest priority simply includes "Environmental Sustainability," "Sustainability General Concepts," "Climate Change/Disruption," "Ecology," and "Biology" as the top five. These may or may not be the most important knowledge areas in the ideal ESS curriculum, but they certainly do not represent the wide range of knowledge items and categories included in the survey. This simple ranking result may be more telling than the sophisticated factor analysis results based on Likert scale ratings, for the obvious reason that curricula are finite—only certain courses can be included. One could, in other words, rate a wide variety of knowledge areas as potentially relevant to the ESS curriculum, but ranking, not rating, represents the realistic curriculum choices that are eventually made.

Theory step 2: this diverse knowledge can be organized into three major curricular models

The 2013 NCSE report represented, in part, the responses of 242 undergraduate programs on 41 potential knowledge area contributions to the ideal ESS curriculum. For meaningful patterns to emerge, this relatively large data matrix was

[6] See www.nsf.gov/dir/index.jsp?org=SBE.

subjected to a variety of statistical data reduction and aggregation techniques. The first step involved factor analysis, a standard data reduction method in which (assuming a sufficient number of responses) a large set of variables may be reduced to a smaller set based on their interrelations.

In the case of the 2013 report, factor analysis revealed seven underlying composite variables or factors the study called “knowledge components,” onto which the original 41 knowledge items loaded with variable weight, aiding factor identification (p. 12). One is, however, immediately struck by the close match between the original six knowledge categories and these statistically derived factors: the natural sciences category was split into physical and life science factors, and items under the applied/professional and interdisciplinary categories were renamed as “built environment” and “systems” factors, but all others were retained as originally categorized. This result could be seen as an unsurprising validation of the original knowledge area categories, or it could suggest that whatever theoretical assumptions resulted in selecting and populating these categories effectively determined the eventual factor analysis. As one example alluded to above, it would have been highly unlikely for sustainability to have been retained as a knowledge component (factor) had it not been divided up in six separate items, unless that one item were statistically unrelated to, yet explained significant overall variance relative to, all other items. Factor analysis, in short, works with theory-derived data and thus produces theory-influenced outcomes.

The next step in identifying patterns in ideal undergraduate ESS curricula involved cluster analysis, by which factor scores for each of the seven knowledge components [and seven skills components, not summarized above] for all institutions were further aggregated into three curricular models, one of which was then associated with each program based on factor means and other program information. The three models were titled “Natural Systems Emphasis” (34 % of surveyed programs), “Social Systems Emphasis” (29 %), and “Sustainability Solutions Emphasis” (37 %); considering the seven knowledge components factors alone, these models are unsurprising. Thus, for instance, programs following the “Natural Systems Emphasis” model placed relatively more emphasis on physical and life sciences and relatively less on systems, humanities, built environment, social sciences, and sustainability, than all programs on average. It should be noted, in anticipation of theory step #3 below, that the sustainability knowledge area factor received only slightly more emphasis among Social Systems Emphasis programs, and far less emphasis among Natural Systems Emphasis programs, than all programs on average.

A final step in identifying patterns in ideal undergraduate ESS curricula from the 2012 survey involved a two-dimensional discriminant analysis of participating programs, based on their knowledge [and skills] factors, into a Sustainability and Solutions axis and a Natural Sciences and Traditional Research axis. Again, identification of these axes followed directly from factors: for instance, the sustainability knowledge component was strongly correlated with Sustainability and Solutions, and the second axis was strongly correlated with physical and life science knowledge components. Yet discriminant analysis also suggests important theoretical implications, in that sustainability and the natural sciences proved the key differentiating elements. It is worth deeper analysis as to why these elements received such variable support among participating programs.

Theory step 3: sustainability integrates these curricular models

One summary graphic from the 2013 NCSE report (Fig. 1) depicts cluster and discriminant analysis results summarized above, as well as the final theory step.[7]

Significantly, “Problem Solving for Sustainability” was placed at the intersection of the three curricular models, yet no empirical justification was provided. It seems as if sustainability were simply assumed to integrate these models: for instance, the text introducing the figure states “Each model emphasizes different knowledge and skills components to prepare graduates for different types of sustainability-oriented problem solving” (p. 18), and the executive summary reads “IES programs have a distinctive goal: preparing sustainability-oriented problem solvers through interdisciplinary scholarship, research, practice and informed citizenship” (p. 5).

As a reminder, six sustainability items were included in the set of 41 knowledge areas (theory step #1), leading to inclusion of sustainability as one of seven knowledge components (factors) in the theory step #2. Yet sustainability proved to be a significant variable of differentiation between programs that did and did not emphasize it. To be empirically faithful to this finding, sustainability would by necessity be located toward the right side of Fig. 1, i.e., toward the center of the Sustainability Solutions Emphasis model, not at the intersection of all three models where it was depicted.

What, then, was the basis for the claim that sustainability integrates these ideal ESS curricular models? One possible answer can be gained from earlier NCSE-related publications. The first (Vincent and Focht 2009) summarizes a Q sort of 47 statements (e.g., “The most important thing is for students to understand environmental issues from a broad perspective rather than training them for a specific professional career”) by representatives of 42 CEDD institutions, resulting in three desired curricular core competencies: “Environmental citizen,” “Environmental problem

[7] Fig. 1 is an idealized graphic; see the NCSE report for figures that plot actual cluster and discriminant analysis data.

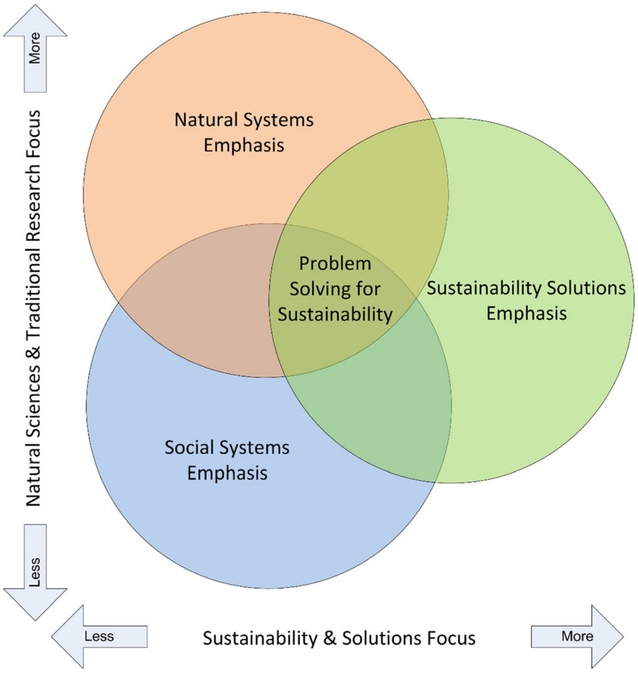

Fig. 1 Summary diagram showing results of cluster and discriminant analysis, with "Problem Solving for Sustainability" located at the intersection of the three ideal curriculum models. Figure used with permission from National Council for Science and the Environment (Vincent et al 2013)

solver," and "Environmental scientist," with a fourth competency of "Environmental integrator" derived via a second Q-factor rotation. Though none of the 47 statements include sustainability, the authors conclude that the results "…support the development of core competencies for interdisciplinary environmental programs and that sustainability may serve as a paradigm to guide their development" (p. 179). In a follow-up publication (Vincent and Focht 2010), the authors repeat their summary of the Q sort analysis and provide an empirical justification for a similar claim regarding sustainability: "Discussions that the authors moderated at three recent meetings of higher education environmental program leaders, faculty, and students indicate broad support for adopting sustainability as an overarching paradigm" (p. 84). A footnote to this statement mentions CEDD and AESS meetings but provides no empirical data nor methodology.

A later publication (Vincent and Focht 2011), providing an analysis of the 2008 NCSE curriculum study, concludes with a diagram remarkably similar to Fig. 1, in which "Problem Solving for Sustainability" lies at the center of three curricular models. The authors note, without empirical justification, that "All three curriculum models prepare students to engage in problem solving for sustainability, but using different approaches" (p. 26), and conclude "Our findings provide a broad framework based on coupled human-nature systems and sustainability that can serve as a foundation for understanding IE programs and guiding curriculum design" (p. 33). This inclination continues in a more recent publication on sustainability curricula in ESS programs (Gosselin et al 2013). In their conclusion, the authors state "Sustainability is acknowledged as the primary normative goal for IEE [interdisciplinary environmental education] programs" (p. 329).

Does sustainability reside at the intersection of the three curricular models derived from the 2012 NCSE survey? Perhaps as a theoretical leap, but not as an empirical result. The same theoretical leap is evident, without detailed empirical justification, in the NCSE-related publications that preceded it. Certainly, there is interest in sustainability among ESS programs: the 2013 NCSE report mentions tremendous growth from 2008 (13 sustainability programs) to 2012 (141 sustainability programs). Sustainability has undoubtedly become central to the "new normal" of the ESS curriculum, in spite of a range of conceptual critiques (e.g., Luke 2005; Parr 2009; Benson and Craig 2014). But sustainability is only one of a set of candidate integrative concepts that theory could supply: a wide range of alternatives exist, including the Anthropocene (e.g., Castree 2014), complexity (e.g., Holling 2001), human dignity (Clark et al. 2001 a, b), political ecology (e.g., Robbins et al 2014), and values (Chapman 2007).

This third and final step thus makes even larger theoretical claims than the previous two, with less empirical basis, and effectively closes off discussion on one of the most interesting questions of all: what options do we have to lend greater conceptual coherence to the ESS curriculum in future? The ideal blend of pluralism and integration in the ESS curriculum is an open question and potentially poses the sort of contradiction inherent in the NCSE report as it moves from embrace of pluralism (theory step #1) to integration around sustainability (step #3). Whatever the reality and desirability of pluralism among ESS curricula, some degree of theoretical coherence may better facilitate the sort of engaged, cross-disciplinary scholarship many ESS programs profess; sustainability is one, but only one, among a range of integrative options.

Implications: moving forward

The 2013 NCSE report reviewed above contains invaluable empirical data on the ESS curriculum and should serve as the basis for discussion and debate for some time. Perhaps more significantly, it holds up a mirror to key, often unquestioned conceptual assumptions and implications possibly shared by a significant proportion of the ESS academic community, and thus provides the opportunity for deeper interrogation of the ESS curriculum as we move forward. The NCSE report embodies both theory in the broad sense, as a set of implicit conceptual frameworks accompanying the analysis, and theory in the specific sense, recommending sustainability as the core concept to guide the ESS curriculum. Without engaging with theory more deeply and explicitly, however, NCSE's report drifts dangerously close to what is often summarily dismissed as positivism—that wishful world where empirical data speak for themselves, a world where theory is just talk.[8]

If the 2013 NCSE report and NCSE-related ESS curriculum study efforts more broadly are important but theoretically limited, what next steps should be taken? I do not call for abandoning empirical data nor for neglecting the perspectives NCSE offers. What arises is an opportunity for continued, more theoretically informed discussion among the ESS academic community, and it could be built on the three theory steps in the NCSE report mentioned above. From a future-oriented perspective, we could reframe these three steps into the following questions:

1. What knowledge areas ought to be included in future ESS curricula, relative to the 41 areas included in the NCSE report?
2. What kinds of valid ESS curricular models could be organized around these knowledge areas, relative to the three curricular models included in the NCSE report?
3. What key theme(s) could be advanced to help integrate these models and knowledge areas spanning the ESS curriculum, relative to the sustainability theme recommended in the NCSE report?

As suggested in the wording of these questions, our future-oriented answers may well be informed by the NCSE curriculum study, but they would not be determined by it. What *is* (even in the context of the "ideal curriculum"—the basis for NCSE survey responses) is not the same as what *should*, or *could*, be. We have choices to make, choices informed both by empirical data and theoretical depth. Without the former, we lose grounding; without the latter, theory in leads to theory out, and the "new normal" constrains the future possible. If the 2013 NCSE report is to mark a turning point in our collective imagination of the ESS higher education curriculum, we must move beyond it.

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[8] Space unfortunately precludes exploration of "positivism" (an often imprecisely deployed term) and its relationship to the ESS curriculum. As one resource, Clark et al. (2011a) explores positivism and its possible ESS connections in some detail.

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