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The Case for Interdisciplinary Environmental Education and Research

[1]Will Focht and [2]Charles I. Abramson
[1]Oklahoma State University, 003 Life Sciences East, Stillwater, OK 74078
[2]Department of Psychology,
Oklahoma State University, 401 North Murray, Stillwater, OK 74078

Abstract: Problem statement: Interdisciplinary environmental education and research at American colleges and universities have been criticized for ambiguous focus, insufficient integration and lack of rigor. Part of the reason for a clearly articulated conceptualization of the field is the failure to reach a consensus among those in the environmental profession and academic community on an overarching paradigm of environmental education and research. **Approach:** This essay argued for situating interdisciplinary environmental education and research on the principles of sustainability. **Results:** We believe that sustainable solutions to the complex problems facing us at the interface of society and nature cannot be found using unidisciplinary and multidisciplinary approaches. Instead, what is needed is an interdisciplinary synthesis across a wide range of natural sciences, social sciences, applied sciences and the humanities. The appropriate mix of these depends on the particular problem being addressed. **Conclusion:** By focusing on human quality of life, the health of systems that supply the resources needed for quality of life improvements and the regulation of capital flows between and among these systems, we can devised an educational and research agenda that more efficiently meets the needs of today's generations and those that follow.

Key words: Environmental science, environmental studies, sustainability, interdisciplinary

INTRODUCTION

We start this discussion of environmental science research with a definition of environmental science. In doing so, we must come to terms with the differences, if any, between environmental sciences and environmental studies. It is commonly believed that environmental sciences programs emphasize natural and applied sciences whereas environmental studies programs place more emphasis on social sciences and the humanities. Preliminary results obtained from an ongoing study directed by one of us (Focht) do not reveal major differences in the core curricula among programs entitled environmental sciences and environmental studies. Both program types address cognitive skills such as systems thinking, critical thinking, problem solving and communication. Moreover, the inclusion of life sciences, physical sciences, statistics, policy and ethics as important components of their curricula is popular in both program types. We therefore must conclude that reified differentiation of environmental sciences from environmental studies is neither justified nor helpful.

Now, we can properly consider whether a universal definition of environmental sciences and studies exists. Based on a survey conducted as part of the same study mentioned above, Vincent and Focht[1] demonstrates that we can state with some confidence that no universal agreement exists on the definition of environmental sciences and studies.

If little agreement can be found among environmental program directors on a definition of environmental sciences, perhaps a consensus can be discerned within the environmental field. Unfortunately, this is not the case. Even a cursory search on the Internet turns up 47 environmental licensures, registrations and certificates in environment, health and safety and another 11 relating to environmental specializations within other fields.

We now turn to the plurality of the terms "environmental sciences" and "environmental studies". It is apparent that several disciplines and fields can be considered as environmental sciences or studies. Certainly, geography, geology, agronomy, botany, zoology, microbiology, climatology, ecology, oceanography, chemistry, engineering and physics concern themselves with the environment. Likewise, political science, sociology, psychology, economics, management, communication science, ethics, history, literature and the fine arts devote significant attention to

Corresponding Author: Will Focht, Oklahoma State University, 002 Life Science East, Stillwater, OK 74078-3011

the environment. In fact, almost every discipline on a college campus can legitimately claim an interest in, and offer important contributions to, the study of the environment. So we must face the question: what do the disciplines and fields commonly referred to as environmental sciences and studies offer?

The most obvious answer is that environmental science and study seek to integrate the insights and methods of multiple disciplines in their investigations. The reader will notice that we used the singular forms of science and study. This, of course, is intentional. While there are many environmental sciences and studies departments and programs at colleges and universities across the U.S., we wish to distinguish our topic of conversation by referring to environmental science and study in their singular forms. In fact, many environmental science programs now use the singular form; however, programs labeled as "environmental study" remain few. In the remainder of this article, we will use only the singular forms.

Given that the difference between environmental science and study is vague, often superficial, and rarely determinative, a term that combines them is desirable. However, no such term has emerged that has gained widespread support. In fact, a new national organization established last year has taken the name of Association for Environmental Studies and Sciences, which unfortunately, uses plurals. For the moment, therefore, we are left only with the combined term, "environmental science and study".

We are now ready to offer our definition of environmental science and study. Environmental science and study is an interdisciplinary enterprise whose goal is to understand and preserve the health and integrity of the systems lying at the human-nature interface.

This definition makes clear the singular, integrated nature of the field. It also focuses our attention on the interface between natural and human systems, rather than on either natural or human systems alone. Finally, it articulates the purpose of the field: to understand and preserve the health and integrity of the systems lying at the interface.

Figure 1 shows the human-nature interface as a recursive relationship between human impacts on nature and the provision of natural resources (ecosystem goods and services) to humans. Human systems include those involving socio-cultural institutions, economies and governments. Natural systems include the ecosystems. Technological systems overlap both human and natural systems.

In the next two sections, we extend our definition of environmental science and study through incorporation

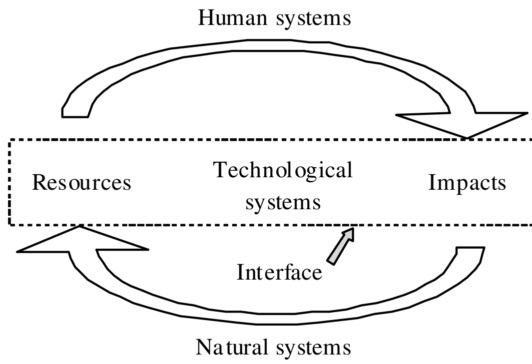

Fig. 1: Human-nature interface

of the concept of sustainability. We also propose "sustainability" as a replacement for the awkward term, environmental science and study.

ON SUSTAINABILITY

Over the last decade or so, we have witnessed a growing embrace of sustainability as a core principle in environmental science and study. Sustainability is now becoming, we believe, a moral imperative in the field.

Though sustainability and sustainable development have many, sometimes conflicting, definitions, the most popular of these is: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[2].

Other popular definitions refer to some variant of the "triple bottom line": Economic prosperity, environmental quality and social equity. We wish to expand on these definitions by including references to what is to be sustained and the critical importance of resource, resilience and control systems.

We propose the following definition of sustainability:

> Sustainability refers to the long-term improvement of human satisfaction with quality of life through a balanced and adaptive stewardship of resources that lie at the human-nature interface, which in turn requires that the systems that provide these resources be maintained in a healthy and resilient condition.

Let's parse through this definition. First, we propose that what is to be sustained is improved human satisfaction with quality of life. We chose this target because we believe that the human drive to improve well being is universal. We specify satisfaction with quality of life to acknowledge that well-being judgments are necessarily subjective and to imply that quality of life improvements need not require ever-increasing consumption.

Second, human judgments of quality of life satisfaction are based on personal assessments of physical health and existential contentment.

Third, our conception of sustainability is based on systems and the forms of capital that these systems require for their structure and function and which they can produce for export. The first system in our framework, to which we just alluded in the previous paragraph, is the autonomous human system, which includes individual humans who make personal quality of life judgments.

Fourth, we envision only three primary systems are required to provide the resources needed to sustain improvements to satisfaction with human quality of life, with an auxiliary system added to provide resilience. The three primary resources systems are the ecological system (which provides natural capital), the societal systems (which provides social capital) and the technological system (which provides fabricated, or human-made, capital). Satisfaction with quality of life thus requires sufficient supplies of capital from all three of these systems, which in turn requires that these systems be maintained in a healthy state. The fourth resource system, the economic system that provides financial capital, plays a special role in the health of the other three resource systems. Because financial capital is easy to store and serves as a convenient facilitator of exchange among the other three systems, the economic system plays a resilience role for the entire resource pool.

Fifth, if individuals are dissatisfied with their quality of life, they may initiate behavioral changes in an attempt to restore loss happiness. However, in many cases, individual action is not sufficient to bring about the changes in capital flows needed. In these cases, they may make political demands on a sixth system: the governance system, which requires and generates political capital. This control system can respond with policies designed to regulate resource capital flows or induce collective behavioral change to accommodate political demands to improve resource availability and distribution. It is important to point out that the governance system includes not only government agencies but also civil society organizations that participate in motivating collective action for the benefit of citizens.

Figure 2 shows a diagram of this conception of sustainability.

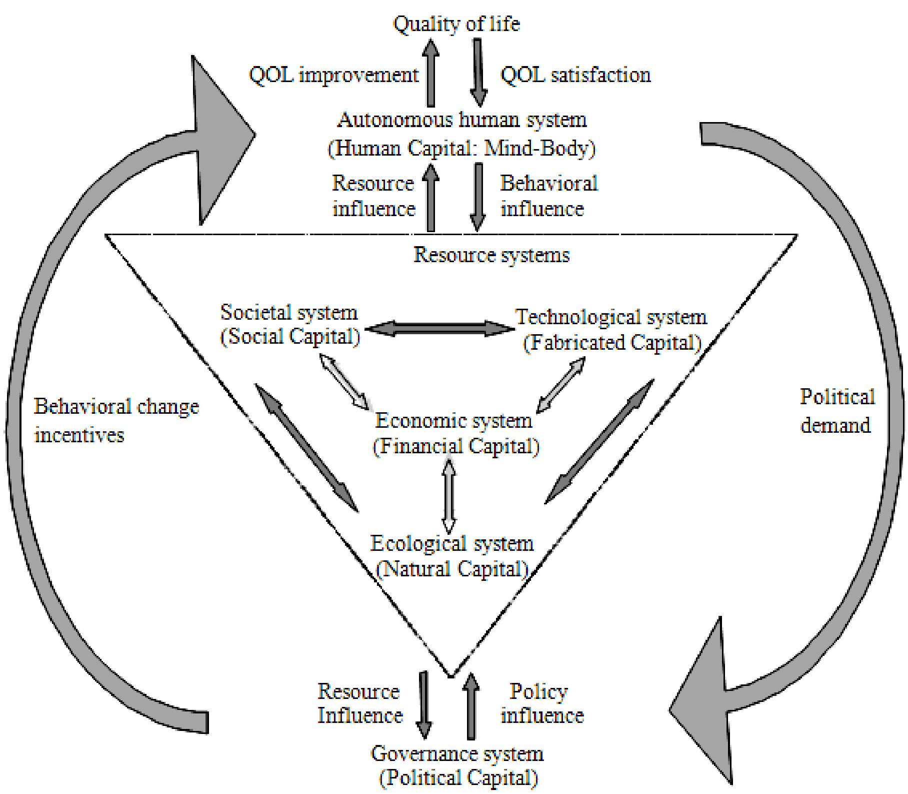

Fig. 2: Sustainability framework

INCORPORATING SUSTAINABILITY INTO ENVIRONMENTAL SCIENCE AND STUDY

In the study, we presented a definition of environmental science and study that focuses on the interdisciplinary study of the interface between human and natural systems. In the second section, we developed a definition of sustainability that focuses on the health of systems that provide the resources necessary to improve human satisfaction with quality of life. We are now in a position to combine sustainability with environmental science and study, since both definitions refer to the interface between human and natural systems. In fact, we see the addition of sustainability to our expanded conception of environmental science and study as a normative commitment: environmental professionals have an ethical duty to steward both human and natural resource systems to improve satisfaction with quality of life. Clearly, such a challenge requires an interdisciplinary synthesis of approaches, models, concepts and methods -a challenge that environmental professionals should be trained to meet.

Let's take another look at the human-nature interface (Fig. 3) this time adding approaches that are less comprehensive than the one we are advocating. We included in our figure various pairs of subfields of our notion of an integrated field of study of the human-nature interface. On the outer right, we included environmental study and science because these two fields are concerned primarily with impacts. On the outer left, we placed conservation study and science, which are counterparts to the environmental pair but which focus on resources. Notice that the study pair (environmental and conservation) are located nearer the human system part of the interface whereas the science pair is located nearer the natural system part of the interface. This is simply an acknowledgement of the popular conception of study versus science-but their distance from each other is small due to their substantial common ground.

The economics and policy/administration pairs are situated squarely within the human system while the engineering pair is situated within the natural system. All three pairs are concerned with the interface but the environmental versions are located toward the right (impact side) and the ecological/natural resource versions are located toward the resource side of the interface.

We can now arrange these ten subfields into five left-right (resource-impact) pairs based on their sustainability system anchors: ecological, societal, technological, economic and governance (Table 1). We have argued that sustainability is concerned with both human impacts on resource systems and the resources provided by these systems to humans. Therefore, we combined each system-based resource-impact pair into a sustainability interdisciplinary. Then, we combined all five sustainability interdisciplines into a sustainability supradiscipline.

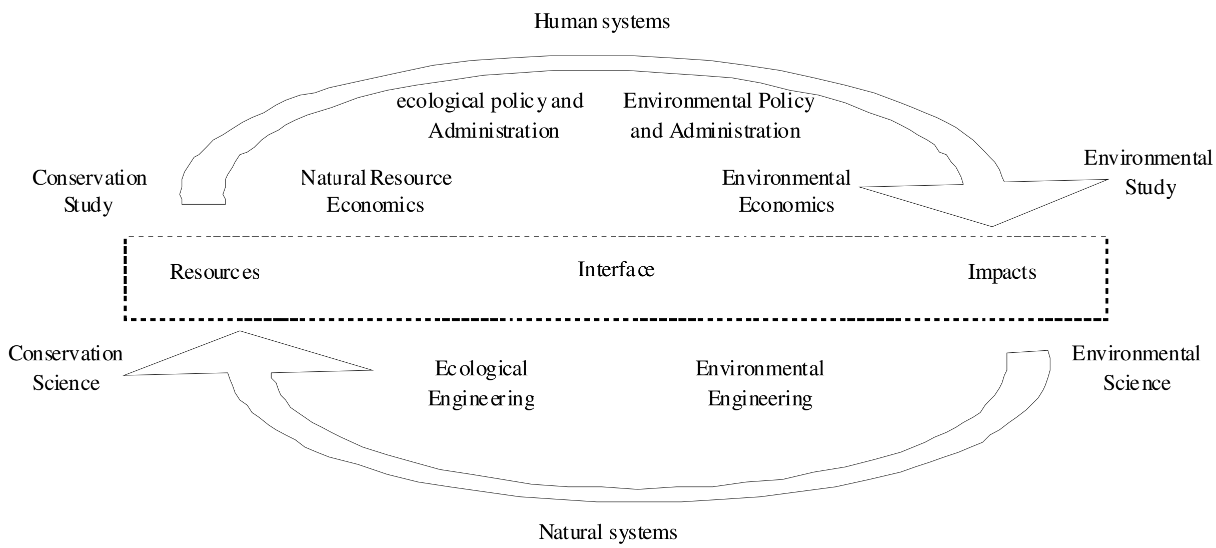

Fig. 3: Some of the interdisciplinary approaches to the study of the human-nature interface

Table 1: Interface interdisciplines integrated into a sustainability supradiscipline

System anchor	Capital	Parent interdiscipline	Interface interdisciplines	Focus
Ecological	Natural	Natural Ecology	Environmental Science	Impact
			Conservation Science	Resource
			Sustainability Science	Both
Societal	Social	Human Ecology	Conservation Study	Resource
			Environmental Study	Impact
			Sustainability Study	Both
Technological	Fabricated	Industrial Ecology	Environmental Engineering	Impact
			Ecological Engineering	Resource
			Sustainability Engineering	Both
Economic	Financial	Business Ecology	Environmental Economics	Impact
			Natural Resource Economics	Resource
			Sustainability Economics	Both
Governance	Political	Political Ecology	Environmental Policy and Administration	Impact
			Natural Resource Policy and Administration	Resource
			Sustainability Policy and Administration	Both
All	All	Sustainability ecology	Sustainability (supradiscipline)	Both

THE CASE FOR INTERDISCIPLINARY EDUCATION AND RESEARCH

We are now in a position to make our case for making a place for interdisciplinary environmental education and research in our higher educational institutions.

First, people everywhere are fundamentally interested in and motivated by a desire to improve their quality of life, as they themselves judge it. People also want these improvements to be sustained intergenerationally.

Second, sustained quality of life improvements require healthy resource systems that can provide adequate supplies of various forms of capital whenever and wherever needed. When people become sufficiently dissatisfied with their quality of life, they modify their behavior to regain satisfaction or, failing that, make demands of sociopolitical institutions to provide additional capital.

Third, history has taught us that failure to consider the damage we do to resource systems as we continue to increase demand for capital can cause resource system collapse. Therefore, sustainable improvements to quality of life satisfaction require enlightened stewardship of resource systems as well as education of consumers about their resource system impacts, available supplies of capital and the value of reconceptualizing quality of life.

Fourth, resource systems are inextricably linked in a complicated, dynamic and chaotic metasystem. The behavior of each individual system within the metasystem is likewise complex and poorly understood. Not only do we know little about how these systems behave and interact, we can’t even agree on what should be measured in order to understand the health of these systems. An aggressive, broad and sustained research program is needed to get a handle on the health of resource, resilience and regulatory systems and the rate of capital consumption that can be sustained over the long term.

Fifth, given the uncertainties about resource system health and productivity, we should develop active adaptive management techniques to learn as much as we can about the systems and our impacts on them. Prudent stewardship requires that we should be guided by the precautionary principle in order to avoid irrevocable commitments of resources if the risks of being wrong are high.

Sixth, we should develop and evaluate rehabilitation and restoration practices to restore system health and productivity wherever possible. We should also examine how to improve resource use efficiencies and impact mitigation.

We recognize that this is an ambitious education and research agenda. More to the point, we recognize that such an agenda requires a synthesis of disciplines. Society certainly needs disciplinary specialists to tackle the problems that lend themselves to unidisciplinary solutions. However, society also needs interdisciplinarily trained specialists who can discern and understand the interactions between human and natural systems and who can develop solutions that integrate knowledge and skills across disciplines. Disciplinary synthesis is not obtained through the mere juxtaposition of unidisciplinarians in multidisciplinary teams. Interdisciplinary insight is best achieved through rigorous reflection of connections and relationships across disciplines to address a class of problems with which the interdisciplinarian is familiar. In short, we recommend that sustainability serve as the overarching paradigm in education and research aimed at improving human quality of life.

We recognize that no one person can know all areas of sustainability. Therefore, we recommend that sustainability education and research be focused on particular problem themes. For example, sustainability themes could be organized something like this:

- Sustainable manufacturing and product design
- Sustainable architecture
- Low impact development (smart growth)
- Sustainable communities
- Sustainable agriculture and natural resource management
- Sustainable energy management
- Sustainable watershed management
- Pollution prevention (zero waste and recycling)
- Climate change mitigation and adaptation
- Sustainable business
- Metrics of sustainability and system performance monitoring
- Quality of life attributes, measurement and change

An environmental (sustainability) student would be trained in one of these themes and justifiably later claim professional expertise in it. Moreover, researchers would focus on one (or perhaps more) of these themes in order to achieve competence and success.

CONCLUSION

We hope that this article motivates discussions among environmental educators, researchers and practitioners about the future of environmental science and study and the role that sustainability could play within it. This issue of AJES presents some of the research conducted at OSU that highlights how interdisciplinary research aimed at problems lying at the interface of human and natural systems was conducted.

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