

Volume 11 Issue 4
12 / 2013
tamarajournal.com



Moving Beyond the Single Discipline: Building a Scholarship of Engagement that Permeates Higher Educationⁱ

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Keywords

Interdisciplinary Research
Engaged Scholarship
Community Engagement
Stakeholders
Sustainability

Abstract

Communities face complex problems that are best addressed by integrating the perspectives of multiple disciplines, yet many forms of engaged scholarship remain disciplinarily specific. Universities struggle to bring together highly disparate disciplines linking knowledge with action to address community problems. Sustainability is an important example of a complex, urgent problem that is best addressed by integrating multiple disciplines. In the United States, a unique multi-year initiative, Maine's Sustainability Solutions Initiative (SSI), addresses sustainability problems by working

***Community Based PAR
Transdisciplinary
Engagement***

across disciplines on engaged research. Scholars, representing multiple disciplines and most of the higher education institutions in the state, working with their community partners, are addressing sustainability problems related to landscape change, specifically urbanization, forest ecosystem management, and climate change. This initiative is composed of over two dozen interdisciplinary, engaged research projects that include diverse stakeholders (e.g., nongovernmental organizations, communities, policy organizations, and governmental leaders) as members of the research teams. Reflecting on the challenges of involving multiple disciplines in research projects, we discuss SSI as an exemplar of interdisciplinary, engaged campus initiatives. The scale and reach of the initiative (on-campus and statewide), the number of disciplines and stakeholders involved in the project, and the conversations around engaged scholarship occurring at the University of Maine capture the challenges and opportunities of moving the scholarship of engagement beyond the isolated work of individual disciplines.

Introduction

“Calls to action” for increasing the emphasis on engaged scholarship are plentiful. Boyer (1996) conceptualized a “new American college” that would incorporate engaged scholarship. A Kellogg Commission report (1999) and the Wingspread Declaration on Renewing the Civic Mission of the American Research University (Boyer & Hollander, 1999) urged universities to become more engaged with communities. The Kellogg Commission on the Future of State and Land-Grant Universities called for more effective engagement in the 21st century (Byrne, 2006). In its conclusions, the Kellogg Commission advocated moving beyond outreach and service toward engagement by integrating teaching, research, and service. What these calls to action do not address is how best to move beyond the institutional and disciplinary boundaries that constrain our efforts to engage deeply with our communities.

In this paper, we describe how Maine’s Sustainability Solutions Initiative (SSI), a multiyear, community engaged sustainability initiative funded by the National Science Foundation (NSF), captures the challenges and opportunities of working with partners outside of the academy and engaging in interdisciplinary collaborations in the scholarship of engagement. Using SSI as an example, the purpose of the paper is to examine and further understand interdisciplinary collaboration as part of community engaged research. Interdisciplinary and collaborative, engaged approaches will become increasingly important as we investigate pressing public challenges which defy easy disciplinary categorization, and which necessitate stakeholder involvement. However, moving interdisciplinarity and engagement forward as practical, useful approaches, researchers must better understand the obstacles and difficulties which such frameworks can engender. Absent such considerations, interdisciplinary engaged approaches may not fulfill their unique and exciting promise. In order to address this question, we first provide historical and conceptual framing and then present aspects of SSI that capture the complexities of transdisciplinary collaboration (between academic researchers and stakeholders) and interdisciplinary collaboration (between academic disciplines) in engaged research. We conclude by considering how these aspects can be generalized to other areas of research and community engagement.

Community-Engaged Interdisciplinary Research: History, Ethics, and Contradictions

The most recent iteration of calls for engagement in higher education is only a few decades old. In response to criticism that higher education was not extending its significant resources toward meeting important community needs (Boyer, 1990; O’Meara & Rice, 2005) many institutions began to build partnerships with community members (O’Meara et al., 2011). This response is spreading and deepening, with colleges and universities throughout the United States and globally prioritizing the development of partnerships and engagement in community-based research and activities (Weerts & Sandmann, 2010). Community engagement is an umbrella term encompassing a broad range of interactions and collaborations between higher education and communities that promote inclusivity, mutuality, and reciprocity (Driscoll, 2009). The term refers to a variety of approaches involving communities in activities that attempt to solve perplexing community issues.

Community engagement differs from traditional concepts of service and outreach in that communities and institutions of higher learning collaborate for the purpose of addressing societal needs (Boyer, 1996; Kellogg Commission, 1999). The Kellogg Commission (2000, 2001) issued a series of reports challenging higher education to become more engaged with

communities. Engaged research is not about doing research for its own sake, nor is it about merely publishing research results in academic journals. Engaged research is about finding practical solutions in collaboration with partners. The process of conducting engaged research is complex, involving multiple stakeholders with various expertise areas and ideas about methods for conducting research and defining solutions. In this paper we use the Carnegie Foundation for the Advancement of Teaching's definition of community engagement as a "collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity" (Carnegie, 2006). In Boyer's challenge to higher education, he targeted land-grant institutions because of their recognition of the importance of applying knowledge and providing service to the community (Bonnen, 1998).

Yet this focus on engagement is not a fundamentally new mission for higher education; rather, it should be considered as a *return* to the earlier understandings of the purpose of colleges and universities, understandings that date back over a century. In fact, the *origins* of many such institutions are rooted in the public purposes that they were designed to fulfill. In the United States, the Morrill Acts of 1860 and 1862 created land-grant colleges with the aim of serving local communities, specifically within agriculture and the "mechanical arts" (Beere et al., 2011). The Smith-Lever Act of 1914 created the Cooperative Extension Service aimed at community outreach, applied research in local settings, and agriculture and home economics training (Beere et al., 2011). Extension served as an entity bridging the gap between universities doing research and communities that need research-based knowledge to address their problems. Beyond the United States, in Europe and elsewhere, the training of skilled, competent civil servants and bureaucrats was the core function of the university long before contemporary calls for an engaged public mission (Albritton, 2006).

For scholars at research-oriented institutions, it is hard to imagine a time before rigid disciplinary walls governed the work of disparate academic fields. It seems inconceivable that a world existed where academics split their time and inquiry among economics, psychology, scientific laws of motion, the invention of new technologies, art, literature, and the like. The versatile scholars of centuries past strike us as oddities because modern academics are generally trained within a single discipline. However, here too, it is useful to remember that disciplinary compartmentalization is a historical development with a lineage that can be traced.

In North America and Europe, this contemporary organization of universities did not begin to emerge until the nineteenth century (Wallerstein, 1991). As universities became increasingly independent from non-secular authorities, they also increasingly organized themselves according to specialized areas of study (Bok, 1982). Today, scientific innovation and discovery occur via rigorous data collection and scrutiny by highly trained experts. This model is necessarily rationalist and reductionist. Objective data collection is the "raw material" of discovery; rational scientific inquiry is the means by which we understand it, usually with the aid of increasingly sophisticated technology. This is reductionist in the sense that it aims to diminish complex social, environmental, and physical phenomena to "first causes," "key variables," or "covering laws." Scientific discovery therefore occurs via the work of a select cadre of experts, laboring in seclusion from other disciplines and, frequently, from society as a whole.

Subsequent decades saw academe's "public" mission increasingly focused in a particular way. Recognizing the need for continuous innovation and discovery, public and private funding for scholarly research became a national priority in many countries. However, it was often the interests of elites that shaped the funding initiatives supported. Research funds centered on a handful of key strategic areas such as military technology, enhanced food production, mechanisms to manage and shape global economic interdependence, public health, and medicine. In the U.S., federal funding for research and development increased from \$280 million in 1953 to \$2.4 billion in 1970 (Beere et al., 2011). Today, the American government spends nearly \$150 billion annually on research and development (Sargent, 2011).

Although the disciplinary approach has succeeded in attracting funding and fostering technological innovation and scientific discovery, disciplinary compartmentalization has often been to the detriment of understanding complex, integrated, social, economic, and ecological challenges. As Bruns et al. (2011) recently observed, "The kinds of specialized knowledge that dominated the latter part of the 20th century are inadequate to address fully today's complex societal issues" (p. 6). Although universities may operate according to established disciplinary boundaries, the challenges we face do not. As researchers, we risk ending up much like the old Indian parable of the "blind men and the elephant," grasping but a small part of a complex whole and never its entirety.

Interdisciplinary investigation and demands that research better address society's complex challenges can run counter to the specialization that characterizes higher education (Repko 2012, Ch. 2). Universities struggle to meet these calls,

which are difficult to understand in the abstract. Concrete examples help clarify the form these struggles take and how we can address them. Our paper examines one of the largest existing efforts to bring faculty, staff, and students from diverse campuses and disciplines together with community members to address sustainability issues through engaged research. By highlighting four aspects of SSI research, we present the complexities of advancing a statewide, engaged research initiative. We illustrate how partners in different disciplines and fields who do not share assumptions, approaches, or expectations can develop productive common ground in problem-focused research partnerships.

The Sustainability Solutions Initiative

The University of Maine's Sustainability Solutions Initiative (SSI) brings together multiple disciplines and stakeholders to address a range of complex, pressing, interlinked, social, environmental, and ecological problems crucial to Maine's future. As such, SSI participants are implementing a collaborative and integrative interdisciplinary model of problem solving (Klein & Newell, 1997; Klein 2004). Such interdisciplinary approaches address complex problems by "relating the particular to the larger whole by drawing on multiple disciplinary perspectives" (Repko 2012, p. 35) as well as those of interest groups beyond the university itself. SSI aligns with NSF's Coupled Natural Human Systems directorate, a branch of research that examines how human and natural systems influence each other, and SSI receives its primary funding in the form of a five-year, \$20 million grant from NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). SSI aligns itself with sustainability science, a growing field of research that supports long-term ecological and socio-cultural functioning, where these domains leverage rather than compromise each other (Kates et al, 2001). SSI subscribes to this definition of sustainability science:

...an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: meeting the needs of present and future generations while substantially reducing poverty and conserving the planet's life support systems. (Kates, 2006).

Sustainability science analyzes these interactions through the coproduction of "useable knowledge" (Cash et al., 2006; McNie, 2007; Pielke, 2007) that integrates local perspectives (Clark & Dickson, 2003) in contrast to traditional trickle-down models that privilege university research (van Kerkhoff & Lebel, 2006). To study the complex social-ecological interactions in a way that such findings can be linked to action, scholars in this field further argue that those conducting research must work across disciplines (Matson, 2009) and with communities in novel ways (Lindenfeld et al., 2012).

In SSI, university and college researchers represent over 20 disciplines, including communication, economics, environmental science, and engineering, to name a few, and 12 institutions of higher education in the state. Like the sustainability issues that SSI addresses, the project's stakeholder groups (those who share a vested interest in an issue, solution, or outcome) are broad and comprehensive. They include nongovernmental organizations, communities, policy organizations, tribal communities, and governmental leaders. SSI's mission is:

... to connect knowledge with action in ways that promote strong economies, vibrant communities, and healthy ecosystems in and beyond Maine (<http://www.umaine.edu/sustainabilitysolutions/>).... SSI's strategy for advancing the field of sustainability science and helping to solve sustainability-related problems requires the active participation of integrated interdisciplinary research teams, fundamental understanding of the dynamics of Maine's coupled social-ecological systems, and strong stakeholder – university partnerships. (Year 4 report).

Although many faculty members in Maine previously worked on sustainability issues, SSI catalyzed an integrative approach that fosters interdisciplinary and transdisciplinary collaboration. SSI works across disciplines and institutions to conduct research that bridges disciplinary and community-university divides. In doing so, SSI confronts many of the challenges that have thwarted past attempts to move universities toward engaged research.

Below we present some of the ways in which SSI creatively confronts such obstacles, utilizing this example in which we were embedded as a qualitative case study. We draw upon our personal experiences as part of the project. In addition, we consulted with the stakeholders involved in the various initiatives to ensure that they felt this was an adequate representation of their experiences as well. We adopt this approach as it enables us to draw out both the challenges posed

by such an approach, and the creative ways in which they can be productively confronted. We should note here that the purpose of this piece is not generalizability or hypothesis generation and testing for future engaged, interdisciplinary projects; in many ways, this mode of research resists this framework of empirical inquiry, at least at the level of project conceptualization. Rather it attends to the social dynamics of research inquiry by giving voice to the variety of perspectives embedded within such a project, and the challenges that such diversity can produce. As we present aspects of SSI's engaged, interdisciplinary research, and describe the complexities faced and techniques used for managing those complexities, we will address: 1) defining, selecting, and engaging stakeholders, 2) defining and achieving solutions, 3) strengthening communication among project partners, and, 4) identifying and working through divergent epistemologies. We acknowledge from the outset that the information we present below is largely derived from our experiences as, and discussions with, other academics. Stakeholders may identify different complexities and techniques, and future research should explore these issues from a stakeholder perspective.

1. Is this a Stakeholder I see before me?

Participating in interdisciplinary, engaged research is illuminating in that it forces us to consider under-scrutinized groups such as "stakeholder." It seems self-evident that stakeholders should be central to the engaged research process and that viable solutions will result only when researchers involve those who have a stake in the research findings and their application. There are as many definitions of stakeholder in the literature as there are stakeholders, but the one used most widely identifies stakeholders as "any group or individual who can affect or is affected by the achievement of the organization's objectives (Freeman 1984, p. 46 as cited in Mitchell et al., 1997, p. 854). Although hailing from the business world, this definition is applicable to university-community partnerships because it draws attention to the fluid nature of those relationships and simultaneously underscores some of their challenges. Power differentials, access to resources and information, and geographic constraints are some of the challenges faced in both identifying and working with groups or individuals who have a stake in the research. Given these differences, it is problematic to assume that all researchers will confront the same challenges in identifying and working with stakeholders. Rather, we must learn from each other's experiences and build a flexible set of practices for engaging stakeholders in complex research projects.

After SSI researchers in various disciplines began to focus on stakeholder engagement, it became apparent that disciplines were using the term "stakeholder," but referring to markedly different groups and different relationships with those groups. Interviews with and a survey of SSI researchers found that, across all teams, researchers varied in who they identified as their stakeholders. For many teams, internal and external stakeholders included both organizations (e.g., National Science Foundation, nonprofit agencies) *and* individuals (e.g., colleagues, municipal officials). For one team, the amphibians they are studying are stakeholders, while another sees future generations of people as their stakeholders (McGreavy, Hutchins, Lindenfeld, Silka, & Leahy, 2012). For an SSI team investigating solutions to an impending invasion of emerald ash borer, an invasive species that attacks ash trees, members of Maine's Wabanaki community and their artists and basketmakers are among the key stakeholders (Ranco et al, 2012). Likewise, city planners are stakeholders for projects building models of urbanization. Some project leaders envisioned state policy makers as their stakeholders. Still other teams of researchers are working with "groups" of stakeholders who neither identify with the group label given to them by the researchers (e.g., landowners whose land happens to be partially forested) nor see themselves as a community sharing common interests. Other researchers held some amorphous image of a possible stakeholder who might be interested in what would result from the research.

In short, conceptualizations of stakeholders in SSI differ in many ways depending on: a) if one is discussing internal or external stakeholders, b) the perceived role of the stakeholder in the problem and/or solution, c) how long a stakeholder has been in a particular role, d) whether the stakeholders identified with their perceived role, e) what resources stakeholders have for enacting solutions, and f) whether stakeholders are perceived as conducting scientific research. The lesson we learn here is that our understanding of stakeholders, who they are and their role, will vary during the course of conducting interdisciplinary engaged research and requires a process of negotiation *with* stakeholders. Effectively working with stakeholders presupposes a nuanced attention to defining and understanding who the relevant stakeholders actually are throughout all stages of the research project.

2. Solutions ... or More Complexities?

Whitmer et al. (2010) argue: “Engaged research ... has the potential to transform our fundamental knowledge of human and natural systems and to develop solutions for the world’s ongoing environmental challenges” (pp. 314-315). This goal of finding solutions seems straightforward, but as SSI has discovered, it is complex. First, the problems addressed in sustainability science are often complex and layered. They transcend simple solutions and frequently lead to disagreement about when enough knowledge has been produced to create a clear solution or what that solution should look like in application. Second, because studying and addressing complex problems requires that we conduct interdisciplinary, stakeholder-engaged research, deep differences among researchers and stakeholders often surface. Researchers and stakeholders may differ not only in how they define solutions but also in how they decide when a solution has been reached. They may not agree on what needs to be known, how it needs to be known, when enough is known, or how to apply that knowledge. For researchers assuming that data will reveal what should be done, the solution may be to collect data to understand the problem (Kreuter et al., 2004). Kreuter et al. point out that data are but a piece of the puzzle, and gathering more data will not by itself result in unambiguous solutions. For stakeholders, the solution may be a new regulation, the conservation of a piece of land, or a set of best management practices. Like researchers, different stakeholder groups may not agree on the solutions. If stakeholders identify different problems or have different levels of knowledge about the problem, the expected solutions will likely also be different (Crona & Bodin, 2006). A brief look at differences of how people define solutions within SSI, in individual and institutional roles within the problem context, and in time scales shows the importance of these differences in engaged research.

Diversity of thought about solutions is evident in the mission statement of one SSI team focusing on solutions to the challenges of landscape change, as explained here:

Landscape change has not only been identified as one of the grand challenges in the environmental sciences by the National Research Council, it is also a central concern in recent reports focusing on the future of Maine’s economy and way of life. For example, portions of southern Maine are experiencing rapid sprawl while record sales of private forest lands and mill closures are transforming the social and economic fabric of northern and western Maine. In addition, climate change will likely alter the composition and function of forests, influencing their ability to meet traditional markets as well as potential new markets (e.g., carbon sequestration and bioproducts). *Our ultimate goal is to build our capacity for generating solutions to an array of sustainability problems in and beyond Maine* (SSI, 2012 emphasis added).

Analysis of this statement reveals multiple conceptualizations of solutions: solutions are making the problems go away; solutions are ways of understanding the problems; solutions are about process; solutions are about creating things, solutions are about building capacity.

The SSI Vernal Pools team provides an example of an approach that shares the same goal, but must bridge differing perspectives on what comprises a sustainable solution. Vernal pools are seasonal water bodies that provide optimal breeding habitat for certain amphibians and ecologically are an integral part of New England forests. The team, composed of biophysical scientists, social scientists, consultants, developers, landowners, and federal, state, and local government officials, is studying vernal pool habitats, amphibian behavior, and conservation strategies.

When considering solutions, each of these stakeholder groups brings a unique perspective. For biophysical scientists, understanding and protecting the habitat is central in their work; solutions must ensure some level of protection. At the federal and state level, protecting the natural resources of country and state are central, so solutions must meet certain standards and be enforceable. Local officials must balance economic development and natural resource protection; solutions must be informed by input from developers and conservationists. Finally, for individuals, maintaining the value of and freedom to use their land is key; solutions must address land values and individual freedoms.

Although these apparently incongruous perspectives may stymie some groups, the Vernal Pools team is seeking innovative ways to accommodate everyone’s concerns. For example, scientists are studying the effects of urbanization on pool-breeding amphibians and vernal pool functions and using the results to develop decision-making processes to guide development and conservation planning strategies at the municipal and home-owner scale. University scientists, town planners, and regulators are collaboratively developing new rules that will permit development in prime growth areas in exchange for increased protection in rural zoned areas. Two communities are piloting this process to serve as models for other towns. Importantly, team members recognize that conservation of natural resources on private property at the municipal scale requires incorporating the concerns and needs of all stakeholders and requires flexibility and compromise. Not doing so can lead to conflict; by contrast, open communication can lead to broadening of perspectives and what Thompson (2009) refers to as “communication competency,” a core tenet of successful interdisciplinary and

transdisciplinary collaboration. This appreciation of diversity contributes significantly to the success of the Vernal Pool team.

As this example demonstrates, views on solutions also differ at individual and institutional levels. State policymakers may see certain results as solutions because they offer guidance for policies that can be enacted statewide. For community business leaders operating only at the local level, solutions that are not under their control may not be seen as solutions. The owner of a small forest plot trying to deal with an invasive species has both a local and a regional perspective. To a researcher, the solution may be a model that explains something novel in a global system. Whether one is working locally, regionally, statewide, nationally, internationally, or globally, scale may shape what constitutes a solution.

Moreover, views on solutions may differ in terms of time. Some disciplines emphasize geologic time; others think in terms of the time period in which effects from an action, like the removal of a dam, should be apparent. Historians involved in studying the impact of a recreational lake focus on generations of families; others look at the immediate effects of short-term changes in lake use. Researchers studying environmental views on wind power may be focused on the short-term impact of the next political campaign or the long-term population effects of bird mortality. Thus, a mismatch between partners' views on timeframe in relation to solutions can make it difficult to reach agreement on what constitutes a solution.

Divergent beliefs about "solutions" are not an obstacle that can be definitively overcome and SSI has hosted numerous discussions involving SSI researchers that attempt to unpack what we mean by solutions. Typically, these hour-long roundtable discussions are led by an SSI researcher who discusses a concept from the literature, from funding agencies' requests for proposals, or from his/her own experience and then opens the floor to an open exchange of ideas. These discussions have not produced a singular description of a solution. Instead, they revealed that beliefs about solutions vary depending on the problem being addressed, the timeline for solutions, and what constitutes a solution, to name a few. As Kreuter et al. (2004) argue, "wicked problems" like those often addressed in sustainability science do not necessarily have clear stopping rules or final solutions. However, this diversity of perspectives about solutions reminds us of the need for careful and patient communication among all project participants throughout the course of an engaged research project.

3. Research (Mis)Communication and Community Engagement

Unsurprisingly, communication across disciplines is challenging (Thompson, 2007). Initially, many disciplinary scholars in SSI failed to understand each other. Yet, these same scholars recognized that delivering meaningful, culturally responsive solutions depends on interdisciplinary collaboration, and that good communication is essential to this collaboration (Thompson, 2009). Because issue-driven, interdisciplinary, engaged research depends upon mutual understanding and space for multiple voices to contribute to the process, open access to all information is necessary so that participants can be engaged at appropriate times and under optimal conditions. Recognizing the potential conflicts inherent in interdisciplinary collaboration, SSI invests in research on these collaborations to increase the likelihood of success.

SSI's Knowledge-Action ($K \leftrightarrow A$) Collaborative studies how university scientists and stakeholders co-produce knowledge that leads to action. This interdisciplinary social science team works with other SSI teams that include biophysical scientists and engineers. We have discovered that differing ideas about when and how stakeholders should become involved is a central challenge for most teams. Some non-social science colleagues envisioned $K \leftrightarrow A$ research as involving "outreach" only, and misconstrued the role of social scientists to be disseminators rather than generators of knowledge. There were also misperceptions of the rigor and purpose of social science research that had the potential to affect the success of the stakeholder engagement process. For example, social science research demonstrates that process, design (Depoe et al., 2004), and managing stakeholder expectations (Barreteau et al., 2010) are critical for effective stakeholder relationships and retention. Some social scientists specialize in approaching stakeholders, listening to their needs, and aligning research with those needs. Seeing social scientists as knowledge disseminators rather than knowledge co-creators limits their ability to design a productive stakeholder engagement process that is informed by their expertise in human behavior and is responsive to observations of the process. By beginning with a collaborative, interdisciplinary approach, research teams can benefit from the strengths of all involved, leading to improved stakeholder engagement and retention.

The challenges associated with the misperceptions of social science have been overcome on many SSI projects. A biophysical colleague on SSI's Tidal Power Energy Development team noted the critical moment when she realized that

social scientists are not just outreach specialists. This realization enabled the development of a robust team that collaboratively designs research utilizing the skills of all involved. For example, social science researchers helped their biophysical counterparts identify ways to engage and communicate with stakeholders, such as using maps to generate discussions about fishing grounds and fishing gear technology. They also helped to identify questions of interest to stakeholders that University of Maine researchers could address in their research. Without these critical pieces of information, the fisheries scientists, for example, may never have had participants to assist them in identifying missing species in their catch data. The success of this process depends on quality communication and respect among researchers. Otherwise, the social scientists may not have asked the “right” questions, and the fisheries scientists may never have known how to effectively work with the stakeholders. On many SSI teams, researchers across disciplines now collaboratively design stakeholder engagement processes that promote high quality engagement, research on this engagement, and improved outcomes for all. Understanding each other’s research skills and needs is just one factor that influences successful communication in interdisciplinary, engaged collaborations. Other factors however, such as differing worldview, also must be acknowledged in creating sustainable and successful partnerships, as the next section illustrates.

4. Dueling Epistemologies – When Researchers See the World through Different Eyes

The imperative of bringing disciplines together to conduct engaged research seems self-evident. As Whitmer et al. (2010) note: “Now more than ever, society requires academic research – with its creativity, diversity, and impartiality – to address environmental problems. No other sector is as well-equipped as academia to gather information and determine the most effective ways to tackle today’s complex problems” (p. 314). In practice, difficulties quickly emerge as researchers discover how significantly their approaches diverge. Such departures may not matter in the academic world, where scholars publish in disciplinarily specific journals, but what happens when academics with very different disciplinary approaches to the same problems work together with stakeholders to create solutions? In SSI we have seen the challenges firsthand. Here we consider how resource economists and social psychologists tackled their dissimilar approaches to addressing sustainability issues related to new energy technologies.

Maine is particularly well suited for the development of offshore wind energy installations, and Maine residents’ amenability to the technology will impact the development of this resource. Working separately, researchers in economics and social psychology studying “Environmentally Responsible Behavior” (ERB), in this case new energy technologies, use different approaches and may reach different conclusions.

Economists often regard ERB as a failure of rational choice, assuming that rationality means that individuals select their maximum expected utility via a private function. Economists regard people as “consumers,” rational, utility-maximizing people, and as “citizens,” those who act in the “public good” rather than individual self interest. To psychologists, on the other hand, concepts like values, norms, motivation, altruism, and preferences for the status quo, are important aspects of human behavior. As with divergent theories on behavior, research methods also differ as preferences for surveys versus experiments or qualitative versus quantitative approaches vary by discipline. Debates about hypothesis testing, sample sizes, and analysis quickly emerge. Importantly, SSI provides the space and opportunity for researchers from both disciplines to come together *with stakeholders* to design research to understand the acceptability of wind energy.

The Wind Energy team has expanded and tested current economic and psychological models of stakeholder values, an integrated approach that has provided more useful information than either acting in isolation. They have provided crucial knowledge about how people evaluate environmental problems and popular perceptions of potential technological approaches. The Wind Energy team has helped test the effectiveness of various information strategies to educate and promote environmental solutions, looking at a broad array of factors that may influence a person’s evaluation of “public good” attributes. As a result, they have combined choice and technology adoption models into a more unified framework. Even more, researchers on this project have skillfully demonstrated how to cross disciplinary boundaries, and their collaboration has drawn other researchers to the table, including communication researchers who are interested in how news media frame stories about renewable energy. This project provides a model for how researchers can overcome seemingly contradictory epistemologies and create bridges to solve problems.

Although the example considers two related social science disciplines and highlights the complexity even *among* disciplines that share some common ground in social science research, it is important to recognize that when civil engineers, ecologists, and social scientists attempt to work together, collaboration becomes even more complicated. With that said, over time and with shared dedication, many of SSI’s researchers have developed ways to integrate their different

approaches and adopt new ones, and the wind energy example illustrates but one case. Interdisciplinary research is leading to highly productive results in economic psychology and the various decision making approaches heralded by Kahneman's Nobel Prize winning work (2011). How might scholars recognize and overcome our differences to get more such results? Further, how do academics leverage interdisciplinarity to improve engagement with those outside the academy? Experience from SSI indicates that understanding interdisciplinary processes is a first step to evaluating and improving communication and decision making within a team and with stakeholders. Further, working in interdisciplinary teams encourages disciplinary researchers to break out of their silos and see the multiple perspectives and approaches others take to understanding the world around them. This helps academics work outside of the academy because stakeholders not only occupy a different "discipline," their experiences, expectations, and needs may vary drastically from those within the academy.

Summary of Lessons from SSI

As a statewide, engaged initiative, SSI helps us understand both the complexities and opportunities involved in creating solutions-oriented research. SSI's struggles to create synergistic links across disciplines, institutions, and groups are characteristic of any collaborative research endeavor, and most especially of one that attempts to operate at a statewide scale on pressing and multi-faceted issues related to sustainability. Three characteristics of SSI are important to keep in mind when considering how it relates to engagement-focused initiatives occurring on other campuses. First, SSI is a comprehensive effort to rethink and re-envision higher education's role in addressing persistent social issues by conducting engaged, problem-focused research, and experimenting with innovative ways of training future generations of interdisciplinary researchers in sustainability science. Second, SSI is producing portfolio of projects with collaborations that involve different combinations of disciplines and stakeholders. This robust framework enables SSI to undertake an institutional experiment that helps us understand which processes, struggles, and arrangements are most effective and efficient. Third, SSI is bold enough to keep trying. Engagement is hard work, especially for those of us in higher education who have been trained according to disciplinary conventions and who have flourished within these parameters. SSI exemplifies a program that seeks to address a higher calling: working collaboratively with communities and stakeholders to address complex problems.

We often joke that the most important course that new SSI researchers should take might be labeled "Humility 101." Pushing aside disciplinary arrogance and individual goals to work in concert with each other requires a collaborative mindset and a generous spirit not always seen in higher education. SSI is a project that is both typical – in that we have faced problems that other academics face in approaching engaged, interdisciplinary work – and atypical – in that, with the help of significant funding for five years, it attempts this work by piloting a statewide research effort that crosses institutional and geographic boundaries as well. Our discussion of SSI has addressed some serious, pressing issues and recognizes their difficulties, but also illustrates the opportunities that remain. In conclusion, we reflect on implications for the future of engaged research, and the ethical imperatives that drive such research.

Conclusion

Interdisciplinarity and engagement are rooted not simply in scientific certainty (i.e., better "answers") but in a key ethical imperative: the re-establishment of the relevance of scientific research that serves and empowers the communities in which we live, work, and conduct research. Throughout this discussion, we have noted the challenges that such endeavors engender: the ways in which engaged, interdisciplinary approaches entail relinquishing the role of "the expert," recognizing the importance of localized sources of knowledge, and forgoing notions of "control" that permeate scholarly inquiry.

Interdisciplinarity undergirds the very definition of scholarly inquiry that integrates perspectives and ideas across multiple scholarly disciplines. Klein and Newell (1997) define interdisciplinarity, as "... a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession and drawing on disciplinary perspectives and integrating their insights by producing a more comprehensive understanding" (pp. 393-394). Complexity and depth are the very qualities that issue the call to transcend traditional disciplinary convention (Newell, 2001). Sustainability constitutes such an issue, and SSI attempts to move beyond singular approaches to a complex, multi-dimensional, engaged research process.

Stressing the necessity of interdisciplinary research that engages the local community as a partner is a far cry from suggesting that such endeavors will be easy or intuitive. Working across boundaries in SSI has at times felt akin to learning to speak a new language late in life. These experiences speak to broader and enduring challenges that accompany interdisciplinary and transdisciplinary collaboration. The depth of our disciplinary socialization is such that we may even *perceive* core concepts and processes in fundamentally different ways and this same training may encourage us to think of ourselves and our way of knowing as “expert,” potentially delegitimizing other forms of knowledge. Furthermore, as our experience demonstrates, fruitful inter- and transdisciplinarity in practice involves not simply the accumulation of multiple perspectives, but a complex process of negotiation and intellectual exchange. Szostak (2006) writes that successful interdisciplinary research entails “integration [that] involves not the simple adding up of disciplinary insights, but that it is a process of critique, extension, and identification of common ground” (p. 146). Such integration is considerably more challenging when working across disciplinary and institutional boundaries.

Yet, as demonstrated here, our ability as researchers to confront the difficult problems that humanity faces in the 21st century hinges upon our ability to overcome such stumbling blocks. Driven by important ethical imperatives, interdisciplinary engaged research seeks a more holistic orientation that grasps the totality of the phenomena. It aims for a more direct relationship that mitigates the hierarchies of power and control that arise out of disciplinary thinking. And as SSI graduate students, not yet fully socialized in a single discipline, can attest, part of breaking down the walls between disciplines and the academic-nonacademic worlds must include training scientists to be interdisciplinary and transdisciplinary thinkers.

Furthermore, although SSI focuses its efforts on the complex problem of environmental sustainability, the promise of engaged, interdisciplinary research extends far beyond any one topic or area of research. The model we present here is one that could be implemented in any domain where willing university and community partners seek to engage in solving complex problems that defy analysis according to disciplinary abstraction. Engaged interdisciplinary research is currently being used to confront issues as diverse as community health care (Sadler et al. 2011), urban and downtown revitalization (Aloi 2010; Boston Main Streets Foundation 2012; Great Cities Institute 2012), economic development (Gonzalez et al., 2005), youth mentoring and childhood development (Freedman, 2003), food systems and nutrition decision-making (Gillespie and Gillespie 2000), and an array of other pressing societal challenges. These are all multi-dimensional and complex issues, likely to generate their own unique set of obstacles and learning experiences. Yet, as the examples drawn from the SSI suggest, they can also be valuable settings for engaged research and richly rewarding settings for community change.

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ⁱ Acknowledgement: The Sustainability Solutions Initiative described in this article was supported by National Science Foundation award #EPS-0904155 to Maine EPSCoR at the University of Maine.