Insights on Interdisciplinary Teaching and Learning

A White Paper by

Tanya Augsburg, Barbara M. Bekken, Kevin Hovland, Julie Thompson Klein, Douglas B. Luckie, Bernard L. Madison, Paula J. S. Martin, William H. Newell, Marci Sortor, and Richard Vaz

Edited by

Aaron M. McCright and Weston Eaton

Contents

Recommended Citation
Augsburg, Tanya, Barbara M. Bekken, Kevin Hovland, Julie Thompson Klein, Douglas B. Luckie, Bernard L. Madison, Paula J. S. Martin, William H. Newell, Marci Sortor, and Richard Vaz. 2013. *Insights on Interdisciplinary Teaching and Learning*. White Paper. Edited by Aaron M. McCright and Weston Eaton. Available at lbc.msu.edu/CITL/whitepaper.cfm. East Lansing, MI: Michigan State University.

The May 2012 Conference on Interdisciplinary Teaching and Learning

Aaron M. McCright
Lyman Briggs College, Department of Sociology, and
Environmental Science and Policy Program
Michigan State University
mccright@msu.edu

Weston Eaton
Department of Sociology
Michigan State University
eatonwes@msu.edu

Despite the complexity of today's social, technological, economic, and ecological challenges, university-level teaching and learning practices tend to perpetuate disciplinary boundaries that restrict fresh and creative approaches to complex problems. Efforts to initiate a shift towards more interdisciplinary practices are promising, but present their own difficult set of challenges. To address these challenges to and opportunities for interdisciplinary teaching and learning in post-secondary education, Michigan State University Professors Elizabeth H. Simmons and Aaron M. McCright co-organized the Conference on Interdisciplinary Teaching and Learning. This conference took place on May 13-16 at the Kellogg Hotel and Conference Center on the East Lansing campus (lbc.msu.edu/CITL).

We designed the conference to: facilitate the ongoing discussions between leading scholars and practitioners of interdisciplinary teaching and learning; promote the integration of scholarship and practice regarding interdisciplinary teaching and learning; and foster communication to help us all expand our networks for engagement, outreach, and service learning. Substantively, we organized the conference around five themes, perceived to be a mix of salient foundational and frontier issues for interdisciplinary teaching and learning in post-secondary education: (1) the roles of disciplines in interdisciplinary curricula; (2) the contributions of specific pedagogies to interdisciplinary learning; (3) global engagement in interdisciplinary teaching and learning; (4) assessing interdisciplinary curricular/learning outcomes; and (5) meeting administrative and institutional challenges. The subsequent five sections of this white paper address these themes, respectively.

All invited speakers submitted a brief invited paper addressing the theme of their respective session (available at lbc.msu.edu/CITL/papers.cfm). Invited speakers crafted these papers to provide insights and provoke discussion at the conference. The co-authors of this white paper combined ideas from these invited papers, the plenary sessions, and respective workshops to craft the subsequent chapters of this white paper. Thus, this white paper allows us to share existing and identify new solutions to the curricular, administrative, and logistical challenges of interdisciplinary teaching and learning with the broader academic community.

In the first section, Marci Sortor and Barbara M. Bekken deal with the role of disciplines in interdisciplinary inquiry. They contemplate the potential synergies between disciplinary and interdisciplinary learning, inquiry, and problem solving. They first discuss disciplinary contributions to interdisciplinary thinking and knowing and vice-versa. They emphasize the ways disciplinary knowledge contributes to interdisciplinary inquiry, such as through the transfer of specific, disciplinary ways of knowing and thinking to interdisciplinary contexts. Moreover, "metacognitive themes"—learning and knowing capacities developed within specific disciplines—are essential to interdisciplinary practices. However, other conference participants challenged the assumption that disciplinary practices ought to precede interdisciplinary inquiry. Thus, Sortor and Bekken detail conference discussions on the ways that interdisciplinary courses can provide a wide array of disciplinary experiences that both allow students an introduction to many ways of knowing and learning about the world, as well as warding off disciplinarily isolated worldviews. Sortor and Bekken also focus on the role of the university in enhancing interdisciplinary and disciplinary learning. Here they discuss the tensions between the promotion of interdisciplinary teaching and learning and the structures and policies born within disciplines, while calling for and outlining more flexible ways of delivering education.

In the second section, Douglas B. Luckie and William H. Newell posit a pedagogy for interdisciplinary habits of mind, which are presented as pedagogical practices and practical knowledge accumulated by faculty experimenting with interdisciplinary teaching and learning in their classrooms. To develop this section, the authors ask conference participants to make additions to their own emergent list of habits of mind both before and during the conference. The result is a list of four categories of best practices for interdisciplinary habits of mind, which can be used by faculty and administrators when designing interdisciplinary programs and courses. Additionally, from this exercise, the authors point out the need to integrate interdisciplinary habits of mind into course design (as opposed to only daily class preparations), their relation to traditional, disciplinary pedagogies, and the overall importance of active learning in practicing interdisciplinary pedagogies.

In the third section, Kevin Hovland and Richard Vaz focus on the ways conference participants contributed to the notion of global learning. After debunking common misunderstandings, they present global learning as a teaching and learning practice that aims to engender worldviews that value empathy and responsibility along with student learning. The authors first discuss keys ways that conference participants expanded on and negotiated this topic, especially with the relationship between global questions (in teaching and learning, how do we "engage" globally?) and disciplinary perspectives. Second, they discuss

the workshop activities in which conference participants struggled over these definitions and assumptions. From these conference activities, they present a list of "promising practices" for both curricular strategies as well as pedagogical approaches.

In the fourth section, Bernard L. Madison and Tanya Augsburg explore the challenges of and ways to assess interdisciplinary education. Their section reports on workshop discussions where participants considered possibilities for how rubrics could be helpful for assessing written assignments, student portfolios, and national testing standards. Moreover, the authors present and discuss the multiple difficulties of and barriers to assessment as pointed out by conference participants. Assessment is important due to its capacity to communicate to students the goals and methods of interdisciplinary teaching and learning. This in turn can help students and faculty who struggle with learning goals, such as synthesizing and applying knowledge and insights from one discipline with others. The section provides not only lists of challenges, but also potential solutions such as incentivizing assessment. Additionally, the authors present arguments for writing as a means for assessment and rubrics as a clear way to organize the expected learning outcomes. Throughout, the authors ground their discussion in the challenges of performing initially disciplinary methods and practices in increasingly interdisciplinary environments—complex spaces that lack established, agreed upon goals.

In the final section, Julie Thompson Klein and Paula J. S. Martin tackle issues of administrative challenges of interdisciplinary teaching and learning by presenting not only impediments, but also—and more importantly—ways they might be overcome. To do so they draw on scholarship, institutional experiences, as well as insights derived during the conference. After discussing the structure and policies of institutional organizations, leadership, and funding in relation to interdisciplinary agendas, they conclude by arguing for the importance for administrative openness to innovation and tolerance for risk—which includes recognizing and enabling faculty to operate across disciplinary boundaries. Overall, doing so requires what the authors call an increasingly flexible, or "systematic," approach where the abundance of opportunities and possibilities for interdisciplinary undertakings are explored.

Reflections on the Roles of Disciplines in Interdisciplinary Courses

Barbara Bekken
Department of Geosciences
Virginia Tech
bekken@vt.edu

Marci Sortor
Provost and Dean
St. Olaf College
sortor@stolaf.edu

The first conference session examined the role of the disciplines in interdisciplinary inquiry and vice versa, with an emphasis on the potential synergies and feedbacks between disciplinary and interdisciplinary learning, inquiry, and problem-solving. Conference participants were asked to reflect and respond to two questions: (1) How do disciplinary ways of thinking and knowing contribute to developing interdisciplinary ways of thinking and knowing? and (2) How can universities enhance interdisciplinary inquiry through existing disciplinary structures? The discussion that follows is a synthesis of conference participants' insights as well as ideas presented in invited participants' pre-conference papers.

DISCIPLINARY CONTRIBUTIONS TO INTERDISCIPLINARY THINKING AND KNOWING AND VICE VERSA

In formal schooling, most learners experience disciplinary inquiry and problem solving before they experience interdisciplinary problem solving. If engaged by an exemplary teacher, a learner may bring a given disciplinary way of thinking and knowing to interdisciplinary inquiry, regardless of whether the learner recognizes that s/he is doing so. Conference participants explored similarities and differences between various disciplinary ways of thinking and knowing to discover similarities and differences in what various disciplines value. In this section, we explore how these values combine synergistically to support interdisciplinary ways of thinking and knowing.

While experts in various disciplines differ significantly in how they define and approach learning, knowing, and discovery in their respective fields and how they translate this process to teaching and learning, conference participants identified several themes that many disciplines share. Disciplinary themes or patterns of thinking and knowing valued by participants were identified as desired learning outcomes of their respective graduates. Valued learning outcomes were sorted into three general categories: (1) content knowledge or didactic learning outcomes, (2) procedural knowledge or methodological learning outcomes, and (3) reflective knowledge or metacognitive learning outcomes. Within this framework, conference participants were asked to identify commonalities or themes between various disciplinary learning outcomes and comment on how these themes contribute to interdisciplinary inquiry. Much as learning a foreign language makes explicit the grammar of one's native tongue, conference participants thought that interdisciplinary inquiry can make explicit the didactic, procedural, and reflective thinking valued by the learner's native discipline. In this manner, disciplinary ways of knowing become the springboard for each learner's approach to interdisciplinary inquiry. Key to success is the learner's ability to recognize not only the similarities in how different disciplines approach interdisciplinary problems, but also—and perhaps more importantly—to recognize and value the various ways of knowing that different disciplines bring to interdisciplinary problem-solving.

Curriculum experts in practically every disciplinary department in higher education have identified a core of content learning outcomes or didactic knowledge that graduates of their respective programs should know. Conference participants did so as well by developing and sharing lists of learning outcomes. From those lists, we have identified several content knowledge themes that emerged from the contributions of approximately seventy participants. Nearly all contributors wanted their graduates to learn *basic knowledge* and information of their discipline, which included the *key governing principles and processes* of the discipline as well as the *governing theories and models* that unify and focus disciplinary inquiry. They wanted learners to be facile with the *language and taxonomy* of their discipline and to have at least a cursory knowledge of the *history of inquiry* in their discipline. Finally, several participants also wanted their graduates to be apprised of *emerging areas of inquiry*. Thus, despite disciplinary differences, there are distinct similarities in the ways in which different disciplines construct and organize knowledge, which in turn can provide common ground to collaborative interdisciplinary inquiry, provided that the collaborators appreciate these similarities.

In addition to disciplinary content learning outcomes, participants also identified key procedural learning outcomes of their respective disciplines. Comparing lists of disciplinary procedural learning outcomes again provided insight into the similarities and differences between the methods and procedures used by practitioners in various disciplines. Conference participants identified several disciplinary procedural learning outcomes or competencies for which graduates of their programs should be proficient. These included understanding and using the *basic methods of the discipline*, which included developing proficiency with both *analytical and synthesis skills* commonly used by the discipline. Several participants stressed the need for their graduates to be able to *adapt and transfer methods* as well as *integrate information* to new and novel situations. Others emphasized the importance of developing *modeling and predictive skills* as well as using disciplinary conventions to *communicate* results. And finally, a large number of participants

were concerned that learners become adept in both *problem-posing and problem-solving*. Thus, disciplinary procedural knowledge contributes to interdisciplinary inquiry through the cross-pollination and transfer of disciplinary methods and ways of thinking and knowing to new and novel situations. Learners who explicitly understand and value the procedural knowledge of their discipline and who recognize that all disciplines have developed robust ways of thinking, doing, and learning are poised to contribute to interdisciplinary inquiry. These graduates are more likely to collaborate effectively with others who are schooled in disciplines well outside their own.

In addition to these emerging disciplinary content and procedural learning-outcome themes, several participants stressed the importance that graduates develop metacognitive awareness of themselves as learners and knowers. Metacognitive themes that emerged included being able to *define and reflect on the epistemology or ways of knowing and creating knowledge within a discipline*, *identify one's cultural situated-ness or sense of place within the broader culture*, *self-assess progress toward a goal*, and *assess the consequences of one's actions*. There was general agreement that these metacognitive themes were essential to developing interdisciplinary ways of thinking and knowing and that disciplines could contribute to interdisciplinary inquiry by placing greater emphasis on explicitly encouraging learners to develop greater metacognitive awareness and skills.

Most but not all participants adhered to the idea that students ideally would first develop disciplinary depth prior to embarking on interdisciplinary inquiry. However, several participants questioned how effectively faculty members make explicit the procedural and reflective learning goals of their discipline. There was general agreement that if the methods of inquiry are not made explicit, students will be less likely to recognize them and may not possess the tools needed to approach interdisciplinary problem-solving.

One participant took a different approach; she had taught collaboratively with faculty from other disciplines in an interdisciplinary, two-year, thematic general education program (Bekken and Marie 2007) designed to accelerate student development according to Baxter Magolda's (2004) Theory of Self-Authorship. Results of student exit interviews clearly showed that they had acquired a breadth of procedural and reflective knowledge through this integrative learning experience that deeply influenced their awareness of disciplinary ways of thinking, doing, and knowing (Bekken 2012). These findings challenged participants' notions of the necessity of developing disciplinary depth prior to embarking on interdisciplinary inquiry. Further, they suggest that teaching disciplinary inquiry alongside interdisciplinary inquiry may have synergistic effects, especially if both programs make procedural knowledge explicit by continuously involving learners in the reflective process of describing "how we know what we know" from a disciplinary and interdisciplinary vantage point.

Newell (1992:213) points out that concern over how much disciplinary base is needed for interdisciplinary courses misconstrues the intent of interdisciplinary inquiry. The understanding developed in interdisciplinary courses is grounded in disciplinary ways of knowing and those lead to the facts, concepts, and theories of a given discipline: "It takes many years to learn a discipline; it takes only a few readings to begin to develop a feel for how that discipline looks at the world." Interdisciplinary courses can invite learners to a tasting menu of

disciplinary points of view that offers them opportunities to compare and contrast disciplinary perspectives. In essence, interdisciplinary courses without prerequisites invite learners to discover, compare, contrast, and ultimately value disciplinary frameworks that provide structure to multiple ways of both knowing and inquiring about the world. Further, without opportunities for learners to experience "standing back" from their major focus of learning, they can become entangled in the minutia of their chosen disciplines and never explicitly recognize the disciplinary cultures in which they are becoming inculcated. This unfortunate outcome can lead to a myopic undergraduate educational experience in which graduates do not explicitly recognize how they understand, know, and make sense of the world (AAC&U 2007).

THE ROLE OF THE UNIVERSITY IN ENHANCING INTERDISCIPLINARY AND DISCIPLINARY LEARNING

Universities and colleges have long supported interdisciplinary teaching and learning through a variety of programs, concentrations, research- and issue-based centers, as well as individual courses. The question at hand was one of the enhancement, continued innovation, and sustainability of this form of inquiry. All three are dependent on institutional issues of resource allocation, staffing, recognition and reward. Institutional issues such as these have developed, by and large, to serve the disciplines. These disciplinary structures by which nearly all colleges and universities organize and govern themselves can have profound implications for the ways in which interdisciplinary teaching and learning are fostered. As a consequence, the sustainability of interdisciplinary enterprises is bound up with those structures. While the disciplines can act both to limit both the growth and long-term viability of interdisciplinary teaching and learning, their structures can serve as a framework for interdisciplinary endeavors. The resulting tension between replication of familiar disciplinary forms of organization and the emergence of new ways of exploring knowledge reflects the on-going evolution of interdisciplinary studies and its place in the academy.

SUSTAINABILITY: ESTABLISHING A PLACE FOR INTERDISCIPLINARY TEACHING AND LEARNING

To the extent that departments are the primary structures by which academic personnel are hired and promoted and through which resources linked to teaching are allocated, they tend to serve as the model used by those developing new interdisciplinary programs and courses. It is important to recall, however, that colleges and universities have a number of institution-wide, and therefore interdisciplinary, academic entities and curricular elements. Interdisciplinary teaching and learning, for example, can be central to institution-wide educational goals for undergraduate students and play an important part in general education. Curricular models include problem- or issue-based introductory, blended, or sequenced courses focused on the development of key intellectual skills and advanced capstone experiences that allow students to synthesize what they have learned in a number of discipline-based courses (Bekken 2012). Conference participants noted that interdisciplinary courses can be particularly of service as a tool for helping colleges and universities develop in students the skills that employers need. Such courses, conference participants underscored, were particularly amenable to "reverse

engineering," in that they could be shaped to address such institution-wide learning goals.

Other extra-disciplinary structures present at nearly all colleges and universities include interdisciplinary concentrations, certificates, minors, and majors; these last two curricular structures are sometimes but not necessarily always offered by interdisciplinary departments. Interdisciplinary programs, centers, and institutes purposefully gather disciplinary specialists for exploration of interdisciplinary issues and topics, and are often the locus for the development of interdisciplinary course offerings and research. Most venerable of all interdisciplinary entities on campuses are libraries in the broad sense of the word beyond the bricks and mortar. Libraries, along with interdisciplinary centers, are important partners for teaching and learning, and also can provide alternatives to disciplinary models of education delivery and resource allocation.

While some of these structures have long histories at their institutions, the establishment of new interdisciplinary courses and programs can be difficult. Launching and then sustaining them over a period of time usually entails working within the existing disciplinary structures by which universities and colleges typically organize themselves. The viability of interdisciplinary efforts was understood by conference participants to be largely an issue of garnering resources. Interdisciplinary programs and curricular offerings depend on reliable faculty lines, guaranteed course slots, funding, and physical space. To the extent that interdisciplinary teaching and learning are seen as competing with established departments and disciplines for resources, they enjoy at best a tenuous place in the institution (Bekken 2012; Holley 2012). Those planning and directing interdisciplinary endeavors typically must find ways to integrate them into the normal staffing and budgetary models of the institution.

Throughout higher education, the great majority of faculty members are appointed to discipline-based departments; beyond their research endeavors, their primary instructional role is to support a discipline-based curriculum. Their participation in interdisciplinary teaching can be perceived as a net loss by departments. This perception can undermine departmental support for interdisciplinary efforts, and can harm the interests of the participating faculty member. The latter is particularly true if departments do not recognize the faculty member's interdisciplinary contributions for tenure and promotion, regardless of whether those efforts are instructional or research-based. Even in cases where the faculty member has been appointed to more than one department or program, personnel reviews must take into account interdisciplinary contributions. Establishing clear institutional expectations for those holding these kinds of positions is essential, both for the faculty member in question and for the sustainability of the interdisciplinary program or course. Conference participants identified the need for clear expectations concerning contributions to departmental as well as interdisciplinary curricula, level of disciplinary and interdisciplinary expertise, type and quality of research, and service obligations. Invariably, doing so calls for negotiations resulting in a nuanced understanding of the faculty member's contributions. Colleges and universities can also help support interdisciplinary teaching and learning by allocating full-time equivalents (FTE) to programs and courses and by ensuring that contributions to interdisciplinary teaching are considered as part of the personnel review process for all faculty members where

this is pertinent. Doing so may challenge the autonomy of discipline-based departments at some institutions.

The difficulties created through dependence on departmental contributions of teaching lines and spaces where there are sufficient resources can result in the tendency to establish independent structures. Such structures look very much like discipline-based ones. Replication of disciplinary structures, such as departments and majors, can help promoters of interdisciplinary teaching and learning negotiate existing channels and secure resources. This strategy can ensure that faculty lines essential for sustained interdisciplinary courses, programs, and centers are guaranteed (Holley 2012). Replication of existing structures can allow the application of established policies and processes pertaining to budgeting and staffing, and to review and promotion. Multiple forces, then, push those who develop interdisciplinary courses and programs to seek to replicate disciplinary forms.

Invariably, however, structures and policies born in the disciplines are not a perfect fit for interdisciplinary purposes. Much as was discussed above, they must be modified in order to suit interdisciplinary circumstances. In particular, the evaluation of scholarly contributions of those who teach and pursue research in interdisciplinary areas can be difficult for institution-wide tenure and promotion committees and even for fellow members of an interdisciplinary department. According to conference participants, college and university policies and processes can play an important role by helping determine who can make authoritative statements about the quality and significance of interdisciplinary scholarship and teaching.

Replication of disciplinary structures for interdisciplinary aims can also bring with it the danger of inertia. Interdisciplinary innovation, by its very nature, is highly responsive to emerging issues, new information, and new methodologies. While replication of disciplinary organizational and curricular structures can protect the interests of individual interdisciplinary endeavors, the strategy ultimately recreates the same sort of obstacles that currently hinder interdisciplinary innovation. Guaranteed faculty lines, abundant program-specific curricular requirements for majors and concentrators, and separate spaces for interdisciplinary programs and departments, after all, function no differently than discipline-based departments. Colleges and universities need to explore how they can ensure that new collaborations can form and new enterprises can emerge. Doing so may call for a more flexible way of thinking about and delivering education than the current structures can provide (Sortor 2012).

FOSTERING INNOVATION AND THE DEVELOPMENT OF AN INTERDISCIPLINARY CULTURE

Interdisciplinary teaching and learning provides fertile ground for exploration of emerging issues and ever-changing "real world" needs. For colleges and universities, part of the task of supporting interdisciplinary knowledge is fostering an environment that allows for continued innovation and the development of new collaborations. As emerging technologies enhance the rate and scale of the collection and analysis of information, existing disciplines and their methodologies are likely to change significantly in the next few decades. Eventually, new disciplines with their own distinctive lines of inquiry and methodologies may emerge. Such an environment provides rich opportunities for new kinds of interdisciplinary collaboration. Particularly as digital technologies facilitate the

identification and exploration of complex systems (natural, social, and cultural), the emphasis on interdisciplinary collaboration in research and teaching is renewed and growing (Sortor 2012). In recognition of the needs and opportunities for interdisciplinary collaboration, government agencies and major foundations have increasingly emphasized interdisciplinary research and learning. Able to focus energies and resources on issues and problems that call for collaboration across disciplines (Narum 2012), these agencies and foundations serve as agents of institutional change for colleges and universities.

Another kind of external partner for colleges and universities are issue-based organizations like Project Kaleidoscope (PKAL). PKAL is a broad-sweeping, self-consciously interdisciplinary organization seeking to improve education in the natural and physical sciences and mathematics. Such extramural and national efforts can help shift the focus from purely disciplinary approaches to the discovery and dissemination of knowledge (Narum 2012). Incentives and models provided by such agencies and organizations provide institutions and scholars with the impetus to explore opportunities for interdisciplinary work. They play an important part in helping change institutional and scholarly priorities. Colleges and universities can look to them as strategic partners in helping faculty members and their departments to explore opportunities for fruitful collaboration.

Colleges and universities can also provide an on-campus environment that invites collaboration within and across disciplines. Conference participants posed a variety of models for the fostering of collaboration, reflecting the range of institutional types, missions, and programs represented at the conference. Given that disciplines and departments tend to inhabit and teach in separate buildings, and given the physical size of many campuses, an essential ingredient to enabling collaboration is simply finding ways to bring together people who may not otherwise regularly interact. Participants identified strategies for enabling collaboration, ranging from low cost (and low effort) strategies such as informal gatherings and coffees, or internal seed grants that require interdisciplinary teams, to significant institutional investment in the design of buildings and/or assignment of office and work spaces with the intent of bringing people from different disciplines together. Even within the disciplines, preparation of graduate students for interdisciplinary collaborations can entail requiring interdisciplinary work or sub-specialization in a second discipline. Assigning teaching or research assistant positions to

disciplines related to but separate from the student's disciplinary specialization also can broaden the graduate students' sense of professional identity. Doing so may populate higher education with researchers and teachers who think of themselves less as members of a single discipline, and more as specialists who can bring skills and knowledge to the interdisciplinary table.

REFERENCES

Association of American Colleges and Universities. 2007. *College Learning for the New Global Century.* Washington DC: Association of American Colleges and Universities.

Baxter Magolda, Marcia B. 2004. "Self-Authorship as the Goal of Twenty-First Century Education." Pp. 1136 in *Learning Partnerships: Theory and Models of Practice to Educate for Self-Authorship*, edited by M. B. Baxter Magolda and P. M. King. Sterling, VA: Stylus.

Bekken, Barbara M. 2012. "An Interdisciplinary Model for General Education Using the Theme of Sustaining Earth's Resources." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Bekken, Barbara M., and Joan Marie. 2007. "Making Self-Authorship a Goal of Core Curricula: The Earth Sustainability Project." Pp. 53-68 in *Self-Authorship: Advancing Students' Intellectual Growth*, edited by P. Meszaros. San Francisco: Jossey Bass.

Holley, Karri. 2012. "Disciplines, Interdisciplinarity, and the Culture of Higher Education." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Newell, William H. 1992. "Academic Disciplines and Undergraduate Interdisciplinary Education: Lessons from the School of Interdisciplinary Studies at Miami University, Ohio." *European Journal of Education* 27:211-221.

Narum, Jeanne L. 2012. "Shaping a STEM Interdisciplinary Committee of Practice: The PKAL Experience." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Sortor, Marci. 2012. "The 'Inter' and the 'Disciplines'." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Pedagogy for Interdisciplinary Habits of the Mind

William H. Newell
Emeritus Professor of Interdisciplinary Studies
Miami University
newellwh@muohio.edu

Douglas B. Luckie
Lyman Briggs College and Department of Physiology
Michigan State University
luckie@msu.edu

We start with the presumption that a major liberal arts goal of teaching interdisciplinary courses should be to instill interdisciplinary habits of mind in students. These habits of mind have been identified over the last half-century by faculty members experimenting (in the non-scientific sense of the word) with different pedagogies for interdisciplinary undergraduate courses (Haynes 2002; Smith and McCann 2001). Often these have been general education courses where the focus was on learning outcomes more than on particular subject matter. The pedagogies that seemed to produce the most desirable habits of mind were the ones that got repeated and tweaked.[1] While subject matter content and interdisciplinary process are unquestionably important, we encourage educators interested in student learning outcomes to pay more attention to which interdisciplinary habits of mind are nurtured and how successfully—by each interdisciplinary course.

The interdisciplinary habits of mind identified through these trial-and-error pedagogical experiments have largely remained at the level of what Michael Polanyi (1958) called the "tacit knowledge" of individual teachers or teaching teams, though some have been shared with interdisciplinarians at other institutions in venues such as the annual conferences of the Association for Integrative Studies, the Association for General and Liberal Studies, and kindred professional groups. Even then, the focus of such presentations has usually been on the pedagogies employed to instill them, not so much on the habits of mind themselves. Little attempt has been made to collect, organize, and codify either the interdisciplinary habits of mind or the pedagogies used to promote them.

As we prepared for the conference, we decided to take advantage of the wealth of practical knowledge of interdisciplinary teaching represented at the conference by enlisting conference participants in identifying pedagogies that promote interdisciplinary habits of mind. We started by sharing with the roughly 75 pre-registered conference participants a random order list of interdisciplinary habits of mind developed by the first author from years of attending national conferences on interdisciplinary studies as well as from serving as consultant and external reviewer on interdisciplinary higher education. We asked the prospective conference participants to propose additions, deletions, or corrections to the list, which we then revised. Next we organized the list into categories representing four generally recognized parts of interdisciplinary process (Repko 2012), i.e., drawing, modifying, integrating, and evaluating insights drawn from different disciplines (see Table 1). The revised and categorized list of interdisciplinary habits of mind was then shared with participants at the conference. Participants were assigned to separate breakout sessions, and asked to discuss two questions announced prior to the conference: What pedagogical techniques are useful in promoting each core habit of mind, and How do they work?

Table 2 presents the list of interdisciplinary habits of mind vetted by conference participants. This list should be of use in its own right to faculty and administrators designing, administering, and assessing general education requirements and the interdisciplinary courses meant to fulfill those requirements. Because the habits of mind are grouped according to the part of the interdisciplinary process in which they are developed, the table can contribute to discussions of interdisciplinary process. The habits of mind listed under each part of the interdisciplinary process—drawing, modifying, integrating, and evaluating insights from different disciplines—can be used to clarify the intellectual activity that takes place in each, grounding otherwise abstract discussions of interdisciplinary process in educational outcomes. Even researchers on interdisciplinary teams, especially those new to interdisciplinary studies, may find the list useful as a check on the interdisciplinarity of their research.

Four separate breakout groups independently arrived at similar strategies for discussing these questions. They focused on the four categories of habits of mind one by one, identifying pedagogies useful in promoting any or all of the habits of mind within each category, and using discussion of how each pedagogy works to clarify how it produces such habits of mind, essentially vetting it. Discussion leaders listed, clarified, and vetted pedagogies under each category—drawing, modifying, integrating, and evaluating—on the whiteboard or Post-it notes (which we photographed immediately afterwards). Student assistants took notes as well on the discussion in each breakout session, and those notes were shared with us following the conference. And a representative of each breakout group reported the results of their discussion in a plenary session that followed immediately (which we recorded). Afterwards, we transcribed and coded this information as data for analysis.

---

[1] "Seemed" because the evaluation of most of these "experiments" tended to be casual and subjective, but also because interdisciplinary habits of mind are notoriously difficult to measure.

Table 1: Interdisciplinary Habits of Mind

_____

1. Drawing insights from diverse perspectives into complex issue
• Strive for adequacy in (the narrowly relevant concepts and theories of) each discipline, as well as a feel for its perspective
• Seek out diversity of perspectives for richer and more comprehensive understanding
• Identify perspectives and knowledge in relevant interdisciplinary fields
• Identify pertinent knowledge and information in diverse disciplines and fields using digital technologies
• In interdisciplinary collaborations, be alert to relevant approaches of other team members and their disciplines

2. Evaluating insights
• Assume every disciplinary perspective has at least a kernel of truth
• Assume whatever you're attempting has probably been tried before, at least in part
• Proceed methodically even though the disciplines from which you draw employ different methods
• Bracket and set aside/suspend personal convictions
• Recognize all sides of an argument, avoiding overstatement and overconfidence
• In evaluating disciplinary insights look for strengths in arguments you dislike and weaknesses in those you like

3. Modifying insights
• Seek commonalties not compromises, i.e., win-win situations (in modifying and integrating insights)
• Think holistically, contextually, and systemically
• Think dualistically, i.e., either/or (in drawing insights from disciplines) but also inclusively, i.e., both/and (in integrating their insights)
• Embrace contradiction—ask how it can be *both*
• Use the techniques for creating common ground in adjudicating conflicts in disciplinary insights

4. Integrating insights into comprehensive understanding of issue
• Look for unexamined linkages and unexpected effects
• Seek unanticipated effects by re-contextualizing: look at different time frames, scales, and cultures
• Expect multiple causes and effects
• Resist urge to assign numbers to things not inherently quantitative, especially if they can be viewed differently from different perspectives
• Don't fall in love with a solution until you understand the full complexity of the problem
• Strive for balance (among disciplinary perspectives)
• Integrate as you go (instead of waiting for all discipline's insights)
• Value intellectual flexibility and playfulness
• Seek understanding equally responsive to contributing theoretical perspectives and to the empirical pattern of behavior
• In constructing a more comprehensive understanding be responsive to all perspectives but dominated by none of them
• Persuade your audience with evidence not claims, keeping in mind that disciplines have different standards of evidence

_____

Table 3 lists pedagogies identified in any of the four participating breakout sessions as useful in promoting the habits of minds associated with each part of the interdisciplinary studies process. To make comparisons of pedagogies across the four breakout sessions, each of which developed its own labels for pedagogies, we identified key common features of pedagogies mentioned in different sessions. For example, "teaming diverse student backgrounds," "creating dialogue between advanced students from two or more disciplines," "peer evaluation," "teamwork," "teamwork/collaborative points," "role playing guests and students," collaborative work," "concept mapping—in teams," and "small group collaboration in person and online" were all coded as "group work." (Each of those pedagogies could also be coded under another commonalty as well, e.g., "teaming diverse student backgrounds" was also coded as "forming heterogeneous streams," and "peer evaluation" was also coded as "peer review.") By identifying common features in pedagogies, we were able to determine which were identified in more than one breakout group and the frequency with which they were identified.

Table 4 identifies pedagogies that are more widely applicable to interdisciplinary courses as a whole. This rich smorgasbord of pedagogies should be of interest to faculty teaching interdisciplinary courses as well as to staff and consultants preparing faculty development workshops on interdisciplinary teaching.

Located at the end of this section, Figures 1 (Drawing Insights), 2 (Evaluating Insights) 3 (Modifying Insights), and 4 (Integrating Insights) identify the frequency with which common features of pedagogies were recommended by breakout groups for each part of the interdisciplinary process. Features of pedagogies that were independently identified by more breakout sessions presumably deserve more attention from faculty members trying to decide which pedagogies to try out in their interdisciplinary courses. Moreover, cursory comparisons of Figures 1-4 make it clear that different pedagogies are useful in different parts of the interdisciplinary process. While the different kinds of thinking required in different parts of the interdisciplinary process have been identified previously (Newell 2007), this is the first empirical validation that different

8

Table 2: Pedagogies Promoting Interdisciplinary Habits of Mind

1. Drawing insights
    a. Teaming diverse student backgrounds
    b. Modeling different perspectives via team teaching
    c. Topics that necessitate interdisciplinary approaches (guest lectures, hot topics)
    d. Rewarding risk taking (encourage perspectives even if seems naïve)
    e. Scaffolding with case studies
    f. Repetition of the incompleteness of insights/resolution
    g. Explicitly identify the perspective behind each insight
    h. Tying explicitly to earlier discussion
    i. Bringing in faculty from different disciplines to explain how they approach a problem
    j. Using real world examples
    k. Dialogue between team teachers
    l. Leading with theory (which helps students engage with different disciplinary models/questions without negotiating with a whole disciplinary paradigm or mischaracterizing them)
    m. Creating dialogue between advanced students from 2 or more disciplines (which helps make explicit the commonalities/differences between disciplines)
    n. Choosing the issue and identifying relevant bodies of knowledge (which helps students make connections between disciplinary models, and build on these connections in applying research
    o. Using role playing or charades (to help students detach from their own perspectives in non-threatening ways and imagine other ways of thinking about an issue, event, or position)

2. Evaluating insights
    a. Recognizing whether an insight is relevant
    b. Having a good rubric and sharing it with students
    c. Peer evaluation
    d. Literature review
    e. Successful and failed examples of disciplinary efforts
    f. Recognizing what you need to know for definitive evaluation
    g. Putting a range of convictions on the table before bracketing them
    h. Online facilitation
    i. Clicker-based responses
    j. Devil's advocate assignment
    k. Double edged pharmaceutical exercise
    l. Presenting both sides or taking opposing positions
    m. Modeling their evaluation
    n. Dialogue (maybe modifying or even integrating it)
    o. Phenomena, e.g., drawn from Szostak's list of phenomena (Repko 2012:106-110) that influence the problem and inform the analysis
    p. Structuring assignments (focusing on IDS methodology and disciplinary perspectives before undertaking the project)
    q. Teamwork fostered by assignments that stimulate rich interaction among students
    r. Assignments that articulate the role of disciplines

3. Modifying insights
    a. Assignment to design and justify course syllabus
    b. Model UN
    c. Role playing
    d. Academic controversy (debate, class discussion)
    e. Concept maps
    f. Presenting range from bargaining and negotiation to alternate dispute resolution
    g. Instructor models interdisciplinary process
    h. Guest lectures representing authentic perspectives, including voices outside academy that present competing arguments
    i. Case studies that present unintended consequences, e.g. historical or current events—the latter are much more powerful—can relate to students lives more efficiently
    j. Panels of experts who can present multiple perspectives and can help students compare/contrast assumptions and arguments to
        1. Get away from binary thinking that is common in debates
        2. Help students understand how they frame questions and seek insights
        3. Ask or modifying questions, uncover assumptions and arguments by comparing/contrasting controversial arguments
        4. Show students multiple perspectives based on different assumptions/evidence
        5. Support finding common ground

4. Integrating insights
   a. Capstone seminars
   b. Film festival or other concrete referrals
   c. Summative public product
   d. Draft National Institute of Health, National Endowment for the Humanities, or National Science Foundation request for proposals
   e. Recognizing and incorporating reality
   f. Write short story that demonstrates integrated understanding
   g. E-portfolios that connect elements with narrative
   h. Shared inquiry (from great books, questions without answers)
   i. Multiple drafts with feedback, including face to face meetings
   j. Creativity exercising
   k. Systems modeling
   l. Teamwork/collaborative points
   m. Case studies that introduce and revise assumptions, arguments and finally propose a different or extended argument
   n. Unintended consequences revealed in those case studies
   o. Annotated bibliographies that offer students a range of perspectives that they have to group and then integrate, e.g., 30 papers selected that student groups must annotate and share and then sort by theme and integrate
   p. Uncovering bad arguments, e.g., from case studies, and re-envisioning them, and using cognitive dissonance to encourage students to revisit their assumptions

---

different pedagogies are therefore required in different parts of an interdisciplinary course.

Figure 5 (General Best Practices) depicts the frequency with which key components of pedagogies were recommended for the interdisciplinary process as a whole. The 17 pedagogical components recommended most frequently (3 or more times) deserve special recognition. These can be organized and categorized into three groups as follows: (A) overall course structure/organization (instructors from multiple disciplines, guest instructors, and case studies that are current event-based and ill-structured), (B) active learning (group work, creativity exercise, interactive practice,[2] role playing, model building, and student projects), and (C) traditional liberal arts pedagogies (reading the literature, critique,[3] reflection[4], class discussion, writing assignments, and instructor modeling). What

---

[2] Interactive practice is illustrated by repetition of the incompleteness of insights/resolution, multiple drafts with feedback in face-to-face meetings to talk about paper, annotated bibliographies—selecting range of perspectives and encouraging students to integrate them, concept mapping through digital, collaboration, small groups, and re-visiting topics and ideas.

[3] Critique is illustrated by repetition of the incompleteness of insights/resolution, choice of issue and development of relevant bodies of knowledge, successful and failed examples of disciplinary efforts, recognition of what you need to know for definitive evaluation, devil's advocate assignment, presenting both sides or take opposing positions, multiple drafts with feedback in face-to-face meetings to talk about paper, uncovering bad arguments and re-envisioning them, critical thinking exercise, confronting evidence, and critical reflections.

[4] Reflection is illustrated by repetition of the incompleteness of insights/resolution, recognition of whether an insight is interdisciplinary, successful and failed examples of disciplinary efforts, recognition of what you need to know for definitive evaluation, devil's advocate assignment, multiple drafts with feedback in face-to-face meetings to talk about paper, uncovering bad arguments and re-envisioning them, critical

Table 3: Overarching Pedagogies for Integrative Learning

---

1. Policy debate
   a. Role playing guests and students
   b. Case studies
   c. Problem based learning
   d. Collaborative work
   e. Critical thinking exercise
   f. Writing exercises
2. Literature review
   a. What do authorities of different disciplines say?
   b. Debates and restate another's argument
   c. Clashing viewpoints
   d. Editorials and then literature review
   e. End with reflection
3. Challenging multiple assumptions, critical reflection
   a. Take people out of their comfort zones
   b. Confront evidence
4. Synthesis: What's in the house?
   a. Active pedagogies
      1. Problem based learning
      2. Case studies
   b. Attention to process
   c. Critical reflections
   d. Blurring boundaries of what and how
5. Concept mapping in teams
   a. Small group collaboration in person and online
   b. Structures syllabi cycling through multiple disciplinary perspectives
   c. Done through digital, collaboration, small groups, re-visiting topics and ideas
6. Case studies
   a. Bring complexity to the classroom
   b. Connect across courses

---

thinking exercise, as well as reflection, critical reflections, and appropriate reflection and assessment.

7. Guest lectures/Mixed faculty
    a. Lining case studies
    b. Followed is appropriate reflection and assessment
    c. "Only the first step"
8. Mixed classes
    a. Students bring their own diverse perspectives to discussion
    b. Use inherent diversity in the classroom not just disciplinary
9. Open discussion
    a. Need modeling common ground
        1. Need to know what disciplines look like (underlying: use role-playing of stakeholders disciplines)
    b. Intentionality and being explicit
        1. About what "it" is > reflexive about teaching/learning process
        2. In team teaching
    c. Identifying limits and strengths of disciplines into context
    d. Embracing tensions
10. More open discussion
    a. Need skills of comparative thinking, methodology
    b. Accepting uncertainty, partiality
    c. Sharing/modeling yourself the and the process of revising
    d. Exposing your thought process
   e. Demonstrate multiple perspectives on the same entity

---

distinguishes this categorized list of pedagogical best practices in interdisciplinary teaching are: (a) it was compiled and vetted by multiple groups of teachers from a variety of institutions; (b) it is grounded explicitly in educational outcomes, namely interdisciplinary habits of mind; and (c) it is consciously embedded in interdisciplinary process.

From the categories of general best practices, we draw three basic inferences. First, course organization and structure have an important albeit indirect effect on pedagogy. That is, pedagogy is something faculty members have to think about as they conceptualize and design a course, not just as they prepare for each class period. Second, perhaps because interdisciplinary studies is grounded in traditional academic disciplines, traditional pedagogies have an important role to play in teaching interdisciplinary courses. Third, active learning is especially important in interdisciplinary pedagogy, not just a nice contemporary add on. In part this may be because

Table 4: An Integrated Model of the Interdisciplinary Research Process [Reprinted from Repko (2012):74]

---

1. Drawing on interdisciplinary insights
    a. Define the problem or that the research question
    b. Justify using an interdisciplinary approach
    c. Identify relevant disciplines
    d. Conduct the literature research
    e. Develop adequacy in each relevant discipline
    f. Analyze the problem and evaluate each insight or theory
2. Integrate disciplinary insights
    a. Identify conflicts between insights or theories and their sources
    b. Create common ground between concepts and theories
    c. Construct a more comprehensive understanding
    d. Reflect on, test, and communicate the understanding

---

interdisciplinarity requires non-traditional as well as traditional thinking; in part, it may be because the central objective of interdisciplinary courses is not to fit students into the *status quo* but to empower them to function effectively in a complex, evolving world.

Finally, Figure 6 (Word Cloud) offers a visual representation of the key features of pedagogical best practices in interdisciplinary studies.

REFERENCES

Haynes, Carolyn, editor. 2002. *Innovations in Interdisciplinary Teaching*. Westport, CT: American Council on Education/The Oryx Press.

Polanyi, Michael. 1958. *Personal Knowledge: Towards a Post-Critical Philosophy*. London: Routledge.

Newell, William H. 2007. "Decision Making in Interdisciplinary Studies." Pp. 245-264 in *Handbook of Decision Making*, edited by Göktug Morçöl. New York: CRC Press/Taylor & Francis Group.

Repko, Allen F. 2012. *Interdisciplinary Research: Process and Theory*. Second Edition. Los Angeles: Sage.

Smith, Barbara Leigh, and John McCann, editors. 2001. *Reinventing Ourselves: Interdisciplinary Education, Collaborative Learning, and Experimentation in Higher Education*. Bolton, MA: Ankar Publishing.

**Figure 1: Pedagogies for Drawing Disciplinary Insights**
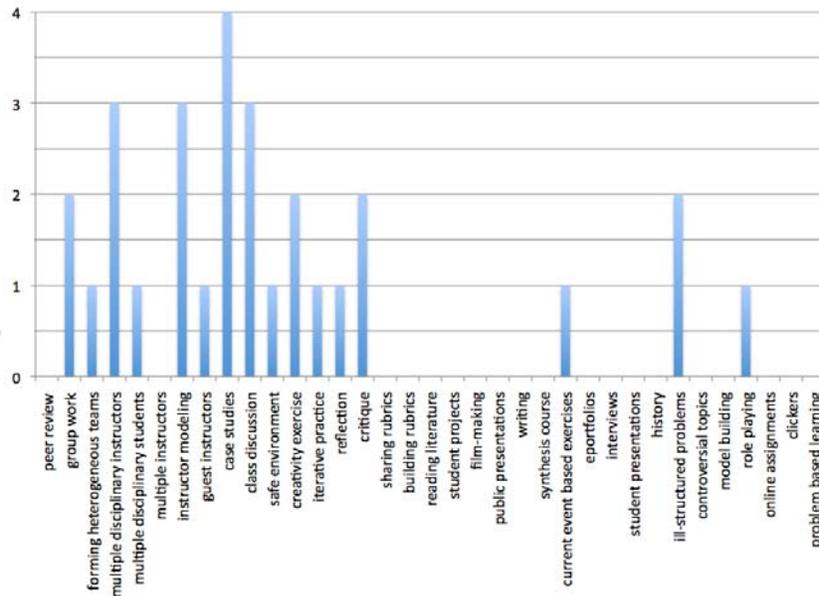
Notes: This figure and those that follow are based on lists, created by faculty experts in four breakout groups, of best practices appropriate for each stage in fostering students' interdisciplinary behaviors and habits of mind. The authors developed a coding system and coded the data in those lists. For each stage, software identified the frequency with which common coded features of pedagogies were recommended for each part of the interdisciplinary process.

Figure 2: Pedagogies for Evaluating Disciplinary Insights
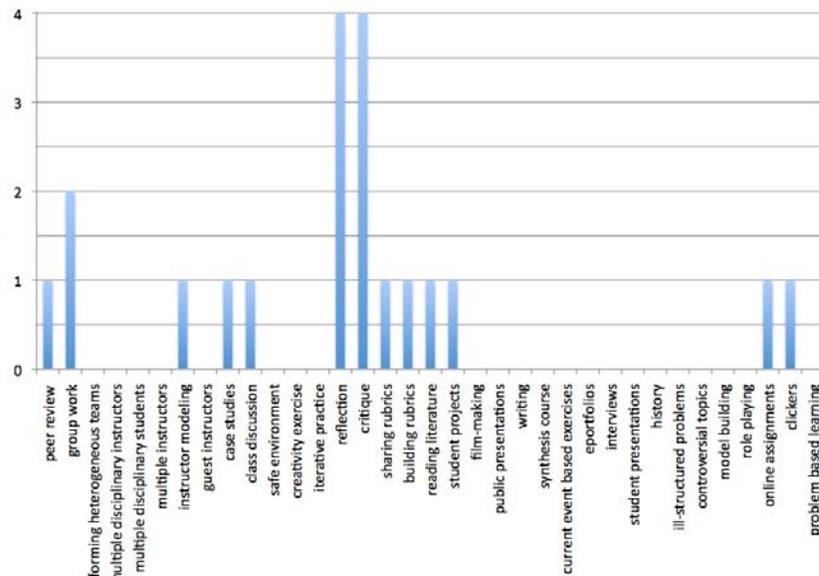
Notes: Expert faculty groups created lists of best practices of pedagogies appropriate for developing interdisciplinary habits of mind during the stage of Evaluating Disciplinary Insights. Software identified the frequency with which coded pedagogies were recommended by expert faculty.

Figure 3: Pedagogies for Modifying Disciplinary Insights
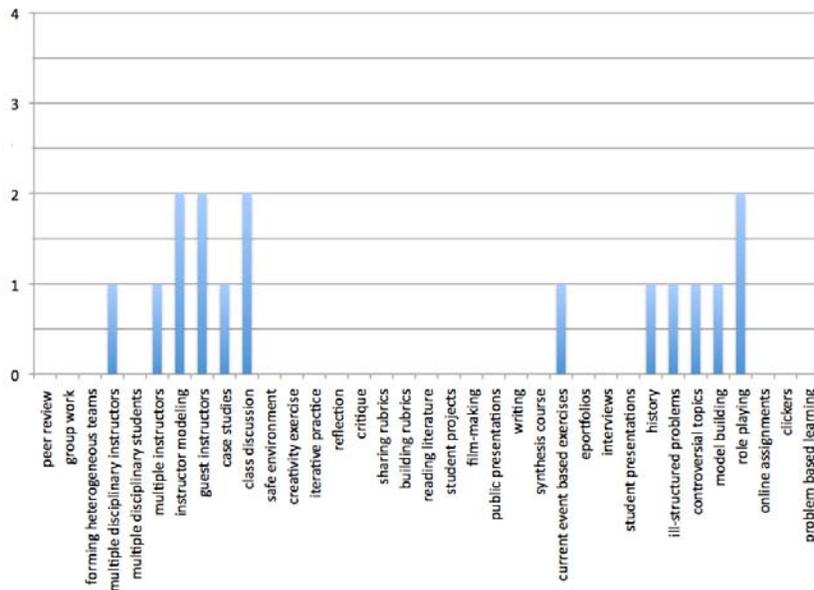
Notes: Expert faculty groups created lists of best practices of pedagogies appropriate for developing interdisciplinary habits of mind during the stage of Modifying Disciplinary Insights. Software identified the frequency with which coded pedagogies were recommended by expert faculty.

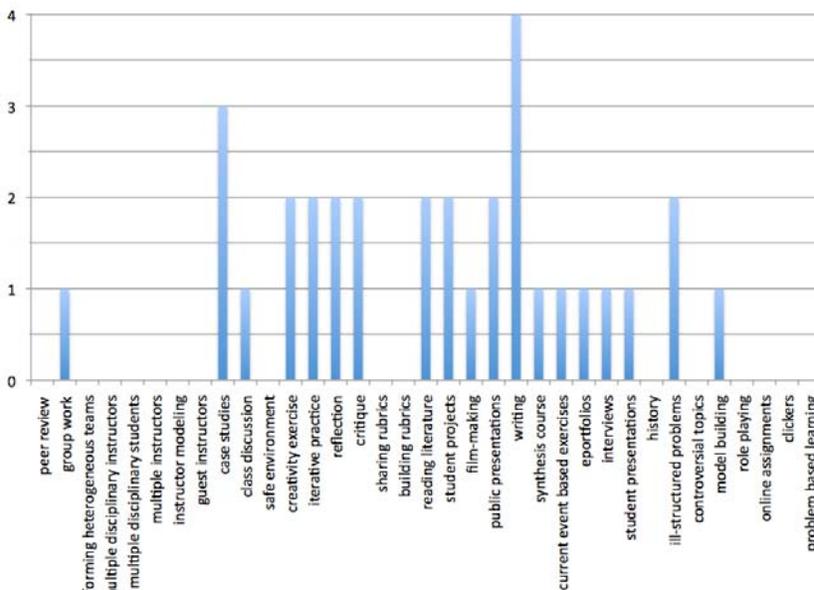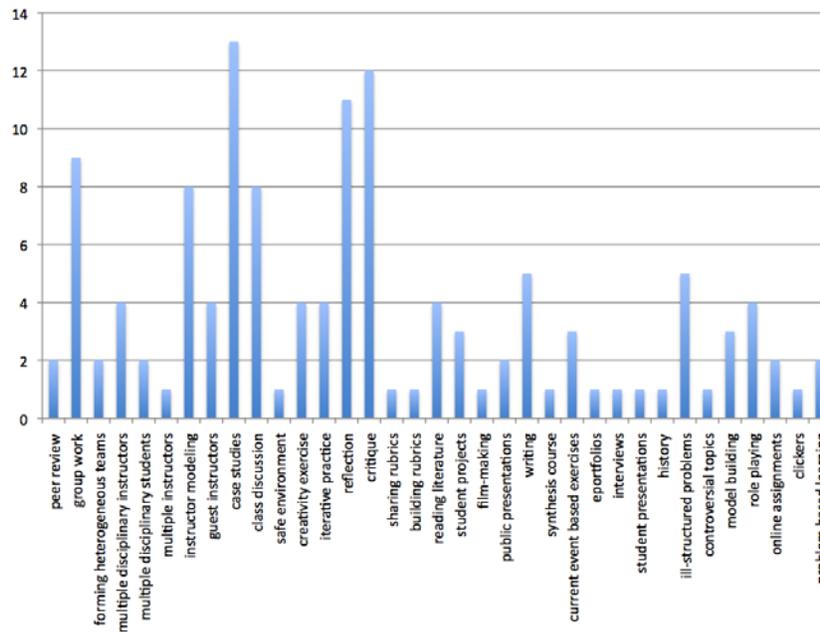**Figure 4: Pedagogies for Integrating Disciplinary Insights**

Notes: Expert faculty groups created lists of best practices of pedagogies appropriate for developing interdisciplinary habits of mind during the stage of Integrating Disciplinary Insights. Software identified the frequency with which coded pedagogies were recommended by expert faculty.

Figure 5: General Best Practices in Interdisciplinary Pedagogy

Notes: The data depict the frequency with which key components of pedagogies for developing interdisciplinary habits of mind were recommended by expert faculty for the interdisciplinary process as a whole.

Figure 6: Word Cloud of Interdisciplinary Pedagogies

Notes: This word cloud is a weighted word list where font size and color was used to visually model frequency. Faculty groups created lists of best practices of pedagogies appropriate for developing interdisciplinary habits of mind. Word Cloud was generated with Jonathan Feinberg's Wordle™ software (www.wordle.net), which mined comments of instructors and represents high frequency usage of terms with increased font size. These are pedagogies recommended by expert faculty.

Global Learning and Undergraduate Education

Kevin Hovland
Office of Integrative Liberal Learning and the Global Commons
Association of American Colleges and Universities
hovland@aacu.org

Richard Vaz
Interdisciplinary and Global Studies Division
Worcester Polytechnic Institute
vaz@wpi.edu

Global learning is frequently misunderstood to be a synonym for international education. Consequently, conversations about global learning and global engagement too often focus on the physical location of learning experiences, rather than on the student outcomes associated with them. In the US context, there is a tendency to assume that "global learning" occurs *elsewhere* and that through global engagement US students are gaining knowledge and skills about events or phenomena that primarily affect *others*. As a result, when colleges and universities aspire to prepare their students for life in a global century, they often assume that existing curricular and co-curricular designs almost automatically become "global" by adding a shift in cultural and/or geographic perspective. Instead, we argue that institutions need to rethink the entire undergraduate learning experience to provide the necessary opportunities for students to gain knowledge and experience dealing with the overlapping issues of interdependence, interconnection, and complexity that characterize today's world.

For more than a decade, the Association of American Colleges and Universities (AAC&U) has been helping colleges and universities explore such changes through its Shared Futures initiative.[5] Recently, colleagues drawn from the Shared Futures project *General Education for a Global Century* have drafted and are testing a global learning rubric. They define global learning as follows:

> Global learning is an analysis of and an engagement with complex, interdependent

---

[5] For information about AAC&U's Shared Futures initiative and the *General Education for the Global Century* project, see http://www.aacu.org/SharedFutures.

global systems (natural, physical, social, cultural, economic, and political) and their implications and legacies through real-world contexts. Through global learning, students should become informed, empathetic, and responsible citizens who understand and reflect on how their actions impact both local and global communities and who seek to address the world's most pressing and enduring issues collaboratively and equitably.

Such a definition is clearly multifaceted, and so the rubric designers have identified six dimensions of student learning as components of global learning:

- Self-Awareness and Empathy
- Personal and Social Responsibility
- Perspective Taking
- Intercultural Competence
- Understanding Global Systems
- Applying Knowledge to Real-World Contexts

Within this framework, we sought to draw from the conference participants their own experiences and insights about connecting global engagement and interdisciplinary teaching and learning.

PANEL PRESENTATIONS

Global engagement is a slippery concept; linking global engagement and interdisciplinary teaching and learning further complicates the matter. Panel presentations at the conference provide an instructive case study of the multiple meanings associated with global. In the keynote, Rick Vaz (2012) describes the Interactive Qualifying Project (IQP) element of Worcester Polytechnic Institute. The IQP is structurally located outside of specific disciplines in a shared space intended to provide students an interdisciplinary research and problem-solving experience. Vaz (2012) shares data suggesting that students are more likely to meet IQP learning outcomes in global settings beyond campus. The "striking difference," Vaz (2012) argues, "in achievement of learning outcomes such as information literacy, contextual thinking, problem solving, and persuasive writing suggests that international settings are particularly conducive to interdisciplinary learning." He suggests that "students more readily understand the impact of social and cultural contexts in foreign settings, where culture as a phenomenon becomes more explicit to them, and interdisciplinary thinking emerges as a habit of adaptation to new surroundings."

This reinforces an important question: is it possible to create such conditions for teaching and learning independent of physical location? What are the elements that create the desired student learning? Can we talk about global engagement in local communities—communities that are connected in global networks and face challenges and opportunities related to interconnection and interdependence?

Kevin Hovland (2012) sketches a framework for liberal education that can focus student learning goals on the shared points of interconnection and interdependence that blur the locational significance of current higher education attention to global. In other words, Hovland (2012) offers a general approach to undergraduate learning goals that opens space for collaborative, cross-curricular efforts to define global learning and interdisciplinary learning in practice. Drawing on the Liberal Education and America's Promise (LEAP) initiative's

Essential Learning Outcomes promulgated by AAC&U,[6] Hovland (2012) urges conference participants to imagine a global liberal education that is:

> focused by engagement with big questions, both contemporary and enduring; practiced extensively, across the curriculum, in the context of progressively more challenging problems, projects, and standards for performance; anchored through active involvement with diverse communities and real-world challenges; and demonstrated through the application of knowledge, skills, and responsibilities to new settings and complex problems.

Hovland (2012) argues that global learning increasingly serves as shorthand for problem-based pedagogies or integrative approaches to complex, multidisciplinary questions. In all cases, growing attention to global learning as an element of college and university mission and vision statements represents an opportunity to create common ground or "trading zones" where faculty members from all divisions and disciplines can come together to determine their own global priorities and to explore the connection between global questions and students disciplinary or interdisciplinary identities, knowledge, and skills. In order to do this, however, stakeholders need to be specific and intentional about the learning goals that they include under the term global learning and thoughtful about how those goals will be met through particular curricular and co-curricular strategies. While the goals may be shared across disciplines and divisions, strategies for meeting them may vary significantly depending on disciplinary perspective.

Laurie Thorpe (2012) makes explicit the civic dimension of global learning as she describes her own attempt to help students understand interconnection, interdependence, and global/local contexts in order that they might be better prepared "to enter the world as informed citizens where they will grapple with the implications of diverse stakeholders such as consumers, producers, scientists, policymakers, or planners." She tells of her success in "building a moral community of care" around the daily care of pigs. At the same time, her students are exploring how "ecology functions in a globalized era connecting biophysical and social systems across distant spaces." Like Vaz, Thorpe (2012) is interested in the power of an unfamiliar place (or a known place made unfamiliar) to enhance student learning.

Thorpe's approach emphasizes responsibility as well as the "role of emotion in teaching, learning and research." She demonstrates the importance of intercultural understanding as a global learning outcome, but, interestingly, the cultures across which her students connect are not geographically dispersed, but determined by relationships to the production and consumption of food. Intentionally creating a community of students around the care of the animals, Thorpe (2012) finds that:

> students are united in their care for the animals and each other, expressing almost a unanimous desire to learn more about each other's production system, and to learn more about the animals themselves. The students also shared a sentiment of being tired of dualisms such as organic/conventional, environment/agriculture, large-scale/small-scale . . . In moving out of

these dualisms, students spoke of the need for leadership skills such as: patience, openness and willingness to learn from each other across different scales and backgrounds.

The farm, Thorpe argues, represents a "practice field for the development of the participatory skills needed for the global challenges we face."

Bruce Magnusson (2012) reinforces the notion that global engagement and global studies "must incorporate a strong intellectual and classroom foundation" in addition to experiential components and thus requires thoughtful and ambitious faculty development efforts. Magnusson (2012) is primarily interested in global learning as a curriculum and faculty development approach to helping all graduates function as successful professionals and community members in a "global economy affected by global currents of migration, financial markets, resource scarcities, and ideologies." Consequently, Magnusson and Whitman College are not interested in developing another interdisciplinary major around global issues, but seek an approach that "permits all of us to become critically aware of changing boundaries, new questions and research agendas, and source of knowledge and information that can help us build strong departmental majors, even as we increase our ability to converse across the college about issues of global importance."

Many of the questions that are directing the work of his colleagues at Whitman College return our attention to the task of defining "the global" and thinking hard about the relationship between global questions and disciplinary perspectives.

- What do we mean by "the global" and "global studies?" What is a global studies perspective?
- How do we converse about texts from multiple disciplines across disciplines with differing assumptions, canons, preoccupations, and methods of knowledge production?
- How can we maintain a critical scholarly pedagogy while "engaging" globally?"
- How do we help students in every major understand and critically engage their position in and connection to the rest of the world? How do we best help them acquire the knowledge and skills necessary to negotiate the world?
- Is it important for students to understand their academic disciplines as global institutions that involve global power relations, norms and rules of behavior, and distinct cultures of knowledge?
- When is it more appropriate to articulate the perspectives of differing disciplines about a global issue, than to try to integrate those perspectives?

WORKSHOP DISCUSSION

The following two questions focused discussion during the conference workshop:

1. Students' perceptions of academic disciplines are often nascent, and it is unlikely they perceive and experience interdisciplinary learning as distinct from other learning in the way that faculty do. Given the inherently interdisciplinary nature of global learning, might it be easier (or more natural) for students to engage the interdisciplinary nature of global learning than it is for faculty?

---

[6] To learn more about LEAP, visit www.aacu.org/leap.

2. Embedding global learning across the curriculum can engage students with interdisciplinary thinking at multiple points in their intellectual development. Can early and regular exposure to global learning change the way students perceive and make connections between the disciplines?

Conference participants raised significant concerns about the suggested connections between global engagement and interdisciplinary study.

Conference participants not only questioned the definition of key terms, but also the assumptions embedded in prioritizing key learning goals. Should "global" be the goal of undergraduate learning? Or should experience be the goal—in local, global, or intersectional spaces? What is the role of the disciplines in allowing students to translate experience into meaning? Is forcing students (or faculty) out of their comfort zones an effective strategy for increasing complex thinking, or the opposite? What about civic engagement? How is it related to global learning? How is it changed by notions like global citizenship?

Some participants argued that global engagement can indeed facilitate interdisciplinary learning due to the inherently interdisciplinary nature of global challenges such as public health, energy sustainability, food security, and climate change. Others pointed out that global is just one of many themes or approaches for interdisciplinary learning. Interdisciplinary learning can be a means for helping students explore pluralism and learn to make connections, or it can be an end in itself.

Similarly, some participants questioned the goals of an interdisciplinary agenda. Is the goal to create interdisciplinary scholars? Or is the goal to create broad-minded disciplinary scholars who can have discussions across boundaries? Or is the goal to create pragmatic problem-solvers who can tackle interdisciplinary challenges they face in their careers? In any event, participants agreed that students learn better within a framework that helps them contextualize their experiences. The choice of frameworks, of course, replicates similar questions of priority and design. How do we help students make connections within an interdisciplinary framework? What kinds of organizational structures are needed? How do we provide explicit training on the differences between disciplines?

Consensus emerged around the idea that "real world" contexts open up possibilities for more interdisciplinary engagement. There was less agreement that such contexts were inherently global. Yet conference participants saw the importance of scaffolding learning experiences in developmentally appropriate ways so that students come to appreciate—and engage—in the complexity of messy problems. Such complexity, they pointed out, includes the political and ethical implications of operating with a fuller understanding of the role that the United States plays vis-à-vis the rest of the world and the dangers of stereotyping or attitudes of exceptionalism.

In discussions of the impact of learning "out of the comfort zone," one participant identified the concept as connected to Piaget's "decentering." Others noted that such experiences promote a sense of agency in students, as they learn to advocate for situations and develop skills to take effective action. Several participants observed that study abroad has the potential to help students better understand their own society, culture, and personal perspectives. Understanding one's own discipline from a different disciplinary context can be seen as another form of learning through cognitive dissonance. Faculty are often in as good a position as students to benefit from this dissonance.

In sum, conference participants were open to the idea that global learning broadly defined might be a useful framework for interdisciplinary learning, and vice-versa. They were, however, largely convinced that global learning and interdisciplinary learning have distinct purposes. How do we differentiate between the two capacious concepts? And if we define them too broadly, what meaning and value do they retain?

PROMISING PRACTICES

The following curricular strategies and pedagogical approaches were identified as particularly promising ways to integrate interdisciplinary and global learning.

Curricular Strategies
- International studies options/minors: embed in the curriculum; incorporate reflection at multiple points in the program; tailor to institutional context
- Global seminars: experiential seminars in the first year and beyond, addressing interdisciplinary topics
- Undergraduate research experiences tied to global initiatives: select topics that combine, e.g., science, national policy, international relations
- Team-taught courses on global/interdisciplinary topics: especially those that allow and help students address discomfort in dealing with difficult topics
- Incorporating international experience into an interdisciplinary program: short-term faculty-led study abroad can augment campus-based study
- "Local as global" courses that draw on local issues tied to international debates: these can incorporate service learning or community-based research
- Thematic courses that involve both in-class and out-of-class experiences and challenge students to make connections between disciplinary ways of thinking
- Curricular design that signals to students the importance of global and interdisciplinary learning
- Adopting a common set of learning outcomes across the institution, and having those be part of the institutional culture and mission

Pedagogical Approaches
- Case studies for intentional exploration of different ways of thinking: examining how different cultural viewpoints generate distinct situational behaviors
- Problem-based learning: interdisciplinary problems in global context as a vehicle for team-based student work; incorporate into the curriculum early and often; embed effective assessment of learning outcomes

- Peer learning and review: engaging students in learning from and constructively reviewing the work of others in interdisciplinary and global learning contexts
- Immersion in unfamiliar settings (physical or intellectual): getting students out of their comfort zones; design learning experiences including preparation and pre-assessment; post-experience assessment and reflection
- Collaborative and team-based work: provide training for teamwork; facilitate formation and mediation of teams; address conflict resolution and reflection; build on diversity in the classroom
- Team-teaching as faculty development: helping faculty gain skills, experience, and confidence in interdisciplinary teaching about global issues and problems
- Writing across the curriculum as a strategy for getting students to confront different disciplinary viewpoints regarding global issues

REFERENCES

Hovland, Kevin. 2012. "Interdisciplinary Teaching and Learning for Global Engagement." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Magnusson, Bruce. 2012. "Global Engagement in a Small Place: Whitman College's Global Studies Initiative." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Thorp, Laurie. 2012. "Growing Ecological Relationships Near and Far: Local Pigs in a Global Context." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Vaz, Richard. 2012. "Do Global Experiences Facilitate Interdisciplinary Learning?" Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Assessing Interdisciplinary Education: Process, Writing, and Rubrics

Bernard Madison
Department of Mathematical Sciences
University of Arkansas
bmadison@uark.edu

Tanya Augsburg
Liberal Studies Program
San Francisco State University
tanya@sfsu.edu

Assessment of student interdisciplinary and integrative learning outcomes provides evidence for important curricular reforms that can improve student learning. Assessment offers challenges in individual disciplines, and the challenges are even greater in interdisciplinary studies where standardization rarely exists. However, such challenges are accompanied by exciting new opportunities centered on understanding evidence of disciplinary, interdisciplinary, integrative, and reflective thinking. Part of the added difficulty is the heterogeneous typology of interdisciplinary studies, a "very large box," as one of the participants noted during the Conference on Interdisciplinary Teaching and Learning. That variety was patently evident in the recounted experiences of the four leaders of the conference session on interdisciplinary assessment: Bernie Madison in a quantitative reasoning (QR) course at the University of Arkansas; Tanya Augsburg in a pilot assessment of an interdisciplinary gateway course at San Francisco State University; Carolyn Haynes in a developmental, outcomes-based framework for honors students at Miami University; and Colleen Tremonte in a study of electronic dialoguing in core courses in an interdisciplinary major at Michigan State University.

The session leaders described their respective experiences in individual papers that formed the intellectual background of the conference's panel discussion on assessing interdisciplinary studies. Madison (2012) and Dingman and Madison (2010) describe assessment as one of the major challenges in developing the QR course; Augsburg (2012) writes of the complexities of doing assessment in an undergraduate interdisciplinary degree program; Haynes (2012) argues that assessment of interdisciplinary learning requires courage and even temerity; and Tremonte (2012) cites experience in localizing learning outcomes and reducing assessment issues to research studies of student-generated data in the form of electronic dialoguing. While all four plenary session speakers cited established interdisciplinary learning outcomes (See Table 5) and Haynes (2012) asserted that interdisciplinary learning outcomes should not be limited to the strictly cognitive, the conference discussions focused on interdisciplinary assessments, writing, and rubrics.

In addition to the discussion of advances in understanding and implementing interdisciplinary learning assessment at the undergraduate level, the session prompted lively commentary about assessment's future directions given the new economic exigencies and rapidly changing demographics facing many colleges and universities in recent years.

As an aside, we note that the discussions at the conference did not always distinguish between interdisciplinary studies and integrative learning (or studies), so it should come to no surprise that this section does not either. Klein (2005) and Newell (2001) each offer clear distinctions between the two terms. Klein (2005:9) writes in *Peer Review*:

> Heightened interest in integrative learning and interdisciplinary studies has led many to wonder about the relationship between these concepts. "Integrative learning" is the broader of the two. It is an umbrella term for structures, strategies, and activities that bridge numerous divides, such as high school and college, general education and the major, introductory and advanced levels, experiences inside and outside the classroom, theory and practice, and disciplines and fields. "Interdisciplinary" studies is a subset of integrative learning that fosters connections among disciplines and interdisciplinary fields.

GUIDING QUESTIONS

The session leaders provided four questions to prompt discussions in the workshops on assessment. They were:

1. What are some of the outcomes you have identified for assessment of interdisciplinary learning?
2. Why is writing a useful vehicle for assessing outcomes?
3. What are some examples of writing assignments or activities that have been particularly effective in assessing students' interdisciplinary learning?
4. How might interdisciplinary writing be affected by changing cultural practices and new technologies?

The session leaders chose writing as a focus vehicle for assessment because it was central to the assessment experiences of three of the session leaders: Madison, Augsburg, and Haynes. In addition, all three have experience with some of the Valid Assessment of Learning in Undergraduate Education (VALUE) rubrics of the Association of American Colleges and Universities (AAC&U). Haynes (Boix Mansilla et al. 2009; Wolf and Haynes 2003a, 2003b) has previous experience developing rubrics for interdisciplinary writing assignments. Of particular interest and relevance for this session were rubrics for integrative learning, written communication, critical thinking, and quantitative literacy. While acknowledging that there are

Table 5: Summary of Discussed Interdisciplinary Learning Goals

Five Learning Outcomes from an Interdisciplinary Gateway Course (Augsburg 2012)
1. Become familiar with the scholarship on which knowledge in a specific discipline is based
2. Learn how to integrate different disciplinary approaches to the study of complex issues
3. Develop skills required to read and evaluate a wide variety of academic, creative, professional and popular sources
4. Be able to frame questions, make claims and support assertions
5. Develop the ability to craft well written, thesis-driven papers that can distinguish between different disciplinary methods and potentially integrate them

Five Learning Outcomes Adapted from AAC&U QL rubric (Madison 2012)
1. Glean and explain quantitative or qualitative information presented in various forms
2. Convert information from one representational form into another
3. Make and draw conclusions based on quantitative or qualitative analyses
4. Make and evaluate relevant assumptions in critical analyses
5. Explain thoughts and processes in terms of what evidence is used, how it is organized, presented and contextualized

Four Learning Outcomes from Boix Mansilla (2010)
1. Establish purpose
2. Understand and weigh disciplinary insights
3. Build leveraging integrations
4. Maintain a critical stance

Four Learning Outcomes from Repko (2008)
1. Develop and apply perspective-taking techniques
2. Develop structural knowledge of problems appropriate to interdisciplinary inquiry
3. Integrate conflicting insights (expert views) from two or more disciplines
4. Produce a cognitive advancement or interdisciplinary understanding of the problem

Two Learning Outcomes from Writing Rubric as cited by Haynes (2012)
1. Achieve self-authorship; take learning as one's own; achieve cognitive maturity
2. Integrate knowledge of one's self (e.g. passion, values, strengths, limitations) and various disciplines/fields to address a personally meaningful problem, question or project

Four Learning Outcomes from Integrative Learning VALUE Rubric
1. Be able to connect relevant experience and academic knowledge
2. Develop ability to see or make connections across discipline perspectives
3. Be able to adapt and apply skills, abilities, theories, or methodologies gained in one situation to another
4. Be able to demonstrate a developing sense of self as a learner, building on prior experience to respond to new and challenging contexts

Five Learning Outcomes from the Written Communication VALUE Rubric
1. Demonstrates thorough understanding of context, audience and purpose
2. Uses appropriate, relevant and compelling content to illustrate mastery of the subject
3. Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline
4. Demonstrates skillful use of high quality, relevant sources to develop ideas
5. Uses graceful language that skillfully communicates meaning to readers with clarity and fluency

other assessment tools to measure student interdisciplinary and integrative learning (e.g., program mission statements, course learning outcomes, and student portfolios), the plenary session and subsequent workshops focused on writing and rubrics. During the workshops, participants considered how the rubrics could be helpful for assessing individual writing assignments, student portfolios, and even national testing standards in quantitative literacy.

ASSESSMENT DIFFICULTIES AND BARRIERS

As any discussion of assessment is wont to do, some of the conference participants (including session leaders) recited the difficulties of, and barriers to, assessment (See Table 6). Haynes said it best when early in her remarks she repeated an unpublished witticism by Don Stowe, a pioneer on interdisciplinary assessment: "bringing up the subject of assessment is akin to bringing a skunk to a birthday party." In other words, negative attitudes about assessment are all too common. Why? There seems to be no shortage of reasons, some of which have already been noted by Stowe (2002) and

Table 6: Interdisciplinary Assessment Challenges and Solutions

Challenges to Assessment
Faculty negative attitudes toward assessment
Perceived time commitment on part of faculty
Perceived or actual increase in faculty workload
Imposition from above
Predetermined singular assessment measures
Unfamiliarity about assessment, particularly,
    interdisciplinary assessment
Unfamiliarity with the literature on interdisciplinarity
Concern about high-stakes assessments
Inadequate inclusion of interdisciplinary features
Lack of consensus among faculty regarding what and how
    can be assessed
Difficulties to assess process rather than content
Diminished institutional resources and support during
    budgetary crises
Faculty lack of confidence regarding their ability to assess

Solutions
Incentivizing assessment
Adequate project management
Adequate time provided
Faculty input in determining assessment measures
Adequate resources
Incentivizing interdisciplinary research for faculty
Adequate faculty professional development in
    interdisciplinary teaching, learning, and assessment

Repko (2008), but we will limit our discussion to barriers that were mentioned during the conference.

We state the most frequently mentioned barrier first: assessment requires considerable time and labor. In the view of one participant, assessment is a lot of work whose ultimate value is questionable, especially in the eyes of those performing the assessment: the faculty. Besides the considerable time commitment, assessment is often imposed. Consequently faculty often view assessment as one more thing on their "to do lists." Because faculty do not always make the decision regarding what gets assessed, assessment is not always useful to measure student learning as it narrowly focuses on predetermined singular measures that are not sensitive to "authentic" performance indicators.

Additionally, participants expressed concern over the ever-increasing influence of national assessments on the learning environment, particularly high-stakes national (or even local) assessments. There was also worry about the role of assessments that are too simplistic or reductionist because they do not adequately address features of interdisciplinarity, i.e., integration skills, and even when they do, there can be a lack of consensus among administrators or faculty regarding how they can be assessed.

Lack of consensus can be attributed to a lack of familiarity with assessment, which leads to several possible challenges. Without sufficient familiarity or knowledge, there is the daunting problem of how to do interdisciplinary assessment. Related to unfamiliarity with how to do assessment is a lack of knowledge of how to locate existing assessment resources and

literature (see Table 7). Even when accessed and made readily available, the research on interdisciplinary assessment is far from extensive or conclusive. In contrast, assessment literature within disciplines has a longer history and is consequently more established and accepted.

The reasons for the longer and more established disciplinary assessment literature can be easily explained. Assessing within disciplines is much more obvious than assessment in interdisciplinary programs. Most disciplines are content-focused. One conference participant noted that process and skills—rather than content in its disciplinary configuration—are relevant within interdisciplinary studies, and that assessing process and skills is more difficult than assessing content. Another conference participant reminded the session leaders that we are not assessing students. We are assessing courses and programs—test on the content, assess on the concept. Grading and assessment are categorically different yet often confused or conflated. To be clear, assessment is about improving what is taught and how it is taught. Assessing means systematically collecting data on what students are learning and on the efficacy of specific course assignments. It is a process—a feedback loop process, to be more specific—rather than an isolated one-time event.

Communicating to students the goals and methods of interdisciplinary studies is critically important and complicated. Assessment is a vehicle for doing this, but it can be hampered by many students' struggles to master disciplinary knowledge. Numerous conference participants stated that students at their home institutions often lack understanding that multiple ways of knowing exist; many entering students, in particular, do not have a good understanding of any disciplinary way of knowing or what a major area of studies is. For example, during her keynote address, Marci Sortor asserted that "the ability to meaningfully integrate the information, methodologies, and analytical approaches of more than one discipline in identifying and exploring an issue, problem, or creative project . . . is extremely difficult for an undergraduate to do well."

Haynes (2012) comments on these challenges:

> Honest, in-depth reflection . . . does not come easily for undergraduate students, and particularly for honors students, who have been socialized into presenting a flawless self-image and to compartmentalizing (rather than connecting) learning experiences. . . . Students enter college not only uncritically accepting answers from authority figures, but also having scant understanding of what an academic discipline is, let alone what 'interdisciplinary' means. As a result, they need purposeful guidance on disciplinary as well as interdisciplinary understanding, not to mention on synthesizing disciplinary insights.

Augsburg (2012) recounts how she and her colleagues at San Francisco State discovered that "introductory students need more clarity in instruction regarding what constitutes good and excellent integration versus poor or weak. Moreover . . . students in the gateway course need[ed] more time to practice their integrative skills." With this last point Augsburg echoes Spelt et al. (2009:366), who point out:

> [I]nterdisciplinary thinking does not occur spontaneously, it can take a considerable amount of time for students to achieve an

Table 7: Introductory References for Interdisciplinary Assessment

Boix Mansilla, Veronica. 2005. "Assessing Student Work at Disciplinary Crossroads." *Change* 37:14-21.

Boix Mansilla, Veronica. 2010. "Learning to Synthesize: Toward an Epistemological Foundation for Interdisciplinary Learning." Pp. 288-306 in *Oxford Handbook for Interdisciplinarity*, edited by R. Frodeman, Julie T. Klein, and C. Mitcham. Cambridge: Oxford University Press.

Boix Mansilla, Veronica, Liz Dawes Duraisingh, Christopher R. Wolfe, and Carolyn Haynes. 2009. "Target Assessment Rubric: An Empirically Grounded Rubric for Interdisciplinary Writing." *Journal of Higher Education* 80:334-353.

Field, Michael, Russell Lee, and Mary Lee Field. 1994. "Assessing Interdisciplinary Learning." *New Directions in Teaching and Learning* 58:69-84.

Field, Michael, and Donald Stowe. 2002. "Transforming Interdisciplinary Teaching and Learning through Assessment." Pp. 256-274 in *Innovations in Interdisciplinary Teaching,* edited by C. Haynes. Westport, CT: American Council on Education/The Oryx Press.

Haynes, Carolyn, and Jeannie Brown Leonard. 2010. "From Surprise Parties to Mapmaking: Undergraduate Journeys toward Interdisciplinary Understanding." *Journal of Higher Education* 81:645-666.

Ivanitskaya, Lana, Deborah Clark, George Montgomery, and Ronald Primeau. 2002. "Interdisciplinary Learning: Process and Outcomes." *Innovative Higher Education* 27(2):95-111.

Klein, Julie Thompson. 2002. "Assessing Interdisciplinary Learning K-16." In *Interdisciplinary Education in K-12 and College: A Foundation for K-16 Dialogue*, edited by Julie Thompson Klein. New York: College Board.

Lattuca, Lisa R., Lois J. Voigt, and Kimberly Q. Fath. 2004. "Does Interdisciplinarity Promote Learning? Theoretical Support and Researchable Questions." *The Review of Higher Education* 28(1)*:*23-48.

Newell, William H. 1990. "Interdisciplinary Curriculum Development." *Issues in Integrative Studies* 8:69-86.

Repko, Allen F. 2008. "Assessing Interdisciplinary Learning Outcomes." *Academic Exchange Quarterly* 12:171-178.

Schilling, Karl L. 2001. "Interdisciplinary Assessment for Interdisciplinary Programs." Pp. 344-354 in *Reinventing Ourselves: Interdisciplinary Education, Collaborative Learning, and Experimentation in Higher Education*, edited by B. L. Smith and J. McCann. Boston: Anker Publishing.

Stowe, Donald E. 2002. "Assessing Interdisciplinary Programs." *Assessment Update* 14(3):3-4.

Stowe, Donald E. 2002. "Interdisciplinary Program Assessment." *Issues in Integrative Studies* 20:77-101.

Wolfe, Christopher R. and Carolyn Haynes. 2003. "Assessing Interdisciplinary Writing." *Peer Review* 6(1):2-15.

Wolfe, Christopher R. and Carolyn Haynes. 2003. "Interdisciplinary Writing Assessment Profiles." *Issues in Integrative Studies* 21:126-169.

adequate level of expertise in its practice. In addition, students need help in order to be able to synthesize two or more disciplines.

In the workshops and other discussions, conference participants echoed the insights of Sortor, Haynes, and Augsburg. As one stated, drawing on specific experience, "Most students do not bring ideas from other disciplines, so I learned early on to assess whether students really understand interdisciplinary concepts. Students are told to synthesize, but few do. What hangs them up is the heavy content that caused some backsliding in terms of student understanding." During conference discussions, participants noted that students in interdisciplinary capstone classes struggle with identifying disciplinary knowledge in writing laboratory reports, literature reviews, research proposals, and capstone research projects.

Another conference participant noted that with such a wide range of disciplines and methodologies, it is difficult to define mastery in interdisciplinary learning, and very difficult to measure it. One way is to have assignments that require students to incorporate mixed methods. Use of unconventional projects offer opportunities for interdisciplinary learning, providing a way to see how students understand, use methodology, and how they measure and evaluate. Given a problem, can a student break it down into component parts and find reasonable methods to employ?

As Haynes (2012) points out, among the more vexing challenges of interdisciplinary assessment are faculty fears about engaging in such activity. With regard to assessing interdisciplinary learning, Haynes notes:

> When we have invited faculty and staff to score [an interdisciplinary] competency in the e-portfolios or to incorporate interdisciplinarity into their learning experiences, we have been met with perplexed stares or comments such as, 'I am not qualified to teach or assess this,' which has prompted us to recognize the need for greater professional development on interdisciplinary teaching, learning and assessment.

This lack of confidence and experience among college faculty to assess interdisciplinary learning within writing assignments has been, and continues to be, one of the challenges of the QR course that Madison (2012) describes. Like most interdisciplinary areas, as the need for QR continues to increase and that QR is embedded in all areas of human activity, the problem of confident and able teachers will only get worse without effective professional development and modified graduate education.

In the discussions about assessment during the conference, Julie Thompson Klein offered a pragmatic solution to assessment challenges: incentivization. By incentivizing assessment, faculty will change their negative attitudes, overcome their fear, and be more willing to spend the time and commitment that assessment requires. They will not only seek out and familiarize themselves with the existing assessment

literature; they will also contribute to it. We have included additional solutions in Table 6 based on what we observed and heard during the conference.

WHY WRITING?

Conference participants expressed multiple reasons why and how writing was used in assessing student interdisciplinary learning. As one participant stated, writing manifests thinking. Students need to get writing structure down in order to progress intellectually and communicate that progress to others. Several participants cited journals, diaries, and short write-ups linking class to external events as ways of revealing student thinking and levels of understanding. Reflective writing can reveal how well students are integrating ideas from different sources or disciplines. One conference participant quoted from Richard Guindon's 1989 *San Francisco Chronicle* cartoon: "Writing is nature's way of showing you how sloppy your thinking is." Another combined assessment and writing:

> One of the reasons for coming to this conference was assessment. We are creating our own rubrics for assessing writing. Students have to attend campus events or lectures and summarize the events in papers and tie it back into class. Students learn over several semesters to make connections, although newer students tend to have more trouble with this. We use other students' work to show the new students they can meet expectations.

This anecdote illustrates a theme repeatedly heard throughout the conference. Use a rubric for interdisciplinary and integrative learning throughout the students' careers, but expect higher levels as they progress, requiring that a rubric be organized developmentally, requiring deeper understanding of interdisciplinary learning and integrative skills. Haynes (2012) describes how such a model works in the Miami University honors program.

Writing was an integral part of the interdisciplinary assessments cited in all four background papers for this conference session. Both Augsburg and Haynes report on the use of student electronic portfolios for undergraduate interdisciplinary courses. Tremonte reports on the study of student electronic dialoguing drawing from the scholarship of teaching and learning (SoTL), and Madison cites communication as major components of assessing student responses to quantitative reasoning prompts.

There were some cautions or reservations expressed during the conference workshops about using writing as a vehicle for assessment. Intercultural settings posed concerns about issues where non-native speaking faculty teach native speakers or where science-trained scholars are required to assess writing. Several conference participants reported difficulty in motivating students to get further assistance with writing by using resources such as a writing center even when readily available and required. Two critical questions were raised but remained unanswered: (1) where do students who struggle with English fit into a writing-based assessment framework? and (2) what if a student has excellent ideas but poor writing skills? New technologies that process speaking and perhaps even thinking may alter the use of writing landscape, but, as of now, writing is the principal vehicle for manifesting clarity in thinking.

Such questions and observations reflected the awareness among conference participants that universities are rapidly evolving due to changing student demographics, economic forces, and digital technologies. Indeed, the current global financial situation poses additional, often paradoxical challenges to assessment, such as diminished resources, greater accountability, and increased faculty workloads—which result in less time for assessment. While the questions pertaining to writing competencies and skills remained largely unanswered due to conference parameters, the one conference participant's suggestion of incentivizing assessment as a means for motivating faculty to do assessment despite fears and diminished resources was generally regarded as both plausible and helpful.

WHY RUBRICS?

Rubrics provide one way of articulating and organizing the expected learning outcomes from any program. The fifteen VALUE rubrics, according to AAC&U, are intended for institutional-level use in evaluating and discussing student learning, not for grading student work. However, they can be adapted for local needs. As Clark and Eynon (2012) describe the final versions:

> The flexibility of the VALUE rubrics allows them to be used in different segments of higher education and adapted to serve multiple purposes. . . . Situating a wide range of skills and areas of knowledge over a four-year scale, institutions can use the VALUE rubrics to help students see how their skills and knowledge build sequentially over time, from course to course and sometimes, from institution to institution.

The session co-leaders, Augsburg and Madison, each adapted VALUE rubrics for local institutional use. Madison and colleagues (Boresma et al. 2011) adapted the VALUE Quantitative Literacy rubric so that it was effective in scoring student work. Augsburg and colleagues adapted the VALUE Written Communication and Integrative Studies rubrics to use in assessing interdisciplinary learning artifacts in student electronic portfolios assigned in a gateway course, which led to program-level curricular reform.

Developing or even modifying existing rubrics requires agreement among faculty about missions and learning goals. Worries about rubrics include the possibility that they are limiting; however, rubrics provide a way for faculty to agree on what is valued and to communicate this to students. The session co-leaders' experience with the VALUE rubrics pointed strongly to the need to review them critically as a faculty before using them. That holds for any rubric; faculty rubric users must strive to reach consensus in advance regarding what competencies the rubric includes and what constitutes evidence that these competencies have been demonstrated.

Augsburg (2012) gives a case study of a research project of liberal studies and academic technology faculty assessing a pilot undergraduate interdisciplinary writing intensive gateway course that resulted in significant curricular reform. The case study points clearly to critical steps in assessment: establish learning objectives (in this case, the learning objectives of the gateway course), choose an assessment vehicle (in this case, electronic portfolios), choose an evaluation method (in this case, the VALUE rubrics on written communication and integrative studies), conduct the evaluation of student work, and, finally,

Table 8: Summary of the Interdisciplinary Learning Assessment Process

1. Establish learning objectives
2. Choose an assessment vehicle
3. Choose an evaluation method
4. Conduct the evaluation of student work
5. Rethink the purposes and learning outcomes of the program being assessed in light of the results of the assessment

rethink the purposes and learning outcomes of the program being assessed in light of the results of the assessment (in this case, the purposes and learning objectives of the gateway course) (see Table 8). This case study was more complicated because it had three components, not all of which are present in other efforts: rubric evaluation, rubric testing and interdisciplinary learning assessment that led to curriculum reform.

Madison (2012) describes the adaptation of the VALUE rubric in quantitative literacy (QL) so that it could be used effectively to score individual student work. The VALUE QL rubric has six core competencies needed to resolve quantitative situations: interpretation, representation, calculation, analysis/applications, assumptions, and communication. Each competency was to be scored in one of four levels: 1-4, with level 4 indicated as capstone. The adapted version, called Quantitative Literacy Assessment Rubric (QLAR), did not have the capstone level; rather it had levels 0-3, without qualitative indicators, but 0 represented no evidence of the competency while 3 represented clear evidence of the competency. These are not necessarily development levels; rather they are evaluations of the responses to specific QL prompts. The adapted version modified the competency of analysis/applications to analysis/syntheses because the meaning of application was considered too broad for this competency that is defined as "ability to make and draw conclusions based on quantitative analysis." Responses to prompts about a QL situation may require any number of the core competencies, and often the competencies are demonstrated as they are listed, first interpretation, then representation, then calculation, then analysis/synthesis, and finally communication of the results. Making and evaluating assumptions can occur at any point in a QL response.

Madison points out that the rubric had value far beyond the scoring of individual student work. Two major values are guiding development of curricular material and in organizing or developing student thinking. Curricular materials, in particular, prompts for student responses, need to be carefully worded to indicate what competencies are needed (or wanted) in a student response. If one wants written communication of the conclusions, then the prompt should so indicate. If students are thinking that they need to interpret, then represent, and then calculate, they are much more likely to do so, and these habits of mind will serve them well in quantitative reasoning.

The conference participants were asked to comment during the workshops on the VALUE rubrics in integrative thinking, written communication, and the modified QL rubric. Comments on the written communication rubric included questioning if it was too reductionist, if five categories (competencies) were too few, and noting that it did not seem to acknowledge interdisciplinarity. The integrative leaning rubric was judged to require more self-reflection and assessment, while the written communication rubric required less, leading to the suggestion that it might be beneficial to merge the two. The integrative learning rubric was viewed as being applicable to program assessment rather than individual papers, consistent with its stated purpose. One participant did not see a connection between theory and practices, and there were suggestions that the rubric needed to be inclusive of multi-modal forms—visuals, music, art, etc.

No doubt partly due to the dominance of qualitative disciplinary associations of the conference participants, the QLAR rubric was viewed as somewhat off center to interdisciplinary teaching and learning. This probably means that the merging of words and numbers in academia has ways to go. One participant summarized, "We are a long way from integrating quantitative reasoning in our courses across curricula. One problem is that you have to teach many skills and techniques that educators assume students have. . . . We cannot evaluate the level of student understanding because there are so many holes in student knowledge of basic content." QLAR was criticized because of its lack of qualitative descriptions of achievement levels, the ordering of the six core competencies (addressed above), and the linearity of the achievement scale. One participant wanted indications of appropriate method for problem posed and a check of the common sense of the answer.

Haynes (2012) describes a developmental, outcomes-based framework to guide students' learning experiences throughout college:

> Under this framework, students complete a sequenced and integrated set of liberal education outcomes, focused on six competencies: critical and integrative thinking, collaboration, inquiry, written communication, intercultural understanding, and self-reflection. . . . Each competency included ten gradations of quality that are sequenced according to the students' developmental process as discovered in Baxter Magolda's twenty-two-year study of college and adult development (2001).

Haynes offers some examples of increasingly sophisticated outcomes related to critical and integrative thinking and the developmental rubric for critical and integrative thinking with the ten quality gradations.

FINAL THOUGHTS

Over the past three decades assessment of student learning in collegiate disciplines has become better understood and widely accepted—somewhat reluctantly, in many cases. The session on interdisciplinary assessment that is summarized above reveals rather diverse views of the difficulties of and progress toward effective and productive assessment of interdisciplinary learning outcomes and interdisciplinary curricular. Part of the difficulties is inherited from disciplinary learning, but others are added because of the complexity of interdisciplinarity and the lack of established, agreed-to learning goals of interdisciplinary programs. In order to assess student learning—always viewed as for program curricular improvement—one must know the learning goals, agree on evidence that the goals are being met, and devise ways to measure the evidence. There will be no generic interdisciplinary rubric, and we are far from having much uniformity in interdisciplinary programs. The variety is

too vast. What we have is a rich area of research on how students best learn to integrate, to reflect, and to prosper intellectually. In the meantime, we need to temper our expectations about what students bring from their disciplinary experiences and to curb our expectations of what entering students are prepared to do. We need only look to our disciplinary faculty colleagues' fears of interdisciplinarity to get a hint of the enormous challenge we face.

REFERENCES

Augsburg, Tanya. 2012. "From Rubric Testing to Curriculum Change: Assessing Student Learning in a Pilot Interdisciplinary Gateway Course." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Baxter Magolda, Marcia B. 2001. *Making Their Own Way: Narratives for Transforming Higher Education to Promote Self-Development.* Sterling, VA: Stylus Publishing.

Boix Mansilla, Veronica, Liz Dawes Duraisingh, Christopher R. Wolfe, and Carolyn Haynes. 2009. "Target Assessment Rubric: An Empirically Grounded Rubric for Interdisciplinary Writing." *Journal of Higher Education* 80:334-353.

Clark, J. Elizabeth, and Bret Eynon. 2012. "Measuring Student Progress with E-Portfolios." *Peer Review* 13-14:1-2.

Dingman, Shannon W., and Bernard L. Madison. 2010. "Quantitative Reasoning in the Contemporary World, 1: The Course and Its Challenges." *Numeracy* 3(2): services.bepress.com/numeracy/vol3/iss2/art4.

Haynes, Carolyn. 2012. "The Courage to Assess." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Klein, Julie Thompson. 2005. "Integrative Learning and Interdisciplinary Studies." *Peer Review*, Summer/Fall:8-10.

Madison, Bernard. 2012. "Assessing Student Learning in Quantitative Reasoning." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Newell, William H. 2001. "A Theory of Interdisciplinary Studies." *Issues in Integrative Studies* 19:1-25.

Repko, Allen F. 2008. "Assessing Interdisciplinary Learning Outcomes." *Academic Exchange Quarterly* 12:171-178.

Sortor, Marci. 2012. "The `Inter' and the 'Disciplines'." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Spelt, Elisabeth J.H., Harm J. A. Biemans, Hilde Tobi, Pieternel A. Luning, and Martin Mulder. 2009. "Teaching and Learning in Interdisciplinary Higher Education: A Systematic Review." *Educational Psychological Review* 21:365-378.

Stowe, Donald E. 2002. "Interdisciplinary Program Assessment." *Issues in Interdisciplinary Studies* 20:77-101.

Tremonte, Colleen. 2012. "The Dialogics of Assessment and the Scholarship of Teaching and Learning." Conference on Interdisciplinary Teaching and Learning. May 13-16. Michigan State University. Available at lbc.msu.edu/CITL/papers.cfm.

Wolfe, Christopher R., and Carolyn Haynes. 2003a. "Assessing Interdisciplinary Writing." *Peer Review* 6(1):12-15.

Wolfe, Christopher R., and Carolyn Haynes. 2003b. "Interdisciplinary Writing Assessment Profiles." *Issues in Integrative Studies* 21:126-169.

Meeting Institutional and Administrative Challenges of Interdisciplinary Teaching and Learning

Julie Thompson Klein
Professor of Humanities, Department of English, and Faculty Fellow for Interdisciplinary Development in Division of Research
Wayne State University
julietklein@comcast.net

Paula J.S. Martin
Assistant Director for Academic Affairs and Associate Professor
Kenai Peninsula College, University of Alaska Anchorage
ifpjm@uaa.alaska.edu

Administrative structure in modern higher education continues to be dominated by the organizational logic of disciplinary divisions, often creating barriers and disincentives for interdisciplinary activities. Yet, colleges and universities around the country are using effective strategies to modify and even breach those structures. Drawing on pertinent literature and conference sessions, we present a brief overview of impediments in administrative and institutional structures, followed by ways they are being overcome in targeted areas vital to interdisciplinary teaching and learning. The tables that frame the discussion are from a recent book on changing campus cultures that bought together scholarship on the topic, but the examples also draw on a wider range of institutional experiences focused on teaching and learning and added insights from the conference.

BARRIERS AND DISINCENTIVES

We choose to focus on positive ways of overcoming impediments, rather than the obstacles themselves. Yet, an informed framework for meeting challenges is crucial for successful planning and implementation. Some of the challenges are not unique to interdisciplinary teaching and learning but must still be confronted: increasing privatization of public universities, corporatization of universities in general, increased reliance on part-time and non-tenure track faculty, and diminished support for teaching over research and grants.

Table 9 provides a condensed digest of barriers and disincentives for overcoming structural and institutional impediments in interdisciplinary contexts. The list spans all aspects of institutional culture. Structural divisions and canonical practices establish norms that influence decision-making and behavior at all levels. The standard model of higher education, Trowler and Knight (2002) find, assumes that organizations are culturally simple, with all activities fitting into a small number of pigeonholes. Yet, Trowler and Knight (2002:143) exhort, universities possess unique and dynamic cultural configurations that render simple depictions erroneous. Interdisciplinarity compounds the problem of "contextual simplification" because faculty interests cut across boundaries. Furthermore, incorporation of new interdisciplinary research and scholarship has an energizing effect across the curriculum, from reinvigorations of general education in the late 20th century (e.g., LEAP initiative, AAC&U 2011) to interdisciplinary field studies and new initiatives in disciplinary and pre-professional education. Impediments, though, still confront proponents of interdisciplinary teaching and learning. Being aware of the full range of recognized factors in the literature will help in identifying local manifestations more quickly and setting priorities for short-, mid-, and long-range planning.

OVERCOMING AND BRIDGING BARRIERS AND DISINCENTIVES

The rhetoric of change in higher education is exhilarating. Contemporary images of the curriculum suggest that *fragmentation* and *segmentation* have been replaced by *integrating, connecting, linking,* and *clustering.* Reports in the academic press herald new courses and programs, and research digests such as Holley's (2009) book on the current challenges and opportunities for interdisciplinarity point the way to more flexible visions, structural modifications, and shifts in organizational behavior and norms. Organizations such as the Association for Integrative Studies (2012) also provide resources on interdisciplinary teaching and learning, including links to a large literature on the subject. Informed use of precedents at the national levels, coupled with an inventory of local interdisciplinary structures, activities, and interests, is essential to successful outcomes.

ORGANIZATIONAL STRUCTURE, ADMINISTRATION, AND POLICIES
Alternative Administrative Structures

As Table 10 suggests and conference participants affirmed, interdisciplinarity occurs in a wide range of contexts and is the result of both incremental approaches and radical transformations. Participants reported a rich variety of strategies ranging from cross-listed courses, enhanced general education and honor programs, learning communities and residential colleges to dual degree programs, innovative structures organized around targeted themes and faculty learning communities that develop emergent interests.

If institutions utilize a rigid structural system, then overlaying an additional or modified administrative structure can foster and support interdisciplinary approaches. In the most comprehensive national study to date, the U.S. National Research Council (2004) noted the range of interdisciplinary structures that occur: from the solo individual within an existing structure who achieves and integrates expertise in two or more areas to combinations of researchers in large-scale innovative programs focused on a common goal (e.g., search for life on Mars). This spectrum also appears in teaching and learning, ranging from the individual interdisciplinary faculty member in a single course or alternative program to multiple

Table 9: Barriers and Disincentives to Interdisciplinarity [Reprinted from Klein (2010):72-73]

Organizational Structure and Administration
Rigid one-size-fits-all model of organizational structure
Discipline- and department-based silos of budgetary and administrative categories
Territoriality and turf battles over budget, ownership of curriculum and research
Ambiguous status of interdisciplinary programs, centers, and institutes
Piece-meal approaches
Lack of experienced leaders
Resistance to innovation and risk
Dispersed infrastructure
No clear and authoritative report lines for interdisciplinary units

Procedures and Policies
Inflexible guidelines that inhibit approval of new programs and courses
Rigid and exclusionary degree requirements
Lack of guidelines for interdisciplinary hiring, tenure and promotion, and salary
Inadequate guidelines for grants management and research collaboration
Unfavorable policies for allocation of workload credit in interdisciplinary teaching
Unfavorable research policies for sharing indirect cost recovery from external grants and allocating intellectual property

Resources and Infrastructure
Inadequate funding and ongoing support for interdisciplinary units
Inadequate number of faculty lines for interdisciplinary studies and research
Restricted access to internal incentives and seed funds for interdisciplinary research and curriculum development
Competition for funds and faculty between departments and interdisciplinary units
Inadequate or no interdisciplinary student assistantships and fellowships
Inadequate space and equipment and inflexible allotments of use
Weak or no faculty development system
Ignorance of interdisciplinary literature and resources in national networks
Insufficient time for planning and implementing program and project infrastructure
Insufficient time to learn the language and culture of another discipline
Insufficient time to develop collaborative relationships in team teaching and research

Recognition and Reward /Incentives
Invisibility and marginality of interdisciplinary research, teaching, service, advising, and mentoring
Reliance on volunteerism and overload
Weak networking channels and communication forums
Ineligibility of and bias against interdisciplinary work for awards, honors, incentives, and faculty development programs
Lack of support at department, college, and/or university-levels
Negative bias against interdisciplinary work

interdisciplinary programs within an institution or a higher education system.

Overlays became more common in research with the creation of special centers focused on particular questions or problems. Similar overlays of interdisciplinary teaching programs are also arising, and in the process fostering local solutions for institutional impediments. QB3 of the University of California at San Francisco is an interdisciplinary research and teaching project overlain across traditional departments of multiple university units which feed it with faculty and supply it with students (U.S. National Research Council 2009). QB3 addresses its educational mission through interdisciplinary core curricula in multiple graduate programs, along with courses, internships and seminars for both undergraduate and graduate students. Conflict with the traditional structure is minimized because the overlay provides added benefits to the traditional arrangement. At the University of California San Francisco

(UCSF), the QB3 interdisciplinary consortium provides graduate student funding for students in associated, traditional department programs while providing a robust, unified vision of graduate education at UCSF (QB3 2012; QBC 2011). The interdisciplinary collaboration thereby communicates research strength more effectively than could a single department.

Cooperative benefits such as the QB3 consortium help institutions and individuals meet interdisciplinary challenges while increasing interdisciplinary opportunities. So do flexible movement of faculty and other resources between units, whether departments, schools or colleges, Distance education, as well, is fueling the growth of interdisciplinary teaching and learning; interdisciplinary consortiums are connecting via technology across multiple, geographically dispersed systems around particular interdisciplinary fields, themes, and problem areas.

One increasing common alternative to a single campus-wide administrative structure is a matrix (NRC 2004), facilitating

Table 10: Facilitating Strategies and Mechanisms for Interdisciplinarity [Reprinted from Klein (2010):73-74]

Organizational Structure, Administration, and Policies
Alternative administrative structures
Program-level control of budget and infrastructure
Report lines with designated responsibilities
Procedures for course and program approval, research management
Policies for hiring, tenure and promotion, salary, and merit
Policies for research and teaching evaluation, program review, learning assessment
Openness to innovation and tolerance for risk
Alignment of interdisciplinarity with strategic plan themes
Timely interface between new research developments and the entire curriculum
Inventory of activities, structures, and interests

Leadership, Advocacy and Stewardship
Top administrative support at the level of president, provost, and deans
Central oversight body for interdisciplinary research and education
A central interdisciplinary website
Annual forum for directors of programs, centers, and institutes
Strong and experienced leaders
Unit-level advisory boards of internal and external stakeholders

Funding
Baseline funding for interdisciplinary units
Dedicated tenure-track faculty lines and stable appointments in programs and centers
Cross-department budgeting mechanisms
Flexible resources at the department level
Seed funding through internal special initiatives and regular programs
Systematic identification of external sources
Equitable credit allocations for team teaching, indirect cost recovery on external grants
Alignment of interdisciplinarity with capital campaigns at both campus and unit levels

Infrastructure Support
Dedicated space for interdisciplinary units
Pooling and sharing of space, facilities, and equipment
Interdisciplinary design principles for new buildings and remodeling projects
Communication system for collaboration and information flow
Release time for program and project development in teaching and research
Faculty development programming (including graduate students and postdoctoral fellows)
Resource banking of interdisciplinary resources and literatures

Recognition
Visibility on central interdisciplinary website
Visibility in the public face of a campus (e.g., materials, advising, and recruiting system)
Counting service for committee work, mentoring, and thesis/dissertation advising
Awards and honors in existing system and new interdisciplinary-specific competitions
Inclusion of interdisciplinarity in all annual and unit reports
Interdisciplinary unit-level publications: online newsletter, journal

---

movement between disciplinary departments connected via programs, courses or curricula. Reformulation of administrative structure at Arizona State University made this kind of movement possible in an existing institution by introducing new interdisciplinary units. An even more extensive alternative structure, Florida Gulf Coast University (2005) is a new institution with a commitment to interdisciplinary learning. Redesign of traditional structure and policies at Duke University also facilitated interdisciplinary research and teaching on an expanded scale, while creating the first Vice Provostship for Interdisciplinary Studies in the country.

Program-Level Control

The strength and sustainability of interdisciplinary teaching and learning at the program level is influenced by a number of factors. Strong programs, Augsburg and Henry (2009) and others emphasize in a recent book on the politics of interdisciplinary studies, have core faculty with full-time

appointments located entirely or partly within a program. Here too, however, attention needs to be paid to the relationship between traditional and additional, modified, or innovative structures, lest they be marginalized or orphaned. When faculty from other units are involved, the program's leader should have leverage to obtain their participation and a formal affiliation or joint appointment. Sustainable programs also need a clear report line to an upper-level administrator with designated responsibilities and control. Their leaders and faculty require a voice in policy, curriculum, budget, space allocation, program evaluation, and personnel matters. And, practices must be anchored in best practices and an understanding of interdisciplinarity. When other units play a role, they have shared governance too, and all support staff and advisors are knowledgeable about the program. In addition, the curriculum has a spine of required core courses or experiences, ensuring attention to interdisciplinary theory, concepts, and methods. Moreover, the larger institutional culture supports the program, with equitable policies for participation in workload assignments and the reward system. The course and program approval processes are transparent, while allowing for flexibility rather than a one-size-fits-all model of curriculum design. And, the institution's faculty development system supports the program.

Policies for Hiring, Tenure, Promotion, Salary, and Merit

The most important policy in this area is that of written plans and expectations for an interdisciplinary position, produced in advance of the search process (Pfirman et al. 2006; Pfirman and Martin 2010). A written record provides a touchstone for the multiple faculty and administrators who at a future date will evaluate the position, whether for hire, tenure, promotion, salary or merit. Having expectations of the position spelled out at the onset, with attention to the nature of the particular interdisciplinary field or program, makes it less likely that defaulting to conventional discipline-based criteria will occur when an interdisciplinary teacher/scholar comes up for hire or promotion. The University of Southern California is noteworthy in providing a manual for departments and committees with instructions on how to weigh interdisciplinary research and collaboration, including responsibilities for insuring adequate evaluation (Berrett 2011; USCAPT 2011).

The hiring of interdisciplinary faculty is aided when institutions administer some positions centrally, thereby stimulating departments to act collectively for cross-disciplinary projects such as cross-unit and cluster hire appointments at the University of California-Berkeley and the University of Wisconsin-Madison. Defining the position at the time of its creation, getting buy-in from appropriate chairs, deans, directors and provost , and recording stipulations in a memorandum of understanding (MOU) or other written record of agreement define expectations associated with the position, easing many future problems. If the position is a joint appointment, a strategy widely endorsed in the conference workshops, then the percentile breakdown of responsibilities should be clear. Several key questions should be answered. Who does the position report to? What department or program does the position serve? How is the position to be evaluated? Here too, having details fleshed out at the beginning reduces future problems. Pfirman et al. (2006) also suggest that joint appointments should not be 50:50 but one program or department have the majority of the appointment (60:40 or 70:30). Counting service for interdisciplinary committee work, interdisciplinary mentoring,

and interdisciplinary thesis advising is crucial as well. In these ways, the hire is not doubling service load or regularly attendance at double departmental meetings. The initial MOU informs the tenure, promotion and merit review process; therefore, keeping the MOU as a living document, revising as conditions change, is crucial (For comprehensive overviews of this subject, see Klein 2010; Pfirman et al. 2006; Pfirman and Martin 2010).

Policies for Teaching Evaluation, Program Review, and Learning Assessment

Interdisciplinary teaching and learning is further facilitated by having evaluation procedures include interdisciplinary judges, not just discipline-specific ones. For program reviews, particularly those including an external committee, careful selection of the review team is crucial, insuring a group that appreciates and can analyze the program appropriately. Learning assessments are generally based on success in student learning outcomes; therefore, careful definition of successful completion of interdisciplinary learning outcomes is crucial and e-portfolios have great utility in this regard, because students demonstrate learning through specific examples of their projects and products. E-portfolios can also be a dynamic and performance-based way for interdisciplinary instructors to demonstrate the outcomes of their teaching efforts (e.g., Augsburg 2006; DeZure 2010), to the public or to disciplinary colleagues. Interdisciplinary student learning outcomes communicate to the student, internal colleagues, and external partners the value and purpose of an ID teaching and learning program (e.g., Culligan and Peña-Mora 2010).

It is also important to incorporate appropriate criteria for program review, faculty evaluation, and learning assessment in the literatures and websites of pertinent professional organizations (Klein 2010; Field and Stowe 2002). Given the variety of types of interdisciplinary work, the rationale of the field or program in question should be clarified, and that rationale anchored in pertinent literatures. In a state-of-the-art report on interdisciplinary evaluation, Huutoniemi (2010:311) advises that "Quality is not a unitary concept." Organizations such as the American Studies Association, Women's Studies Association, and Association for Integrative Studies have issued appropriate guidelines. National accreditation organizations, e.g., Accreditation Board for Engineering and Technology (ABET), also provide support for interdisciplinarity of teaching and learning. When ABET defined mandatory accreditation criteria in 2000, they included a broad array of skills within expectations beyond that of the technical, prompting ABET-accredited engineering schools to widen and diversify student education locally (Culligan and Peña-Mora 2010).

Curriculum and Institutional Structure

Curriculum often drives teaching activities into a disciplinary framework by default, especially if teaching is focused on students' content rather than learning skills. Connecting curriculum, and particularly general education, to skill learning outcomes rather than content-knowledge outcomes provides incentives for programs and students to use interdisciplinary curricula. Flexible curriculum processes that permit new courses to arise beyond departmental boundaries also provide a mechanism for the emergence of interdisciplinary coursework. And, administrative seed funding has proved to be a positive force in fostering interdisciplinary cooperation.

Many institutions recognize the importance of interdisciplinarity directly or indirectly as part of their strategic plans, and in alignment with state-level targeted areas. Interdisciplinary may be mentioned explicitly as a value, particularly in terms of real-world problem solving or emerging areas of study. Or, it may be indirectly mentioned in terms of sustainability, environmental literacy or internationalization. Either way, an interdisciplinary teaching and learning program may then be aligned to support long term goals, and this endorsement in turn provide support to interdisciplinary programs of many types.

One example of the potential for alignment is strategic enrollment management (SEM). For the past decade, SEM has been growing as a process for institutions of higher education to better manage enrollment. SEM programs often link not just students coming in the door but also student services programs and academic programs—so higher education administration itself becomes interdisciplinary. SEM often appears structurally as a form of interdisciplinary matrix management. As SEM programs analyze student demand for academic programs, and as interdisciplinary programs often elicit high levels of demand, and as students are attracted to real-world problem solving, connection of interdisciplinary programs to SEM can be valuable for both.

LEADERSHIP, ADVOCACY, AND STEWARDSHIPS

The leadership items in Table 10 (top administrative support, an institution-wide interdisciplinary website, central oversight, an annual forum for directors, strong and experienced leaders, and unit-level advisory boards) provide stability, strength, and efficiency to interdisciplinary programs, leading to long-term sustainability. Conference participants recommended, in particular, a central interdisciplinary umbrella such as an office of interdisciplinary studies and a clearinghouse for matching similar interests. They also repeatedly emphasized working with the Provost in order to foster and support interdisciplinary interests. Support at this level has proved vital to incentivizing curriculum development and new pedagogies.

This level of support may be gained by having interdisciplinary faculty describe how their activities uniquely support institutional goals and how the program is relevant to the needs and interests of administrators (e.g., Casey 2010). Advisory boards also help steer an interdisciplinary program, provide advocacy and increase the perception of program's value and rigor to others. Stable leadership prevents the interdisciplinary faculty from having to repeatedly explain and convince disciplinary leaders of the purpose and value of their interdisciplinary program. Furthermore, when an institution has multiple interdisciplinary programs, having those interdisciplinary administrators regularly share their experiences in an annual meeting provides both a problem-solving forum for unique administrative aspects of interdisciplinary programs and a way to heighten campus awareness of the programs. This strategy in turn builds strength of interdisciplinary leadership across campus.

MATERIAL SUPPORT: FUNDING AND INFRASTRUCTURE

Some items mentioned in Table 10 under funding (baseline funding, dedicated faculty lines, budgeting mechanisms, and equitable credit allocations for team teaching) provide stability, flexibility, and strength to interdisciplinary programs, ultimately determining their long-term sustainability. Other items in Table 10 (seed funding, systematic identification of external sources, indirect cost recovery and alignment with capital campaigns) address opportunities for program growth. Even seed funding of interdisciplinary faculty through temporary joint appointments provides an interdisciplinary growth opportunity, although faculty still need workload protection. Conference participants also urged cross-department budgeting formulas, pooling funds from vacated faculty lines for discretionary use by the Provost, and offering graduate student fellowships and postdocs dedicated to interdisciplinary areas.

As with funding, some items mentioned in Table 10 under infrastructure (dedicated space, pooling and sharing of space, facilities, and equipment, communication system) speak to stability of the interdisciplinary program. Other items (interdisciplinary design principles for new buildings and remodeling projects, release time and faculty development) foster future growth, expansion and greater community awareness of interdisciplinary program. Alignments with existing units such as teaching and learning centers further support cross-campus development of interdisciplinary interests along with best practices.

CONCLUSION

The growth of interdisciplinary teaching and learning is amply documented in Brint et al.'s (2009) longitudinal study of patterns from 1975-2000. Moreover, a search of most campus websites using the keyword "interdisciplinary" will produce one to dozens of examples at both undergraduate and graduate levels. Yet, they require support throughout their life cycles. Underscoring the importance of our overriding topic— institutional and administrative challenges—Racioppi and Tremonte (2003) admonish, "To sustain an interdisciplinary space, broader institutional support is critical in promoting an appreciation of the type of knowledge production that interdisciplinary study fosters." Institutional structural change has followed interdisciplinary program creation, though even with progress in advancing interdisciplinarity sometimes more slowly than desirable across campuses. Openness to innovation and tolerance for risk also emerged as overriding needs. Colleges and universities provide fertile ground for interdisciplinary teaching and learning when faculty are in a position to try new approaches without the penalty of failure. They may be tenured or have an agreement with their chairs, deans or provosts for innovative risk-taking in concert with new initiatives, even in time of economic downturn. Favorable climates for interdisciplinary teaching and learning further benefit from administrators being comfortable with the possibility of failure from experimentation. Advance communication of potential benefits and risks benefits all parties in finding a comfort zone with innovation.

Recognition is no less crucial, in several ways. Both teaching and learning are energized and improved by integrating new scholarship and research, enabling all faculty to translate new knowledge into the curriculum across disciplinary-, interdisciplinary-, and pre-professional contexts. Every barrier and disincentive cited above is matched by a solution. However, it may not work locally or require adaptation to the local campus culture. In order to make informed decisions about appropriate strategies, a ready archive of campus activities is needed, recognizing current accomplishments while revealing

opportunities that can increase wider and long-term involvement and support. Greater visibility transmits new ideas, builds status, and attracts more faculty (e.g., Jasanoff 2010). The items highlighted in Table 10 (visibility on central interdisciplinary website and in the public face of a campus, awards and honors inclusive of interdisciplinary, annual and unit reports inclusive of interdisciplinary and interdisciplinary unit-level publications) all build recognition for interdisciplinary teaching and learning. And, finally, the audiences key to values of interdisciplinarity are both internal and external to the institution. All can help build support: from internal onlookers of disciplinary colleagues, new students or administrators to external stakeholders of industry, professional or graduate schools and program graduates employers.

Finally, even the most honed of actions are not isolated events. Institutional and administrative challenges require nothing less than a systematic approach. Whether designing ambitious signature programs or raising the visibility of currently dispersed and isolated programs—whether modeling innovative approaches to pedagogy, assessment, and broader integrative learning or capitalizing on special support programs from the Lilly Foundation and the National Science Foundation's IGERT program for Interdisciplinary Graduate Education and Research Training—whether proposing new chairs in interdisciplinary research and education and introducing ambitious Knowledge Integration seminars or negotiating routine workload credit for guest lectures in other classes—robust and sustainable programs of interdisciplinary teaching and learning depend on leveraging and capitalizing the abundant wisdom of practice before us. Conference participants added to this body of wisdom by sharing their classroom experiences, strategies for meeting common challenges, and ways their institutional structures are flexing to address the needs of interdisciplinary programs.

REFERENCES

Association of American Colleges and Universities. 2011. *The LEAP Vision for Learning Outcomes, Practices, Impact, and Employers' Views: Liberal Education and America's Promise*. Washington, DC: AAC&U.

Association for Integrative Studies. 2012. *Association for Integrative Studies: Interdisciplinary Studies*. Available at www.units.muohio.edu/aisorg/index.shtml.

Augsburg, Tanya. 2006. *Becoming Interdisciplinary: An Introduction to Interdisciplinary Studies*. Second edition. Dubuque, IA: Kendall/Hunt.

Augsburg, Tanya, and Stuart Henry, editors. 2009. *Disciplining Interdisciplinary Studies?: The Politics of Interdisciplinary Transformation in Undergraduate American Higher Education.* Jefferson, N.C.: McFarland.

Berrett, Dan. 2011. "Tenure across borders." *Inside Higher Education* July 22. Available at www.insidehighered.com/news/2011/07/22/usc_rewards_collaborative_and_interdisciplinary_work_among_faculty.

Brint, Steven G., Lori Turk-Bicakci, Kristopher Proctor, and Scott Patrick Murphy. 2009. "Expanding the Social Frame of Knowledge: Interdisciplinary, Degree-Granting Fields in American Colleges and Universities, 1975-2000." *Review of Higher Education* 32(2):155-183.

Casey, Beth A. 2010. "Administering Interdisciplinary Programs." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

Culligan, Trish, and Feniosky Peña-Mora. 2010. "Engineering." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

DeZure, Deborah. 2010. "Interdisciplinary pedagogies in higher education." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

Florida Gulf Coast University. 2005. *Developing an Ecological Perspective and Fostering Community Involvement: The Quality Enhancement Plan for Florida Gulf Coast University*. Available at itech.fgcu.edu/sacs/QEP-2005.pdf.

Field, Michael, and Don Stowe. 2002. "Transforming Interdisciplinary Teaching and Learning Through Assessment." In *Innovations in Interdisciplinary Teaching*, edited by C. Haynes. Westport, CT: Greenwood Press.

Holley, Kari. A. 2009. *Understanding Interdisciplinary Challenges and Opportunities in Higher Education*. ASHE Higher Education Report 35(2). San Francisco, CA: Jossey Bass.

Huutoniemi, Katri. 2010. "Evaluating Interdisciplinary Research." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

Jasanoff, Sheila. 2010. "A Field of Its Own: The Emergence of Science and Technology Studies." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

Klein, Julie Thompson. 2010. *Creating Interdisciplinary Campus Cultures*. Association of American Colleges and Universities. San Francisco, CA: Jossey-Bass.

Keohane, Nannerl O. 2012. "The Liberal Arts as Guideposts in the 21st Century." *Chronicle of Higher Education*. January 29. Available at chronicle.com/article/The-Liberal-Arts-as-Guideposts/130475.

Pfirman, Stephanie, and Paula J. S. Martin. 2010. "Facilitating Interdisciplinary Scholars." In *The Oxford Handbook of Interdisciplinarity*, edited by R. Frodeman, J. T. Klein, and C. Mitcham. New York, NY: Oxford University Press.

Pfirman, Stephanie, Paula J. S. Martin, L. Berry, M. Fletcher, M. Hempel, R. Southard, D. Hornbach, and B. Morehouse. 2006. *Interdisciplinary Hiring, Tenure and Promotion: Guidance for Individuals and Institutions.* Council of Environmental Deans and Directors. Washington, DC: National Council for Science and the Environment.

QB3. *California Institute for Quantitative Biosciences*. 2012. Available at www.qb3.org/education.

QBC. 2011. *Quantitative Biology Consortium*. University of California San Francisco. Available at qbc.ucsf.edu.

Racioppi, Linda, and Colleen Tremonte. 2003. "Literature and International Relations: The Challenges of Interdisciplinarity." *Academic Exchange Quarterly*. 7(3): www.higher-ed.org/AEQ/choice2430.htm.

Trowler, Paul R., and P. T. Knight. 2002. "Exploring the Implementation Gap: Theory and Practices in Change Interventions." In *Higher Education Policy and Institutional Change: Intentions and Outcomes in Turbulent Environments*., edited by P. R. Trowler. Buckingham, UK: Society for Research into Higher Education/Open University Press.

U.S. National Research Council. 2004. *Facilitating Interdisciplinary Research*. Washington, DC: National Academies Press.

U.S. National Research Council. 2009. *A New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution.* National Research Council Committee on a New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution. Washington, DC: National Academies Press.

University Committee on Appointments, Promotions and Tenure. 2011. *UCAPT Manual*. Los Angeles, CA: University of Southern California. Available at www.usc.edu/academe/faculty/private/1011/UCAPT_Manual_Jan_2011_for_posting.pdf.

About the Authors

Tanya Augsburg is Assistant Professor of Liberal Studies in the areas of the Creative Arts and Humanities at San Francisco State University, where she is Chair of the University Interdisciplinary Council. She is author of *Becoming Interdisciplinary*, 2nd Ed. (Kendall/Hunt, 2006) and editor with Stuart Henry of *The Politics of Interdisciplinary Studies* (McFarland, 2009). She has published two articles in *Issues in Integrative Studies* and three reviews in the *Association for Integrative Studies Newsletter*. She has also published in other interdisciplinary academic journals such as *The Drama Review* and *Critical Matrix*. Dr. Augsburg was the Co-Principal Investigator for a 2008 AAC&U's VALUE Initiative grant, which involved the testing of the effectiveness of the VALUE integrative learning and written communication rubrics. She is juror and co-curator of the Women's Caucus for Art's (WCA) art exhibition *Man as Object: Reversing the Gaze*, which takes place at San Francisco's SOMArts in 2011 and at the Kinsey Institute Gallery in 2012. She is also editor of the exhibition's accompanying catalogue. Her most recent teaching and research examine interdisciplinary studies pedagogy as well as multiple modes of self-presentation, which includes student portfolios. She has been a member of the Executive Committee of the Association for Integrative Studies (AIS) since 2006, and is an avid tracker of interdisciplinary education trends in higher education.

Barbara M. Bekken is a faculty member in the Department of Geosciences at Virginia Tech University and a former director of the *Earth Sustainability* liberal education program. This interdisciplinary and problem-focused four-semester series was designed to foster student intellectual development within a learning community while meeting all of Virginia Tech's general education requirements. Dr. Bekken's research focuses on evaluating the effectiveness of course design and faculty development on both student learning and cognitive and social development. She holds a PhD from Stanford University in geology and has spent the better part of the last decade immersed in the literature on college student development and learning. Her interest in interdisciplinary teaching grew out of her experience; today's complex world necessitates that students must be able to integrate their diverse course experiences in general education with their educational and life's goals. Through her work in resources geology, Dr. Bekken recognized an opportunity to capture students' interest in broad issues of sustainable use of natural resources and to channel this curiosity and energy into a thematic general education programming opportunity. Realizing this vision necessitated developing a team of faculty and other professionals to integrate the goals of general education with sustainability issues in an interdisciplinary two-year program predicated on developing increasingly sophisticated learners and knowers. Virginia Tech's *Earth Sustainability* liberal education program was born of this vision. Since inception in 2004, more than 200 students have completed the program, many of whom regard their experience in *Earth Sustainability* as their most valuable undertaking in college.

Kevin Hovland is Senior Director of Global Learning and Curricular Change at the Association of American Colleges and Universities, working in the office of Diversity, Equity, and Global Initiatives. He is responsible for the multi-project initiative, Shared Futures: Global Learning and Social Responsibility. The most recent Shared Futures project, General Education for a Global Century, is working with 32 colleges and universities to use global learning outcomes as an organizing principle for creating coherent and comprehensive general education curricular designs. That project is funded by the Henry Luce Foundation. Hovland is the author of the AAC&U monograph, *Shared Futures: Global Learning and Liberal Education* as well as several articles further articulating global learning as an essential outcome of liberal education. He is also program director for AAC&U's annual meeting, project director for The Educated Citizen and Public Health, and executive editor of *Diversity & Democracy: Civic Learning for Shared Futures*, an AAC&U periodical designed to provide campus practitioners with readily available information about successful diversity initiatives around the country and to support academic leaders and educators as they design and reshape their diversity programs, civic engagement initiatives, and global learning opportunities to better prepare students for principled action in today's complex world. He earned a BA in Russian Regional Studies from Columbia University and is ABD in History at Georgetown University.

Julie Thompson Klein is Professor of Humanities in the English Department and Faculty Fellow in the Office for Teaching and Learning at Wayne State University. She also has held posts as Visiting Foreign Professor at Shimane University in Matsue, Japan; Fulbright Lecturer at Tribhuvan University in Nepal; Academic Specialist for the U.S. Information Agency in Kathmandu; and Foundation Visitor at the University of Auckland, New Zealand. She was a Senior Fellow at the AACU, and in Fall 2011 a Visiting Professor and Mellon Fellow in Digital Humanities at the Institute. Holder of a Ph.D. in English from the University of Oregon, Dr. Klein is past AIS President and former editor of the AIS journal, *Issues in Integrative Studies.* Her books include *Interdisciplinarity: History, Theory, and Practice* (l990), *Interdisciplinary Studies Today* (co-edited, 1994), *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities* (1996), *Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society* (co-edited, 2001), *Interdisciplinary Education in K-12 and College* (edited, 2002), the monograph *Mapping Interdisciplinary Studies* (1999), *Humanities, Culture, and Interdisciplinarity* (2005), and *Creating Interdisciplinary Campus Cultures* (2010). She was Associate Editor of the *Oxford Handbook on Interdisciplinarity (2010)*, and is co-editor

of the University of Michigan Press series *Digital Humanities@digitalculturebooks*. At present she is completing a new book, *Mapping Digital Humanities*. Dr. Klein received the Kenneth Boulding Award for outstanding scholarship on interdisciplinarity, the Yamamoorthy & Yeh Distinguished Transdisciplinary Achievement Award, and the Joseph Katz Award for distinguished contributions to the scholarship of General and Liberal Education. She also has been a member of numerous national task forces on interdisciplinary studies and research and has advised the U.S. NIH, NAS, and NSF on interdisciplinary research and evaluation.

Douglas B. Luckie is an Associate Professor jointly appointed in the Lyman Briggs College of Science (a residential program) and in the Department of Physiology at Michigan State University. He received his Ph.D. at the University of Virginia in Molecular Physiology and completed his postdoctoral studies at Stanford University in Human Biology. He is director of the CF Research Lab and STEM Learning Lab (http://www.msu.edu/~luckie). He and his research groups pursue both discipline-based physiology research into pH abnormalities and invasive pathogens in the disease, cystic fibrosis, as well as scholarship into the use of visual models, interdisciplinary discourse, and inquiry laboratories to increase student higher-level learning in the sciences. His recent articles include:

- D.B. Luckie, R. Bellon, and R. Sweeder. 2012. "The 'BRAID': Experiments in Stitching Together Disciplines at a Big 10 University." *Journal of STEM Education* 13(2):6-14.
- D.B. Luckie, S.H. Harrison and D. Ebert-May. 2011. "Model Based Reasoning: Creating Visual Tools to Reveal Student Learning." *Advances in Physiology Education* 35(1):59-67.
- M.D. Haenisch, T.A. Ciche and D.B. Luckie. 2010. "Pseudomonas or LPS exposure alters CFTR iodide efflux in 2WT2 epithelial cells with time and dose dependence." *Biochemical and Biophysical Research Communications* 394(4):1087-1092.

Bernard L. Madison was Mathematical Sciences Department Chair for 10 years and Dean of the Fulbright College of Arts and Sciences for 10 years at the University of Arkansas, where he has been since 1979. At Louisiana State University from 1966 to 1979, he was principally engaged in research in topology and algebra in addition to serving as Director of Basic and Applied Mathematics for three years. He has served in many national roles including chairing the MAA's committees on Placement Examinations, Status of the Profession, Articulation and Placement, and Assessment. During the period 1986-1989, he structured and directed the Mathematical Sciences in the Year 2000 at the National Research Council, which included the 1987 National Forum, Calculus for a New Century. Dr. Madison served in multiple roles with the College Board including Chief Reader for AP Calculus. He has directed several NSF-funded national dissemination and research

projects. For the past ten years he has spent much of his time promoting quantitative literacy, including serving as the founding president of the interdisciplinary National Numeracy Network. At present his work on quantitative literacy, teacher education, and placement testing is supported by NSF grants. Dr. Madison has a BS in mathematics and physics from Western Kentucky University and MS and PhD degrees in mathematics from the University of Kentucky.

Paula J. S. Martin is Assistant Director for Academic Affairs and Associate Professor at Kenai Peninsula College in the University of Alaska Anchorage. She has over a decade of experience leading undergraduate interdisciplinary environmental programs paired with extensive experience in academic affairs at both private and public institutions of higher education. She has published structural descriptions of her interdisciplinary undergraduate programs to help address the confusion and settle the debate regarding the role of such interdisciplinary programs in undergraduate education. Dr. Martin was a founding member of the Pennsylvania Consortium on Interdisciplinary Environmental Policy (PCIEP) and was co-author on a number of interdisciplinary sustainability publications for PCIEP (e.g., *Pointing Pennsylvania Toward a Sustainable Future* and *Sustainability Indicators as a Communicative Tool*). She also has served on the Executive Board of the Council of Environmental Deans and Directors (CEDD) and was co-chair of the CEDD Interdisciplinary Scholars Committee. Dr. Martin was co-author on the original CEDD publication *Interdisciplinary Hiring, Promotion, and Tenure: Guidance for Individuals and Institutions* and updated its chapter on *Structural Considerations* in its second edition. She is the co-author (with Stephanie Pfirman) of a chapter (*Facilitating Interdisciplinary Scholars*) in the recent *Oxford Handbook on Interdisciplinarity*.
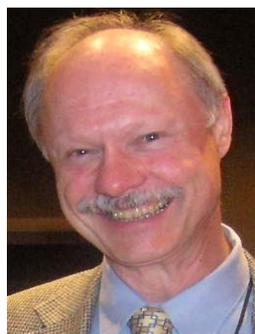

William H. Newell is professor of interdisciplinary studies at Miami University, where he has taught interdisciplinary courses full-time since 1974, when he was a founding faculty member of the School of Interdisciplinary Studies (aka Western College Program). He received his AB in philosophy from Amherst College and his PhD in economics from the University of Pennsylvania, and taught interdisciplinary as well as economics courses at Temple University and in the Paracollege at St. Olaf College prior to teaching at Miami University. In 1979 he hosted a conference on the teaching of interdisciplinary social science at which the Association for Integrative Studies was founded, and served as its first president. Since 1983 he has served AIS first as newsletter editor and then the executive director as well, positions he holds to this day. Over the last quarter century he has worked as a consultant or external evaluator on interdisciplinary studies on well over a hundred occasions, often returning to campuses for repeat visits and giving numerous public addresses. In the early 1990s he was

awarded a three-year FIPSE grant to set up the Institute in Integrative Studies, which over that decade brought around a hundred faculty members from over forty institutions to Oxford, Ohio to observe the Western Program, participate in a pro-seminar on interdisciplinarity, and design an interdisciplinary course. Newell has edited three books and guest-edited three journals, and published over forty articles and chapters on interdisciplinary studies, many examining its connections with higher education, complex systems theory, public administration, integrative learning, liberal arts, experimental colleges, critical thinking, citizenship, and even web design. For the last half dozen years he has been mentoring scholars writing on interdisciplinary studies and reviewing manuscripts on interdisciplinary studies for a wide array of professional journals and edited books.

Marci Sortor joined St. Olaf College in 2011 to serve as its Provost and Dean of the College, and is a member of St. Olaf's department of history. She received a PhD from the University of California, San Diego in 1988, and held a teaching and research fellowship at Stanford University before moving to the Midwest to join the history faculty at Grinnell College in 1989. Dr. Sortor served Grinnell College for twenty-one years in various capacities, including as Professor of History, Chair of the Department of History, Associate Dean of the College, Vice President of Institutional Planning, and interim Vice President for College and Alumni Relations. During her time as department chair, she was program director for a National Endowment for the Humanities Focus Grant for the development of a new, cross-cultural introduction to the study of history. While serving at Grinnell College, Dr. Sortor implemented an interdisciplinary curricular initiative that was part of Grinnell College's strategic plan. This work entailed identifying new areas for curricular growth and developing new faculty lines to bring new knowledge and perspectives to the college. Other interdisciplinary work includes library planning and developing new kinds of teaching spaces for the Humanities and Social Studies. She has taught interdisciplinary courses on disease and societies and on the Renaissance, and team-taught interdisciplinary courses on "Renaissance and Medieval Culture" and "Conceptions of Space and Place in the Ancient Mediterranean and Medieval Europe." Dr. Sortor has given presentations and published on the economic history of northern European cities, medieval market systems, and immigrants in fifteenth-century cities. Her current research project, "Work, Business, and Investments: Economic Networks in a Fifteenth-century City," entails exploring the intersection of social networks and profitable connections for medieval city dwellers.
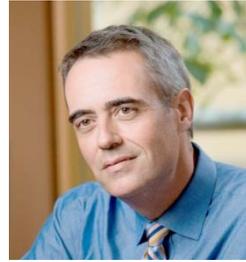
Richard Vaz received a PhD in electrical engineering from Worcester Polytechnic Institute (WPI), specializing in signal analysis and machine vision. He held systems and design engineering positions with the Raytheon Company, GenRad Inc., and the MITRE Corporation before joining the WPI Electrical and Computer Engineering faculty in 1987. Rick is currently Dean of Interdisciplinary and Global Studies at WPI, with oversight of WPI's Interactive Qualifying Project requirement and a worldwide network of 26 Project Centers through which over 600 students per year complete academic research projects. His teaching and research interests include interdisciplinary, service, and experiential learning, local and regional sustainability, engineering design and appropriate technology, and internationalizing engineering education. He has developed and directed hundreds of student research projects in the Americas, Africa, Australia, and Asia. Rick has published over 40 papers in peer-reviewed forums and is the recipient of numerous teaching and advising awards including the WPI Trustees' Awards for Outstanding Teaching and for Outstanding Advising. Rick is a Senior Member of IEEE and from 2004 to 2010 served as a Senior Science Fellow of the Association of American Colleges and Universities. He lives in Worcester, and his interests outside academia include golf, food, wine, and the Boston Red Sox.