Is WAC/WID Ready for the Transdisciplinary Research University?

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Abstract: Over the past two decades, academic and research institutions increasingly moved toward a transdisciplinary model of knowledge production where collaborations occur among disciplines with seemingly divergent methods and ideologies. More complicated than less-integrated modes of collaboration, transdisciplinary research has been described as an inevitable evolution of knowledge making in advanced and post-industrial societies. The author reviews some of the common communicative barriers that emerge in transdisciplinary and radically interdisciplinary collaborations, and argues that as institutional investments in transdisciplinarity become more tangible, researchers and teachers of disciplinary writing should rethink some approaches to writing to learn pedagogy in WAC/WID. The author posits that writing to learn pedagogy should consider teaching disciplinary conventions as situated and negotiable structures, and outlines some specific curricular approaches that could better prepare students for rhetorical effectiveness in future transdisciplinary collaborations.[1]

Knowledge-making in post-industrial society hinges on transdisciplinary collaboration. Transdisciplinary collaboration, sometimes referred to as *radically interdisciplinary collaboration*, consists of people from very different intellectual and disciplinary backgrounds (such as economics, communications, physics, microbiology, epidemiology, etc.) conducting integrated research to solve some of civilization's most profound problems (such as research on cancer, global climate change, sustainable development, etc.). Professionals in these seemingly divergent disciplines must effectively sit at the same intellectual table and work with one another to address increasingly complex research problems. This means that the future success of transdisciplinary work hinges on preparing writers and communicators who can function, if not thrive, in these transdisciplinary settings; which, not surprisingly, makes transdisciplinary collaboration a central interest for disciplinary writing researchers and teachers.

What differentiates transdisciplinary collaboration from other forms of academic collaboration is that cooperation among participants starts at the very highest levels of integration among disciplines involved. Unlike a multi-disciplinary approach through which collaborators might share and analyze data from their respective disciplines, and unlike an interdisciplinary approach through which collaborators might create overarching concepts among disciplines; transdisciplinary collaborators push the methodological and conceptual bounds of their own respective disciplines, making collaborations both participatory and problem-centered in place of disciplinary allegiance (Newell, 2000; Leavy, 2011). Success in transdisciplinary work depends on participant communicators who

are capable of thinking far outside the boundaries of their own disciplinary discourse in order to form situated, problem-centered, and early-integrated methods for problem solving. The readers of this journal, and all those who are an interested in academic discourse and disciplinary writing instruction, should see these transdisciplinary collaborations for what they are: a radical departure from our traditional ways of thinking about disciplinary writing and disciplinary thinking.

The value of diverse disciplines conducting integrated and radically interdisciplinary research is that many of the problems we face in an increasingly-populated and ever-developing world are too complex to be addressed within the confines of a single discipline. This is not to say that highly integrated research is entirely new or untraditional, rather that it is increasingly *essential* in the context of research challenges like global climate change and sustainable development.

The difficulty with making transdisciplinary collaborations successful is that many professionals are trained to function within the parameters of their own discipline. In higher education, teachers and researchers develop expertise in the ways that their profession functions, both discursively and methodologically, and seek to cultivate that knowledge for students participating in their academic programs. Helping students who will become future professionals to acquire this knowledge of their discipline's function through critical investigations of disciplinary language has historically been a foundational goal of WAC/WID curriculums. That latter half of the phrase "learning to write, writing to learn" and the over 40-years of scholarship that has come to be known as writing to learn pedagogy is largely about helping students write to learn disciplinary discourse and understand disciplinary epistemology through language instruction. By cultivating disciplinarity in such ways, WAC/WID curriculums help students learn disciplinary concepts and principles, and perform or enact disciplinary methods and ideologies. Such a view permeates higher education curriculums, including the published principles and best practices of writing in the academic disciplines, writing across the curriculum, and writing in the disciplines.

The primary contention of this article is that a WAC/WID emphasis on disciplinarity is currently, and will be in the near future, insufficient for preparing students for a world that is radically interdisciplinary and transdisciplinary. A review of the common communicative barriers that emerge in transdisciplinary work reveals that the cultivation of disciplinarity creates a plethora of challenges when professionals leave the confines of their discipline and enter into a research collaboration with peers from very different, indeed *divergent*, disciplines. As this article contends, quite often these transdisciplinary collaborations fail to produce meaningful results as a result of entrenched disciplinarity among participants. Many transdisciplinary collaborations divulge into seeming incommensurability among disciplines, most tragically in a time when the success of these collaborations are important for surviving in our rapidly changing world.

An example of such difficulties can be seen in Jakobsen et al.'s 2004 case study of the Interior Columbia River Basin Ecosystem Management Project (ICBEMP), in which transdisciplinary landscape analysis of the Northwestern U.S. was conducted among a team of scientists aiming to address "complex management issues in a planning process for public lands" (p. 18). Jakobsen et al.'s study observes the work of 42 scientists in the ICBEMP with attention to the barriers and facilitators to successful project collaboration. Among the barriers identified, the authors note "the *use* of different scientific methods, such a research design, sampling, data collection, analysis, and interpretation of results between different disciplines" (p. 24) as among the most significant obstacles. The authors further note that while an interdisciplinary writing process was used to help "bridge" this barrier; which saw success among researchers with "overlap in academic backgrounds," among groups where "scientists' backgrounds were very different" publications of findings never

happened (p. 24). In examining such important collaborative projects, it becomes clear that rhetoric and writing specialists should invest their energy to find pathways for success in collaborative writing, especially among collaborators from very different backgrounds.

What I suggest in this article is to continue turning our attention to what ought to be an important turn for teaching and research in disciplinary discourse—transdisciplinary knowledge making. Thinking about WAC/WID principles in light of transdisciplinary work couldn't be more important. Currently, research universities are making growing infrastructural investments in transdisciplinary practices. Arizona State University, for instance, has piloted what they call "The New American University" in which they have "fused disciplines to form new colleges, schools and departments that encourage transdisciplinary collaboration [and]…created new kinds of university structures that promote academic partnerships with the community, industry and government." The University of Vermont launched a 2009 project called the "Transdisciplinary Research Initiative," which takes on projects such as the development of a "national smart grid" in a collaboration that consists of researchers in mathematics, computer science, medicine, economics, engineering, and business disciplines. In 2005, through funding from the National Cancer Institution, the "Transdisciplinary Research on Energetics and Cancer Centers" (TREC) collaborative was formed to address cancers linked to poor diet, exercise and obesity. These ongoing national transdisciplinary research projects through TREC are occurring not just transdisciplinarily, but across different institutions, representing a burgeoning interest and investment in radically inter-disciplinary and transdisciplinary work.

It would be a mistake to think this trend is just about STEM research practices. Transdisciplinary work isn't limited to Research Intensive institutions or graduate student learning—it represents a much broader trend. Those who critique unidisciplinary research and advocate for the surge in transdisciplinary research commonly point to the increasingly complex and transdisciplinary nature of societal problems. Growing concern over enormous scientific and political challenges, such as global climate change, for instance, have resulted in critiques of the limits and boundaries of the traditional disciplinarity of "pure science" disciplines (Gibbons et al., 1994; Heiskanen, 2006; Lenhard et al., 2006). The primary argument in these critiques is that researchers are now faced with problems that cannot be addressed by the "siloed" disciplinary structures that emerged from Enlightenment and Victorian era education. Yet, transitioning toward interdisciplinary structures is quite messy, and riddled with communication challenges.

At their core, I argue that the communication challenges inherent to transdisciplinary collaboration are an important site of inquiry for disciplinary discourse studies and disciplinary writing pedagogy. The aim of this article is to help propel such a conversation forward by providing readers with an entrée into transdisciplinary theory, drawing attention to some of the most common communicative challenges that emerge in transdisciplinary collaborations, and considering some avenues for disciplinary writing research and pedagogy in light of transdisciplinary collaborative work.

An Entrée into Transdisciplinary Theory

The interest in collaborative research practices between seemingly divergent disciplines has been well documented in recent years. Composition and rhetoric scholars have articulated interdisciplinary knowledge making as the deep theoretical structure for English Studies (Kopelson, 2008), as the premiere rhetorical activity of postindustrial society (Payne, 1999), and as the product of a robust feminist rhetorical practice (Royster, Kirsch, & Bizzell, 2012). As interest in interdisciplinary research has grown, so has interest in a more radical form of cross-disciplinary

collaboration, which is commonly referred to as transdisciplinary research. What distinguishes transdisciplinary work from other forms of work such as uni-disciplinary, multi-disciplinary, and even inter-disciplinary research, is the degree of integration through which collaboration occurs. Transdisciplinary collaboration occurs at the highest levels of integration among researchers.

In more simple terms, the differences in multidisciplinary, interdisciplinary, and transdisciplinary collaboration can be understood by observing the role of each collaborator in the design of research methods: transdisciplinary work requires participant collaboration earliest in the process, in the design of research methods, and deliberation about conceptual and theoretical orientations. Multidisciplinary work, on the other hand, promotes researchers *returning* to their own respective disciplines for methods design, and in many cases retaining their disciplines conceptual and theoretical perspectives without deliberation among participants. While definitions of these different disciplinary structures vary among researchers and institutions, many cite Patricia L. Rosenfield's 1992 article as a common ground for defining transdisciplinary work. Rosenfield writes:

> Transdisciplinary research can provide a more comprehensive organizing construct. Representatives of different disciplines are encouraged to transcend their separate conceptual, theoretical, and methodological orientations in order to develop a shared approach to the research, building on a common conceptual framework. (p. 1351)

This depiction of transdisciplinary research as "more comprehensive" and *transcendent* to disciplinary "conceptual, theoretical, and methodological orientations" for the purpose of building "a common conceptual framework" differs drastically from a multidisciplinary approach where "each discipline works independently...and the results are usually brought together only at the end; and from an interdisciplinary approach where "different disciplines use their techniques and skills to address a common problem...[but] the results are usually reported in a partial, discipline-by-discipline, sequence" (p.1351).

The most important clarifying characteristic among these different approaches to collaboration is the point at which collaboration begins and participant disciplines are integrated. Lenard et al. (2006) distinguishes transdisciplinary work from other forms of collaborative research through the principles of "early integration" and "late integration." "Early integration," which Lenard et al. (2006) attribute to educational theorist Erich Jantsch, aims to "blur disciplinary boundaries as early as possible," while "late integration," which the authors attribute to educational theorist Hartmut von Hentig, "pleads for the initial preservation of disciplinary boundaries" only to later integrate researchers into a "democratic process within a 'republic of scientists'" (p. 341). The division between the two approaches to integration hinges on whether a disciplined approach and clearly defined disciplinary identities are useful tools once a researcher is entangled in an interdisciplinary environment. Those who believe the integrity of disciplinary identity to be vital to knowledge production may prefer a collaboration with later integration, such as multi-disciplinary collaboration. Those who see disciplinary identity as a situated social construction, and see knowledge production itself as a situated social construction, may prefer collaborations with early integration of participants, such as transdisciplinary or radically interdisciplinary research.

Transdisciplinary projects, in which integration occurs very early in the collaborative process, is a very important site of rhetorical activity that should be of central concern to rhetoric and writing specialists. These moments of blurred boundaries in early integration particularly among traditionally divergent disciplines such as social sciences and natural sciences should be an especially important site of inquiry for disciplinary writing theorists. In these moments of early integration,

collaboration is occurring at the methodological and conceptual orders of concern, and because they are sites where the very social assumptions that subtend disciplinarity emerge most definitively, the success and failures of early integration must be examined and better understood.

At the heart of these growing research interests in transdisciplinary work are questions central to studies in disciplinary writing theory and practice: what are good practices for communicating within, among, and beyond disciplines? How do disciplinary genres assist writers in the work of a discipline? How might genres help or limit writers in communicating outside of their discipline? What rhetorical activities promote effective collaboration?

Given the growing urgency of problems that require a transdisciplinary approach, such as global climate change, we might re-imagine some of these disciplinary writing questions in light of transdisciplinary research: what are good practices for communicating about conceptual, theoretical, and methodological orientations with divergent disciplines? What role does genre play in transdisciplinary research, and how might genre theory adapt to transdisciplinary work? What rhetorical activities promote the formation of a common conceptual framework among divergent disciplines in transdisciplinary work? What are some of the common barriers to effective collaboration in transdisciplinary work? Metaphorically, these questions represent an iceberg of inquiry for disciplinary discourse studies for which we have not even begun to investigate the tip.

Some of these questions are hardly new, and have been considered to an extent by scholars in disciplinary writing and communications theory. In the field of technical communication, for instance, there has long been conversation about the transformations which occur when technical writers are involved early in the process, such as on the development team, rather than only after project development has concluded (Bresko, 1991; Fisher, 1999). Yet the infrastructural and intellectual investments that have been made in transdisciplinary collaboration in the past five years alone warrant a renewed urgency for considering the role of disciplinary writing theory in future transdisciplinary universities.

This article will address just one of these questions by outlining some of what I'll call the "common communicative barriers" that emerge in transdisciplinary work with an aim to begin sketching the epistemological character of transdisciplinary work. In reviewing some of these common challenges and characteristics, I hope readers will see new opportunities for critiquing existing writing theory, developing new approaches to writing pedagogy, and consider the changing relevance of WAC/WID theory in a transdisciplinary university and world.

Common Communicative Challenges in Transdisciplinary Work

Identifying communicative barriers and challenges is a useful starting point for understanding the rhetorical activity of transdisciplinary work. Addressing challenges to effective language use is not only a useful premise for research, but helps writing researchers find results that better articulate and justify writing instruction to faculty and administrators throughout the university. A review of existing research on the common challenges in transdisciplinary work is a fruitful starting point for better understanding this trend in transdisciplinary knowledge making.

Of particular use to researchers interested in studies of communicative barriers in transdisciplinary work is Eigenbrode et al.'s "Employing Philosophical Dialogue in Collaborative Science" (2007). This study reviewed seven published studies of inter- and trans- disciplinary collaborations to determine the common barriers that emerged across all studies. The authors aimed to create a system for classifying the common barriers and outline an approach to help cross-disciplinary collaborators

identify the "philosophical structure of their research." Eigenbrode et al.'s review of transdisciplinary collaborations are useful for disciplinary writing research because they emphasize specific social and communicative limitations to effective transdisciplinary collaboration, which are echoed in other popular studies of transdisciplinary research (for example Anderson & Scott, 1999; Hargreaves & Burgess, 2009). This makes Eigenbrode et al.'s study a great starting framework for considering opportunities for researchers of disciplinary discourse to reconsider WAC/WID principles and practices in light of transdisciplinary contexts.

Echoing the claims of Lenard et al. (2006), the first barrier described by Eigenbrode et al. is what the authors call disagreements in the "level of integration." The authors describe this barrier as the erroneous tendency to apply the wrong degree of disciplinary integration in cross-disciplinary work. As mentioned previously, the degrees of disciplinarity are frequently classified as "multidisciplinary," "cross-disciplinary," "interdisciplinary" and "transdisciplinary" from order of least epistemologically integrated to most epistemologically integrated. If researchers begin with different intentions for integration, than the discrepancy itself is likely to become a barrier to effective collaboration. The authors confess that a transdisciplinary approach, in which full integration occurs among a variety of divergent disciplines is the ideal, however, a variety of institutional power concerns, such as disciplinary identity, may lead to the wrong level of integration (see also Shove, 2010).

A second major challenge to interdisciplinary collaboration is what Eigenbrode et al. (2007) refer to as "linguistic and conceptual divides." The authors describe these divides as disagreements regarding the specialist terminology used in varying disciplines and the different connotations for the same terms across disciplines. For example, Eigenbrode et al. present the example of "triangulation" as a linguistic and conceptual divide, noting that "triangulation" in the social sciences refers to an entirely different research principle than it does to specialists in navigation and surveying.

The linguistic divides that Eigenbrode et al. (2007) describe are more than semantic divides—they are often at the root of a conceptual divide. For example we can observe a conceptual/epistemological dilemma when we ask: what counts as an observable scientific setting—a strictly controlled lab or a natural (and uncontrollable) ecosystem? Such questions were lively in debates between laboratory Biologists and Environmental Scientists when the environmental science discipline rose to popularity in the mid-20th Century (De Groot, 1992). The word "control" in this example represents more than a linguistic disagreement—it represents a fundamental disagreement on what *counts* as *science*. For some, a natural environment lacks the rigorous *controls* required for information to be repeatable, and is therefore scientifically unreliable. For others, a controlled laboratory setting is merely a fantasy of control, and therefore cannot produce results that are genuinely applicable to the "real" world. So long as biologists and environmental scientists disagree on such a fundamental idea, persistent disagreement is destined to rule the day in collaborative research contexts such as transdisciplinary research.

As discussed earlier in the example of the Interior Columbia River Basin Management Project, these linguistic divides may become serious inhibitors to an interdisciplinary writing process in which collaborators from very different academic backgrounds failed to publish findings. Issues of academic culture such as tenure evaluation, how different disciplines value authorship, and the availability and integrity of journals for publishing interdisciplinary findings, may all accumulate into a disincentive to publish collaborative work. Jakobsen et al. (2004) describe this as a matter of academic culture, which leads to: "questions about authorship, importance of educational level/titles, lack of incentives to work on interdisciplinary projects, and differences in methodological traditions" (p. 28). While these barriers may seem insurmountable, there is hope that as universities invest in transdisciplinary

knowledge making structures, the academic culture which reproduces disincentives for collaborative work may begin to change as well.

Disagreements on what counts as *evidence* is perhaps the most epistemologically-systemic barrier to collaboration in transdisciplinary work. Eigenbrode et al. describe this as a "validation of evidence" barrier, which presents a significant challenge when varying or divergent research methods are utilized by the disciplines involved. For example, a social scientist may take citizen input on environmental quality much more seriously as evidence than a chemist might—especially if she can find no "evidence" of the poor environmental quality of which the citizens complain in her chemical analysis of the environment. In my own interviews with social scientists who identify themselves as environmental epidemiologists this disagreement on the value of social input as evidence is commonly down-played by laboratory scientists. To paraphrase one environmental epidemiologist: it means little to a physical scientist that half a town believes there is a medical problem associated with an environmental odor until that physical scientist discovers the chemical root of that odor.

The social context of research is also an important barrier cited by Eigenbrode et al.'s study because it describes the divides that may be political in nature depending upon how a researcher values the input or influence of external stakeholders. Researchers working in physical sciences may be more interested in reducing or attempting to eliminate social (including institutional or governmental) influence on research being conducted; while, researchers from applied social sciences may be more likely to see social context and stakeholder input as a focal point for the research itself—for applied researchers the social context helps define the problem to be addressed (see Karen Barad's (2007) *Meeting the Universe Halfway* for a precise example of recent interest in challenging the notion of pure and un-objective scientific research in laboratories). The social context of research becomes a clear communicative barrier in transdisciplinary research collaborations on environmental topics in which some researchers may be happy to situate their work in light of the urgent need for change in greenhouse gas emissions, while other scientists may feel uncomfortable conducting research in this political framework.

The final two of the seven barriers cited by Eigenbrode et al. (2007) are less common, but essential considerations in transdisciplinary collaborations. The first is what the authors describe as the scientists' "perceived nature of the world." By this Eigenbrode et al. refer to the question of the relation between researcher objectivity and human values, such as morality. The authors argue that divides between researchers on this issue can serve as a serious barrier to collaboration, but most often the address of these divides is "seldom required" (p. 58). Another cited barrier is what the authors refer to as a "reductionist versus holistic science" barrier. Here, researchers who may begin with agreement on integration levels and terminology may differ on how to best approach scientific problems—should the researchers isolate individual components for observation, or look at the problem more broadly without dividing the subject into individual components? Once a decision on this issue has been made, such barriers are less likely to affect the collaboration, however, it is important that decisions on these questions are carefully detailed and agreed upon by researchers very early in the collaboration.

The common communicative barriers that emerge in Eigenbrode et al.'s review of these seven inter- and trans-disciplinary collaborations have value as imports to disciplinary discourse studies. We might summarize some of the common communicative barriers that emerge in transdisciplinary collaborations as follows:

1. Disagreement on issues related to the value of disciplinarity and the point at which input from participants should be integrated.
2. Conceptual and linguistic divides among participants including what counts as science, what methods are appropriate, and what terms mean.
3. Methodological disagreements about what validates knowledge and what counts as evidence.
4. Methods disagreements about how to approach the research problem (i.e. reductionist versus holistic science)
5. Disagreements about the social and political context of research and the role of objective researchers within this context.

These barriers are important to consider because they help researchers of disciplinary discourse understand where language instruction can better prepare students for transdisciplinary collaborative work. These common communicative barriers provide an enormous opportunity for WAC/WID curriculums to consider means for addressing these issues and for improving student ability to function within such collaborations. This is opportunity is especially evidenced by the fact that the communicative barriers that emerge in transdisciplinary collaborations are rooted in participants' failures to identify and discuss the social and rhetorical constitution of their knowledge-making process. That is, participants in the seven transdisciplinary case studies reviewed by Eigenbrode et al. and summarized in this article enter collaborations with their own particular disciplinary conventions for knowledge making, and as such communicative barriers emerge when divergent disciplinary methods, concepts, and terms, such as those between social and physical scientists, become [seemingly] incommensurable. It is the absence of a rhetorical dialogue about disciplinary conventions themselves, including disciplinary concepts, methods, terms, and social/political contexts for the research that leads assuredly to failed transdisciplinary collaboration.

Eigenbrode et al. (2007) agree that the root of these communicative barriers may be the absence of rhetorical dialogue about disciplinary conventions within these transdisciplinary collaborations, concluding their study:

> philosophical assumptions are implicit in this list [of barriers and challenges to transdisciplinary collaboration]. Interdisciplinary or transdisciplinary efforts that involve the synthesis of conceptual schemes may require substantial interactive exploration of these assumptions...under pressure and heat of day-to-day effort, collaborators at any level of integration are exposed to the philosophical assumptions of their partners, but in a piece-meal and uncoordinated way, rarely deliberated. (p. 60)

This emphasis on "philosophical assumptions" that are "rarely deliberated" points precisely to the challenge that WAC/WID scholars might take as a focal point for preparing a university students for future transdisciplinary work. After all, it is the inherently rhetorical and philosophical structure of disciplines and the encouragement of deliberation about such disciplinary structures that WAC and WID researchers have worked for decades to account for in both theory and pedagogy.

Implications of Transdisciplinary Work for Disciplinary Writing Research and Pedagogy

Preliminarily, we might begin to see disciplinary writing theory and disciplinary writing pedagogy as well poised for the trend toward transdisciplinary work. Given that transdisciplinary work entails the early integration of social and scientific disciplines, studies of the socially constructed knowledge making practices of disciplines provides valuable insight into how divergent disciplines might functionally collaborate. As such, WAC/WID should have a significant disciplinary investment in transdisciplinary work. Bazerman et al.'s (2005) *Reference Guide to Writing Across the Curriculum* notes, for example, that although there are many manifestations of theories and pedagogies under titles such as "Rhetoric of Science, Rhetoric of Inquiry, Writing in the Disciplines, and English for Specific Purposes" that in fact "...these differently motivated and framed inquiries contribute to a common picture of writing practices in the various disciplines and the relation of those processes to the production and use of disciplinary knowledge...how different disciplines construct knowledge through different textual forms, and the kinds of challenges students must meet when learning to write within their chosen fields" (p. 66). This "common picture" of "how different disciplines construct knowledge through different textual forms" might be understood as a keystone to studying, and perhaps, improving transdisciplinary collaborations.

A collective look at the communicative barriers that emerged in the case studies of transdisciplinary work reviewed by Eigenbrode et al. (2007), reveals that each communicative barrier is partially rooted in the absence of deliberation about disciplinary conventions, and accordingly the tendency for participants in transdisciplinary collaborations to ignore the highly rhetorical nature of the knowledge making practices they bring to such collaborations.

From a post-structural view of language and rhetoric, the communicative barriers (conceptual, methodological, linguistic, and social/political) that emerge in these transdisciplinary collaborations are each constituted by the disciplined effect that language has on a participant's ability to conceptualize, act, and imagine within the epistemological schema of a participant's respective disciplines. For transdisciplinary collaborators to succeed in moving beyond these communicative barriers, they must essentially learn to do the opposite of what WAC/WID pedagogy historically suggests—they must become *un*-disciplined in order to establish a situated and collective disciplinary identity in a radically interdisciplinary/transdisciplinary setting. Participants must learn about language not as a means for reinforcing disciplinarity and ideology, but as a means for reflexivity, openness, and situated-ness in knowledge making. Participants must learn to deliberate productively about disciplinary conventions, methods, concepts, terms, and social/political contexts if such collaborations are to succeed.

Given this need for open reflection about disciplinary conventions and assumptions, it makes sense that students who may one day be expected to participate in transdisciplinary work should be given a rhetorical education that prepares them to think critically and reflexively about the social structures of their own and peers' disciplinary conventions. Herein lies two major challenges for transdisciplinary universities seeking a rhetorical education that promotes transdisciplinary success: one, many faculty across the disciplines (some would argue a majority) see student comprehension of disciplinarity among the skills acquired in the furthest reaches of a program, such as senior seminars or even graduate-level work; and two, many faculty themselves may not be rooted in disciplines with a tradition of discourse about disciplinary epistemologies.

One way to understand such challenges is to view them as the byproduct of a historically disciplinary university structure—the very structure that transdisciplinary knowledge-making aims to contradict by design. As an aside to this article, this means that graduate programs training future university faculty in Ph.D. programs may seek to integrate more discussion of epistemology into their curricula as a means of preparing faculty for holding discussion about disciplinary epistemology with their students. Secondly, and of greater meaning to the focus of this article, universities interested in transdisciplinary work must begin to consider student comprehension of disciplinary epistemology as a threshold concept that should be reflected in student learning objectives, and integrated into course curricula much earlier in four year programs (rather than only in senior seminars, for example).

Aside from these two challenges, there are several clear implications for writing programs at universities interested in transdisciplinary work. Certainly a first step for institutions interested in preparing future students for success in transdisciplinary collaborations is to invest in WAC/WID curriculums that seek to address some of these common communicative barriers. The primary emphasis in such curriculums should be to teach students to think critically and reflexively about the ways in which their disciplines socially construct knowledge-production. This should include reflection on disciplinary epistemology and methodology but also disciplinary terminology and the political/social contexts in which these disciplines might operate. Fortunately, a great deal of this work already exists in WAC/WID practice and theory; but in addition, WAC/WID curriculums should place students in learning environments where they can discuss their disciplines' conventions and deliberate with peers from very different disciplines about their respective disciplinary conventions.

One way that WAC/WID curriculums might seek greater deliberation about disciplinary conventions among students is by re-configuring classroom structures away from epistemologically-related disciplines learning together (i.e. physics, chemistry, and biology students), and toward classrooms that enroll students from highly divergent disciplines in upper-division writing courses together (i.e. physics, economics, history). In a more epistemologically diverse classroom, students can learn to work through the many barriers that emerge during collaborations with peers from divergent disciplinary backgrounds and will be given a chance to practice deliberation about disciplinary discourse which is so badly needed in transdisciplinary settings.

Traditionalists in WAC theory and pedagogy may object to this prospect because there is a great deal of work that takes the rhetorical activity of specific disciplines as a focal point of research, such as "Writing in the Social Sciences" (Steward & Smelstor, 1984); *Professional Academic Writing in the Humanities and Social Sciences* (MacDonald, 1994); or the emergent disciplines of "Business Writing" and "Technical Writing." In suggesting an approach to a WAC/WID curriculum that brings together students from divergent fields with a goal to prepare students for transdisciplinary work, I am not advocating for an abandonment of these traditional, and quite successful approaches. I hope to leave such either/or debates to the pleasure of reactionaries and advocate instead for additional attention to a different kind of classroom structure for institutions interested in the future of transdisciplinary work.

A classroom enrolled with students from highly divergent disciplines could be themed around an applied problem of interest to those students. For example, an applied classroom theme of *Environmental Sustainability*, or *Alleviating Poverty* could draw students from economics disciplines, natural science disciplines, engineering disciplines, business disciplines, and the humanities to work together as collaborative writers addressing an applied problem. There is no doubt that a student trained to think as an economist will have a different approach to addressing environmental

sustainability than a student trained in environmental science, or a student trained in English Studies—and that's precisely the point. Struggle will inevitably ensue when students from very different disciplines collaborate on an applied topic like sustainability, but this struggle not only prepares them for rigorous transdisciplinary work, but also forms a valuable pedagogical scene for instructor discussions of disciplinary writing and rhetoric.

The needed adjustments to prepare students for transdisciplinary work largely comes down to a shift away from disciplinarity as the guiding criteria for classroom design and toward applied topics such as environmental sustainability, global climate change, poverty, hunger, or social justice (to name a brief few) as the guiding criteria for classroom design. With applied topics as the guiding criteria for classroom design, WAC/WID leaders can create classrooms where divergent disciplinary frameworks and assumptions that students (and their professors) carry with them in their studies will inevitably emerge. In this difficult collaborative environment, writing emerges not just as a communicative requirement, but also as a means for understanding the perspectives of peers from divergent disciplines, for mediating those differences, and for inventing what can amount to viable solutions to our most pressing social challenges.

In addition to structuring classrooms with students from divergent disciplines around applied problems, writing classrooms interested in promoting transdisciplinary work could also place emphasis on genres whose design helps mediate divergent disciplinary perspectives, such as proposals or visual representations of the applied problem.

In my own interviews with transdisciplinary collaborators, participants commonly reference the grant proposal process as a genre which helped mediate disciplinary differences. Karen Burke LeFevre, in fact, uses the example of "business proposal writing" in her well-known work *Invention as a Social Act* (1987). LeFevre writes of proposal writing: "two or more rhetors collaborate to invent, and in fact, to negotiate, a text. One person may suggest an idea; the other responds; the response becomes a gesture to the first speaker, who then generates another idea…each party must agree, or invention stops" (p. 62-63). There is a great deal of research that needs to be done on the role of proposals as a mediating genre in transdisciplinary collaboration, but there are many indications that such a genre would be useful in an upper-division disciplinary writing course. Transdisciplinary-focused classrooms might also provide an opportunity for studies in visual rhetoric to emerge as an important tool for mediating differences. Robert Evans and Simon Marvin's "Researching the Sustainable City: Three Modes of Interdisciplinarity" (2006), for example, assesses the function of interdisciplinary collaboration by evaluating three United Kingdom research programs' focus on the design of sustainable cities. In their study of collaboration on the applied problem of sustainability in the U.K., social scientists and engineers struggled to model cities together because of different disciplinary conceptions of traffic patterns. The engineers saw transportation infrastructure as something that had to accommodate the needs of humans; while the social scientists saw transportation infrastructure as relatively fixed, positing instead that human behavior could be accommodated most easily, through policy. The fact that visual modeling in the sustainable cities project brought forth deeply rhetorical disciplinary conventions means that such modeling might be a useful way to draw-out and create an occasion to mediate some of the disciplinary assumptions that threaten a transdisciplinary collaboration's success.

Greater emphasis on the communicative barriers inherent to transdisciplinary work may also suggest new content for WAC faculty workshops. WAC directors and consultants, for example, have had great success helping faculty across the disciplines take ownership over writing instruction within their respective programs. WAC workshops have emphasized the value of writing to learn

pedagogy in upper-division courses (Bohr & Rhoades, 2014), have encouraged faculty to discuss the genre systems of their disciplines (Blumner, Eliason, & Fritz, 2001), and have helped faculty across the disciplines consider ways to teach student writing in their disciplines as a process that includes planning, drafting, and revising throughout the semester (Bohr & Rhoades, 2014). WAC faculty workshops for institutions interested in transdisciplinary work might build on these common WAC principles by encouraging faculty across the disciplines to create informal writing assignments which ask students to reflect on the *process* of knowledge making within their disciplines—not informal *writing to learn* about disciplinary content alone. WAC faculty workshops might also encourage faculty across the disciplines to introduce disciplinary genres and methods as dynamic social systems, not as static formulae for disciplinary knowledge making. While this may seem obvious to faculty who are seasoned writers in their fields, WAC directors and consultants directing faculty workshops could discuss the value that teaching disciplinary genres as social systems can have on their students' ability to collaborate with peers from divergent disciplines.

Given the challenge that many faculty themselves may not be confident or trained to discuss and compare disciplinary epistemologies, as mentioned earlier in this essay, WAC workshops may also be a useful tool for training university faculty to hold epistemological conversations about their disciplines with students. Given the nascent development of transdisciplinary university structures many faculty, for example, may have been trained in graduate programs that didn't discuss disciplinary epistemology in explicit ways. Faculty workshops can begin to close this gap in faculty training by providing workshops which help faculty consider the epistemological character of their own disciplines, and by helping to develop the skills for hosting discussions about disciplinary conventions with their students.

Another focal point for WAC faculty workshops at institutions interested in promoting student success in transdisciplinary settings would be to encourage faculty to collaborate on a course writing project among multiple upper division courses across the curriculum. Third and fourth year undergraduate students majoring in Economics might collaborate with third and fourth year undergraduate students majoring in Environmental Studies to write group proposals on a topic such as sustainability. In a setting such as this, upper-division writing projects become an opportunity for students from diverse disciplines to take ownership over their disciplinary knowledge, practice rhetorical deliberation about disciplinary conventions, and produce texts that mediate differences with peers and address authentic applied problems in both disciplines. The classroom discussions about writing, discourse, and knowledge making that might emerge from such a collaboration seem endlessly bountiful. WAC faculty workshops and retreats emphasizing collaboration among divergent disciplines might even become the meeting space through which research collaborations among faculty themselves could sprout early roots.

Conclusion

If we consider the adage "learning to write, writing to learn" that helped define the mission of WAC/WID for some 45 years now, could we not see greater consideration of transdisciplinary collaboration in WAC/WID as an extension of this mission?

The Writing to Learn pedagogy that helps define the work of teachers and researchers of disciplinary discourse hinges on a view of language as a building-block for disciplinary epistemologies. For many, this emphasis on disciplinary writing and rhetoric as epistemic is what WAC/WID is all about. As McLeod and Maimon aptly explain in "Clearing the Air: WAC Myths and Realities" (2000) "Teaching students to write in the disciplines is not an exercise in formalism...it is an exercise in epistemology"

(p. 580). Students who are writing to learn, are writing to learn a particular disciplinary epistemology—including the conventions, concepts, methods, terminology and discourses which do the work of disciplines. We ask students to engage in these discourses and the conventions, concepts, methods and terminology that go with them. A central challenge WAC/WID scholars must address is this: the common communicative barriers that emerge in transdisciplinary collaborations suggest that the root cause of communicative barriers in transdisciplinary work are the very epistemological elements that WAC/WID aims to galvanize through writing to learn pedagogy. More specifically, these communicative barriers are rooted in a *static conception of disciplinary epistemology*, and the absence of reflexivity toward disciplinary conventions, concepts, methods, and terms within participating disciplines. This creates a conundrum for WAC/WID programs deeply invested in reinforcing disciplinarity through writing to learn pedagogy, but not an impasse. Generally, we must press on to consider approaches to writing to learn pedagogy which teach disciplinary discourse reflexively, revealing disciplinary conventions, but portraying them as situated, and negotiable in transdisciplinary collaborative settings. Specifically, we should consider ways to integrate writing to learn pedagogy with opportunities for transdisciplinary collaboration, including teaching the skills of negotiating difference among divergent disciplines and teaching written genres that act as tools for mediating such differences. At its best, such an approach would prepare future students for a future that will likely be characterized by transdisciplinary collaboration; but at the very least, engaging students in transdisciplinary discourses can help them see the specific, unique, and situated nature of their own disciplines.

If transdisciplinarity is the future of knowledge-making in a post-industrial society, as institutions and theorists seem to suggest, then we must re-consider the ways in which we cultivate student understanding of disciplinary discourse, and more particularly transdisciplinary discourses. This might require some uncomfortable alteration of WAC/WID pedagogy that aims to reinforce disciplinarity, but there is no better-poised group of scholars for such work than those who study the rhetorical function of academic disciplines.

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