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Transdisciplinary Scholarship: Integrating Boyer's Model of Scholarship with Transdisciplinary Research

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A recent article by Jahn et al. provided an excellent overview of transdisciplinarity, provided a framework for transdisciplinary research, and discussed challenges of transdisciplinarity. Some of these challenges are lessened if concepts of scholarship promoted by Earnest Boyer are incorporated into theframework of transdisciplinary research. This merger of transdisciplinary research with Boyer's model of scholarship can be called transdisciplinary scholarship'. The goals of the current manuscript are to (1) provide a brief overview of Boyer's Model of Scholarship, (2) integrate the Jahn et al. description of transdisciplinarity with Boyer's Model of Scholarship, and (3) offer a strategy to address the major cognitive challenge that integration presents to transdisciplinarity. (4) I provide an example of trandisciplinary scholarship that I am conducting in Haiti. Finally, (5) the Jahn et al. definition of transdisciplinarity is tweaked by 1 word.

Keywords*:* Boyer model of scholarship, Haiti, transdisciplinary scholarship, vetiver grass.

1 Boyer Model of Scholarship

Ernest Boyer articulated the work that faculty do at research universities, and encouraged university administrators to adapt policies that encourage the kinds of scholarship that today's universities and society value [1, 2] (Boyer 1990, 1996). Traditionally, research universities expected faculty to perform research, teaching, and service. Boyer recognized that faculty are asked to perform a lot of scholarly activities that are not encompassed under the heading 'research'. Boyer advocated for the recognition of different kinds of scholarship, including the scholarship of discovery, scholarship of application, scholarship of integration, scholarship of engagement, and scholarship of teaching. Briefly, the scholarship of discovery is what is commonly referred to as 'research'. Discovery is data-driven, involves the scientific-method, and often takes place in labs. Discovery generates new knowledge, so transdisciplinary "research" certainly involves discovery. The scholarship of application involves using discoveries to improve products or services and address societal problems. Translational sciences practice application. In medical sciences, the phrase 'bench to bedside' refers to application and translation. Unlike transdisciplinarity, applica-

tion is not necessarily interdisciplinary, nor does it necessarily involve the public. The scholarship of integration is placing ones research in the context of related fields. Integration has led to the increased focus on interdisciplinary studies over the past three decades. The scholarship of engagement involves bringing ones science to the public. The state of science literacy in America suggests that scientists must do a better job of engaging the public. For example, evolution is a central tenet of biology, yet only 32% of Americans agree that living things have evolved over time due to natural processes [3] (Pew Research Center 2009). Transdisciplinarity takes engagement one step further by dialoguing with the community and incorporating knowledge gained from the public into the transdisciplinary framework. The scholarship of teaching goes beyond the traditional view of teaching through lecture. Teaching involves applying the scientific method to teaching and learning. It involves discovery, application, integration, and engagement. There is a lot of overlap among the different categories identified by Boyer. Compared with the term 'research', the Boyer Model of Scholarship better describes the activities that university faculty participate in today, and also better describes activities that facilitate transdisciplinary scholarship.

1.1 Research vs. Scholarship

Contrary to what some researchers believe, proponents of Boyer's Model of Scholarship do not want to replace research with scholarship. Rather, Boyer's model recognizes both research and non-research activities with the understanding that application, integration, engagement, and teaching complement discoveries. Distinctions among these terms to describe scholarship extend beyond semantics. At research universities, it is often new scientific discoveries that are most rewarded. The fact that these institutions are called 'research universities' illustrates the emphasis placed on discovery, although faculty duties at these institutions are expanding to include other kinds of scholarship. More institutions, including my own, are reassessing reward systems in order to compensate the other kinds of scholarship. A simple way to encourage recognition of other kinds of activities that Boyer's Model and transdisciplinarity require is to replace the word "research" with "scholarship", or "researcher" with "scholar", in conversation or when reading literature. The only time I use the word "research" is when I am referring specifically to the scholarship of discovery. For me as a natural research scientist, the practice of saying "scholarship" felt forced and awkward initially, but with practice, it became very natural. Following this personal practice, I replaced "research" with "scholarship" as I read [4] Jahn et al., and in doing so, recognized that the challenges to transdisciplinarity that the authors identified are lessened if Boyer's Model of Scholarship is integrated with Jahn et al.'s Conceptual Model of Transdisciplinarity. By integrating Boyer's Model with transdisciplinarity, the advances made to recognize and reward other forms of scholarship in academia could be realized for transdisciplinary activities.

Boyer's model of scholarship in no way reduces the importance of traditional research. Rather, it adds value to research (i.e., the scholarship of discovery) by making the research relevant to addressing societal problems, including 'wicked problems' [5] (Radcliffe 2006). The success of research is evidenced by the fact that science has already discovered much of the knowledge necessary to solve many of the world's 'wicked problems'. What is now needed is for advances in application, translation, integration, engagement, teaching, and transdisciplinary scholarship to use existing discoveries to solve complex problems [6] (Diamond 1992). Transdisciplinarity calls for academics to partner with the public, and for exchanges of information, technology, ideas, and implementation to occur in both directions of the partnership. Advances in the scholarship of engagement would facilitate these transdisciplinary exchanges.

1.2 Climate change: Do We Need More Discoveries, or Transdisciplinary Scholarship?

The wicked problem of climate change illustrates the relationships among these different kinds of scholarship. Science and technology have discovered how to convert sunshine, water and air currents, tides, waves, geothermal heat, and nearly any renewable organic molecule into electricity. Despite having 'discovered' how to sustainably meet our energy needs, human society continues to rely on non-sustainable climate-changing fossil fuels for energy. What is now needed is using engagement, application, translation, economics, policy, business, marketing, arts, engineering, manufacturing, and education to encourage the broad implementation of existing technology into society. For example, the photovoltaic panels on my

roof meet 97% of my homes electrical demand and power my electric car. The low proportion (less than 2% from personal observations) of solar-powered homes in my community is not a geographic (e.g., Colorado gets about 300 days of sunshine annually) or technological problem, but is a problem with implementation that transdisciplinary scholarship could address.

2 Lessons Learned from Transdisciplinary Work in Haiti

The magnitude 7.0 earthquake that struck near Leogane, Haiti on Jan. 12, 2010 devastated the capital city of Port au Prince, killed an estimated 220,000 people (2.4% of the country's population; including 25% of civil servants in Port au Prince), injured 300,000, and displaced at least 1.5 million more [7] (DEC 2012). Haiti is often called the poorest country in the western hemisphere, which is the case in economic terms, and the earthquake left Haitians with a difficult task of rebuilding. Haiti also has the most degraded ecosystems in the western hemisphere [8] (YCELP et al. 2005). A history that includes genocide, centuries of slavery, political corruption, exploitation, disease, occupation, a huge debt from the negotiated indemnity payment Haitian President Jean-Pierre Boyer made to France, deforestation, and natural disasters has created a setting with multiple challenges [9] (Dubois 2012). All of these challenges make the creation of a thriving, sustainable society in Haiti a 'wicked problem', requiring post-normal science and scholarly-societal partnership [10] (Frame and Brown 2008).

Recent work that I have conducted near Port au Prince, Haiti illustrates the need for transdisciplinary scholarship, and some of the institutional and societal barriers to this type of scholarship. Within two days of the earthquake, CU Denver banned all travel to Haiti by faculty, students, and staff. Despite the travel ban, I began making plans to travel to Port au Prince in order to provide relief aid. After some people, myself included, criticized the travel ban, the university announced that faculty and staff could travel to Haiti on vacation or during leave. The ban on student travel officially remains, though these are some flexibility given a CU Denver course was taught in Haiti in Jan. 2013. I have traveled to Haiti four times since the earthquake during breaks, without any support or hindrance from the university. Being in Haiti for only a few weeks a year has hindered progress, but I am currently negotiating with my Department Chair and Dean to arrange my schedule to include extended stays in Haiti as there seems to be growing acceptance of this transdisciplinary scholarship.

International awareness of the wicked problems in Haiti was greatly increased following the devastating earthquake. CBS News determined that nearly $15 billion were donated. About half of American households donated to Haiti earthquake relief, and 60% followed the story "very closely" [11] (Pew 2010). Four days after the earthquake, my band and other local musicians raised over $1,000 with a benefit concert that was used to provide immediate aid. I arrived in Haiti in June 2010, where I determined from casual observation (i.e., no scientific measurements were made) some of the most degraded ecosystems that I had ever witnessed. The ground had little to no vegetation and very little organic matter. Research studies to measure ecosystem health, soil processes, or community structure-function relationships (i.e., scholarship of discovery) were a low priority because the science of ecology had long-established that vegetation is important for ecosystem health. What was more immediately important were other forms of scholarship, such as applying ecological knowledge to getting vegetation established on the bare earth and engaging the community to continue the project after I returned to the US. Restoring ecosystem services will be an important part of creating a sustainable society in Haiti. The project was transdisciplinary because it relied heavily on knowledge and feedback from the local community. In fact, success depended more on community input than it did on academic input. This transdisciplinary scholarship was also done on a shoestring budget.

2.1 Transdisciplinary Approach to Revegetating Bare Soil

Haitians living in IDP (internally displaced persons) camps were in survival mode, and might not have had the luxury to contemplate and appreciate the importance of ecosystem services. However, engaging members of this society would be crucial for the success of ecosystem restoration projects. I used a strategy of providing immediate benefit to the community, educating the community about the importance of vegetation, and engaging the community through music. Vetiver grass,

Chrysopogon zizanioides, has properties that I thought would make it a good candidate to plant in the IDP camp [12] (Greenfield 2008). However, I did not know where to find the plant or how to propagate it. I did not have a plan for this project, but rather did it on the fly, and adapted as opportunities arose or barriers were encountered. Local community members showed me where a source of vetiver grass could be found, and an agricultural expert in the camp taught our team how to harvest and transplant vetiver. Vetiver grass does not propagate well by seed, so labor-intensive transplanting of culms was required. Having a translator was crucial for the success, as I do not speak Kreyol and the agricultural expert and the majority of our work crew did not speak English. I had no budget for the labor-intensive project, but local community members introduced me to the staff of Catholic Relief Services who provided tools and labor through their pay-for-work program. The local community became increasingly interested in the project as they learned about the economic potential of vetiver in terms of ecosystem services and marketable products. Blades of vetiver can be used as fuel, roofing material, and crafts and root oils are medicinal and valuable in the perfume industry. They also appreciated that the plant was making their camp look better, and the vegetation could provide some ecosystem services such as soil stabilization, aquifer recharge, and watershed protection. The community buy-in for the project resulted in the creation of a camp vetiver committee that continued to transplant vetiver grass after I returned to the US. J/P HRO who managed the camp asked that I make a short documentary about the project to be used in promotional material [13] (http://www.youtube.com/watch?v=DnigmTVIbtk).

The vetiver grass established very well in low traffic areas, but did not survive well where it was trampled. On return trips, I witnessed the vetiver grass benefiting the community in unforeseen ways. Some people planted edible vegetation such as squash among the vetiver, with vines growing up the vetiver as a trellis. People would spread wet laundry over clumps of vetiver to dry. The land owner would plant vetiver as families were moved out of the camp to prevent other people from occupying the vacated space [14] (O'Toole 2012). Some of the vetiver was cropped close to the ground, but I could not determine if this was due to it being cut by people or eaten by goats, cows, or pigs. 2.5 years later, the camp has a smaller human population as families relocate, but the vetiver grass remains growing well. Therefore, vetiver can be a valuable, renewable, sustainable crop that can restore ecosystem services when managed properly. However, in the absence of land-tenure and good management practices, vetiver is often poached and its roots are rinsed in streams. This practice disturbs soils, encourages erosion, and increases sedimentation in streams.

My engagement with community members proved to be very important. I sensed that there was initial skepticism about what I was doing and/or my intentions during early meetings, just as Jahn et al. had noted. Persistence, hard manual labor, social interaction with the community through music and athletics, and sincere caring resulted in me being accepted into the community. In evenings, I would take a guitar into camp and play with the community. Local musicians would join me and people would sing and dance. Music is very important in Haitian culture, and musicians are held in high regard. When local musicians became my friends, I gained credibility among other community members. When working in other cultures, even if language barriers exist, it helps to engage the community through common interests. Music is but one example of an interest shared by all people regardless of culture. Good food, clean water, aesthetically-pleasing settings, dance, love of children, spirituality, and play are a few examples of other activities shared across cultures. During subsequent trips to Haiti, I lived in the IDP camp with Haitians rather than among other expatriates. This made a large impression on community members as demonstrated by the agricultural expert who assisted in the vetiver planting project. He stated through a translator that "I once thought white men did not love Haiti, but now I know that is not true because you lived like us."

My efforts in Haiti are embryonic, and are following a loose plan to partner with as many experts, leaders, community members, and friends who share a common vision of empowering Haitians to rebuild a thriving, sustainable society. I was well into these efforts before I realized that what I was doing fell under the category of transdisciplinary scholarship. The observations reported here are early, and will be updated in the future.

As with many academic units, my department has a traditional rewards system that focuses on publica-

tions, and did not have a mechanism to reward the transdisciplinary scholarship described here. Rather than incorporate the transdisciplinary scholarship into the existing roles and rewards of faculty, I was directed to start a non-profit to work in Haiti. I founded "Yon Sel Lanmou" in summer 2012 to formalize my efforts in Haiti. Ecosystem restoration and environmental justice are two foci of Yon Sel Lanmou, whose overall mission is to use love to create a thriving, sustainable society in Haiti. The players involved in these efforts include the seven directors of Yon Sel Lanmou (four are fluent in Kreyol, two are Haitian, one is an American who has lived in Haiti since 1985, and one is an American who was raised in Haiti, but now lives in Denver), agriculturalists, teachers, students, musicians, foresters, land owners, the Ministry of the Environment, volunteers, businessmen, politicians, artists, health-care workers, humanitarians, and scientists.

2.2 The Role of Arts in Transdisciplinary Scholarship: STEM to STEAM

My experiences in Haiti have reinforced the importance of the current movement to transform the STEM disciplines (Science, Technology, Engineering, Mathematics) into the STEAM disciplines (STEM + Arts). The arts can play a crucial role in transdisciplinary scholarship. Video has been used to educate others about the vetiver project and music helped me connect with the community. I was originally inspired to volunteer in Haiti because of a scene in Spike Lee's documentary "When the Levees Broke" that showed Sean Penn rescuing victims of Katrina. Mr. Penn was not acting in this movie; he was just a celebrity with a boat, saving lives. I probably would not have traveled to Haiti if I had not seen Mr. Lees documentary. I was fortunate to work with Sean Penn's non-profit during my first two trips to Haiti. Mr. Penn is now an Ambassador in Haiti, as is film-maker Alison Thompson, who is Ambassador to the Ministry of the Environment. Yon Sel Lanmou is working with Ambassador Thompson and the "Billion Tree Initiative" to reforest large parts of Haiti. We all share the use the arts to engage the community and inspire change. The Directors of Yon Sel Lanmou include a film-maker and four musicians. In fact, Yon Sel Lanmou, which means "One Love" in Kreyol , is the first Kreyol phrase that I learned while singing with community members. Yon Sel Lanmou has hosted concerts to raise awareness and funds for projects in Haiti. We hosted a Haitian band that toured the US in Fall 2012, which brought people interested in Haiti together. My band, other Denver bands, and the Haitian band "2 Roots" performed at the 3rd Annual Haiti Benefit concert in Denver. Concerts and events resulted in networking among scientists, health professionals, academics, artists, politicians, administrators, philanthropists, educators, businesses, and non-profits that are already generating partnerships.

I was recording rappers in camp shortly after the cholera epidemic began. They wanted to make a song to serve as a public service announcement about preventing the spread of cholera. Yon Sel Lanmou made a music video to the song that promotes hand washing, drinking and cooking with clean water, properly disposing of waste, and seeking medical attention when symptoms occur [15] (http://www.youtube.com/watch?v=-K2aVYKLZxQ). I don't consider these kinds of activities as research because no new knowledge is generated. However, it is scholarly, transdisciplinary, and contributes to creating a sustainable society. In Jan. 2013 I asked a public health expert in Haiti why the cholera situation had improved. He responded that it was because of education about hand-washing, drinking clean water, cooking with clean water, and proper waste disposal. Yon Sel Lanmou is partnering with other artistic groups, including YouthOnRecord.org and Playing for Change. Many leaders among the groups that we work with are artists. Haiti's current President Michel Joseph Martelly was a popular Kompa singer.

Being knowledgeable, adaptive, opportunistic, credible, authentic, reliable, ethical, non-judgemental, caring, and kind has served me well in Haiti to date. These traits would likely translate well to other settings. I have at times been naïve, generous, gullible, and stubborn: these traits have served me well in some situations, and have been handicaps in other situations. Good translators are crucial for the success of transdisciplinary projects. I know I would be more effective if I spoke Kreyol, but progress towards becoming fluent in the local language is slow. The work in Haiti has been the most challenging of my career, but it has also been the most stimulating and rewarding.

3 The Term "Scholarship" vs. "Research"

If one considers transdisciplinarity as a scholarly approach (sensu Boyer) rather than a research approach, then unnecessary barriers between the natural sciences, social sciences, and society are lessened. As "researchers" become "scholars", the difficulties of integration identified by Jahn et al. will lessen as scientists practice the scholarship of integration. The general definition of transdisciplinarity provided by Jahn et al. can be easily integrated with Boyer's Model of scholarship by changing one word. Their definition becomes: "Transdisciplinarity is a critical and self-reflexive *scholarly* approach that relates societal with scientific problems; it produces new knowledge by integrating different scientific and extra-scientific insights; its aim is to contribute to both societal and scientific progress; integration is the cognitive operation of establishing a novel, hitherto non-existent connection between the distinct epistemic, social-organizational, and communicative entities that make up the given problem context." I encourage others to read the overview of Jahn et al., and to replace "research" with "scholarship" as you do so. Integrating a broader definition of scholarship with transdisciplinary research can help researchers, non-researchers, natural scientists, social scientists, community leaders, community members, and other stakeholders work together more effectively.

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