

INTRODUCTION

REVOLUTIONS IN SCIENCE AND THE ROLE OF SOCIAL SCIENCE LIBRARIES

Steven W. Witt

The moment for grand-scale organizational transformation is approaching (Wallerstein, 1991)

Real problems of society do not come in discipline shaped blocks (Roy, 1979)

INTRODUCTION: THE ROLE OF SOCIAL SCIENCE LIBRARIES IN FOSTERING RESEARCH COMMUNITIES

Libraries and information services have always been closely intertwined with the social structures that facilitate research and knowledge production. By their nature, libraries serve broader organizational or cultural missions and thus must in some manner simultaneously reflect the logic of the structures in which they are embedded while anticipating future needs and imperatives. Social science libraries, whether they exist within a strictly academic setting or support research and dissemination in any number of specialized governmental or corporate settings are not exempt from maintaining such a balance. In a non-complex world, where problems remain the same and organizational structures are neither fluid nor permeable, collections, services, and the notion of a user community is straightforward. Knowledge production and the structures of inquiry that social science libraries support, however, are by their nature complex and ever changing.

This complexity is evidenced by the growth of new fields of scholarship and research that libraries and librarians within the social sciences are called upon to support. How does one develop the parameters for building a collection to support Sustainability Research? In what department will one find students and researchers involved in Refugee Studies? How does a librarian effectively disseminate information and data from the multiple fields that conspire to inform Global Studies research?¹

This continued growth of interdisciplinarity and problem centered research that both challenges and draws upon the strengths of academic structures presents social science libraries with new opportunities to develop structures for collection building, services, and the organization of knowledge that don't simply reinforce or mirror institutional structures as they are currently codified

in the academic world. If libraries and professional practices are truly going to reflect the nature of the knowledge production they support, then one of the areas of increased focus needs to be changes within the paradigms of science and the logic of the paradigms themselves. As Kuhn notes, “one central aspect of any revolution [in science] is that some of the similarity relations change. Objects that were grouped in the same set before are grouped in different ones afterward and vice versa” (Kuhn, 1996, p. 200). In order to remain relevant to the organizations and scholars that libraries support, librarians need to be able to map and anticipate new interdisciplinary or problem focused research communities. This will allow libraries to not only support critical new areas and forms of research but to also challenge the logic of organizational structures and facilitate the paradigmatic shifts central to problem solving and knowledge production.

Through an exploration of interdisciplinarity and transdisciplinarity, this chapter provides suggestions for ways in which social science libraries can better map and anticipate new interdisciplinary or problem focused research communities in order to serve the needs of researchers and aid in dissemination of knowledge to new groups.

DISCIPLINARITY, INTERDISCIPLINARITY, AND COMPLEX PROBLEM SOLVING

Readings on disciplinarity suggest that disciplines focus research within a single paradigm, while paradoxically striving to expand their authority and domain. This complicates the use of disciplines as the unit of analysis for mapping research communities and developing services to support them. These difficulties are made clear through a review of literature on disciplinarity and interdisciplinarity.

Traditionally, science and inquiry within the academic disciplines are focused on small or esoteric problems in order to “investigate some part of nature in detail and depth that would otherwise be unimaginable” (Kuhn, 1996, p. 24). This rationale forms the basis for disciplinary thinking and drives the organization of scientific communities into disciplines. As Kuhn and others note, these structures serve a valuable function in maintaining the preconditions for research, which includes structures to ensure funding, dissemination, and the training of new scholars to continue work within the discipline. Without the shared knowledge, rigor, and avenues that disciplines provide to support and disseminate research, it is impossible to imagine the explosion of knowledge that humans have experienced in the past century.

As organizations, however, disciplines are also inclined to support and serve the social structures from which research communities emerge. This social layer creates an added level of complexity through which the logic of discipli-

nary objectives has the power to supplant the problem that originally informed the discipline. As Salter and Hearn note, disciplines also serve as registers which dictate “the manner in which information is understood, arguments are marshaled, and issues are discussed” (1997, p. 23). These disciplinary registers are characterized by a dominant set of methods or a paradigm; institutional recognition through departments, conferences and journals; a self-identified community; and methods of disciplining community members (Salter and Hearn, 1997).

Others take a more provocative approach to disciplinary behavior and its impact on knowledge production. Gieryn characterizes disciplines as protecting their boundaries from both inside and outside of the academy by expanding their domains of authority, monopolizing knowledge and resources, and protecting its members from external scrutiny (1983). Damrosch uses of the metaphor of free market competition among nation states to depict disciplines in a state of constant competition for ideas, eroding the sense of communities of inquiry and fostering greater divides amongst the disciplines (1995).

Although the disciplines have erected strong mechanisms of control to sustain work in a problem area, scientific inquiry lays the foundation for disciplinary change. Klein attributes this constant state of change to six drivers of permeation:

1. the epistemological structure of a particular discipline
2. relations with neighboring disciplines
3. the pull of powerful or fashionable new tools, methods, concepts, and theories
4. the pull of problem-solving over strictly disciplinary focus
5. the complexifying of disciplinary research
6. redefinitions of what is considered intrinsic and extrinsic to discipline (Klein, 1993, p. 187).

Klein’s analysis of the permeation of disciplines highlights the paradoxical role that the disciplines play in creating increasingly miniscule research problems and their accompanying new disciplines while simultaneously fostering more cross-disciplinary exchange through the drawing of new borders to be protected and crossed. The nature of disciplines as described by Klein and others suggests an internal structural weakness that has the potential to inhibit work on complex problems that do not fit within one domain. As Roy notes in his plea to develop permanent interdisciplinary units on campuses dedicated to social problems, “real problems of society do not come in discipline-shaped blocks” (1979, p. 165).

Research on interdisciplinarity focuses largely on knowledge production and organization as it occurs outside of the traditional disciplines. As alluded to by Roy, interdisciplinarity is often seen as the optimal approach for fostering research that draws from the knowledge produced by disciplines to focus upon

societal problems such as climate change, health, and food security. This makes understanding interdisciplinary practices and scholarly communications a key ingredient to learning more about how research problems and communities evolve.

Salter and Hearn (1997) provide a good map of interdisciplinarity as it is practiced and viewed by its practitioners. These are broken down into three forms: an instrumental view of knowledge, new synthesis of knowledge, and critical interdisciplinarity. The *instrumental view of knowledge* is problem centered and responds to external demands. This represents research and structures such as thematic research centers advocated by Roy, which don't challenge existing paradigms and draw upon disciplines for expertise. *New synthesis of knowledge* challenges existing structures by developing novel conceptual frameworks and methodologies, leading to a new discipline. *Critical interdisciplinarity* views both as trapped within the logic of disciplinarity and operating under disciplinary control mechanisms when classifying and categorizing interdisciplinary work.

Woven through these three types of interdisciplinarity is the core of scientific inquiry: problem solving. Much of the research on interdisciplinarity focuses on the role of interdisciplinary research in addressing problems that exist beyond the confines of Kuhn's "Normal Science." Mote's research on the information needs of scientists paves the way for understanding interdisciplinary research as a means to solve complex problems that fall outside the limits of a single subject. Mote identifies three groups of scientists, each working within wider and increasingly variable subject areas, arriving at the third group, through which information must be synthesized from a non-organized literature that relies upon more than one specialist literature (1962, p. 171). Although Mote does not address interdisciplinarity directly, he concludes that these researchers need more informational support and thus require more resources by virtue of their existence outside the disciplinary support structures that sustain the organization of literature and research.

As reported by Klein, research on interdisciplinary and knowledge production later yields conclusions similar to Mote's. Reynolds' three types of problems overlap with Mote's while adding "*problems of the third kind*", which are "generated increasingly by society . . . and [call for] policy-action results [or] a technicological quick fix (Reynolds in Klien, 1999, p.13). These paradigms of interdisciplinarity fall within the traditional social framework of science through which interdisciplinary work is carried out amongst the disciplines.

Gibbons, however, articulates a level of research that is abstracted one level further from what might be seen as traditional interdisciplinarity. Often characterized as transdisciplinarity, Mode 2 knowledge production again mirrors Mote and Reynolds yet adds another layer of complexity by theorizing upon a means of knowledge production that not only focuses on problems driven by social need but also includes the emergence of new non-university/non-

disciplinary actors in identifying problems, finding solutions, and articulating research based policy (Gibbons et al, 1994; 2006). This new research paradigm represents a shift away from disciplinarity and even interdisciplinarity by breaking down traditional boundaries between science and society and creating new configurations of research and accountability that even moves beyond the university-corporate-government structure (Etkowitz, 2007).

PROBLEM SOLVING RESEARCH

Research on complex social problems falls within much of what is described as Mode 2 (M2) knowledge production. In the social sciences, the emerging academic area known as Global Studies is an example of scholarly activity that shares many M2 qualities. Global Studies attempts to marshal research, teaching, and even advocacy around global social problems ranging from climate change, human security, sustainable development, and role of the rule of law in governing at a global level. Global Studies often uses the world's population or the phenomena of globalization as a unit of analysis through which to either understand the global dimensions of a problem or determine a means through which a global society is conspiring to develop a solution. Often this is carried out explicitly to inform or advocate for a social outcome or policy position. For example, a topic such as the viability of biofuel production as a replacement for fossil fuels in the context of "global studies" would rely upon the synthesis of knowledge from chemical engineering, agricultural economics, sociology, anthropology, political economics, and area studies. Research methods might combine the use of large data sets for econometric analysis on the real cost of production with deep case studies that document the societal and cultural effects of the displacement of rural economies and traditional food sources. The results of such research might be policy advice on how to best implement technologies taking into account the transnational impact on culture and economies in regions that are seemingly removed from the technical, scientific, problem. Research of this type has all of the hallmarks of the M2 paradigm; Global Studies knowledge discovery is trans-disciplinary, oriented to the solution of an applied problem, distributed across academic and non-academic research communities, and subject to use and analysis by actors from multiple disciplines and organizational settings (Gibbons, 1994).

Given our knowledge of disciplinarity and interdisciplinarity, research of emerging scholarly fields such as Global Studies are of potential merit for examining empirically the organization of communities and knowledge within the M2 framework in order to better understand the broader implications of this kind of research on the library collections, services, and the organization of knowledge.

Problem based research areas such as Global Studies share few qualities with a traditional discipline. These fields of inquiry do not focus on a discrete

or small problem or domain of knowledge, but rather on solutions to problems that encompass other broad domains such as the global population as a whole. There may also be no faculty trained in the area and few structures that yield disciplinary identity or allegiance; journals may be few and degree programs only emergent if existent at all.

As interdisciplinary fields, these problem centered areas would fall within both the instrumental view of knowledge and a critical, transdisciplinary perspective. Research relies upon borrowed methodologies and synthesis from large domains of knowledge. Many also fall into Klien's category of exogenous interdisciplinary knowledge since research problems are created by the real societal problems (1996). This suggests that many of these new areas trend toward the transdisciplinarity that Gibbons attributed to M2 knowledge production.

The methods and disciplines used in any given problem may vary depending on the problem and the way in which the question is framed. Looking at climate change, one may focus on global governance issues that arise from multi-country talks, another may look at global governance from the perspective of the power of civil society to affect policy, and another may focus on variants by which agricultural communities respond to global warming. Each is attempting to answer the question of how humans as a global society respond to climate change.

Research in these domains also tends to be socially distributed. The research community may include multiple institutional, national, and organizational actors that reside within and without the traditional academic based scientific community. This broad network from which to draw and communicate places the mechanisms of control outside of the disciplines and creates the potential for a dynamic system of accountability.

The complexity presented by M2 knowledge production oblige us to re-think how collections are developed and to whom services are focused, requiring new methods of identifying and conceiving users and knowledge organization.

RE-GROUPING PROBLEM BASED DISCIPLINES

The characteristics of transdisciplinary research presents problems in mapping and measuring its research communities. Identifying these communities relies less upon mapping disciplinary structures or institutional practices and more on mapping and exploring the "self-organized ecologies" or "individual constituencies" that emerge around complex problems (Van Raan, 2000; Palmer, 2001). Our knowledge of the difficulties that scholars have in importing and exporting information between scholarly communities also creates a paradoxical situation (Palmer, 2001, p. 125). How does one identify, measure, and analyze an inter/trans-disciplinary group that is not self-identified and operates at an organizational disadvantage? How do libraries justify funds, provide ser-

vices, develop collections, or even identify users in a research community that only exists marginally when viewed through the traditional disciplinary structures? The first step is to map or re-organize research groups to form interdisciplinary or transdisciplinary communities.

Van Raan describes three analytical approaches to studying interdisciplinarity. These include the “research activity profile”, which focuses on a group or institute to break activities down into subfields; “the research influence profile”, which focuses on works that cite a research group / institute; and “the construction of bibliographic maps”, which rely upon co-currence analysis to identify structural relations to expose “*self-organized ecologies*” (2000).

The use of purely bibliometric tools to analyze social connections within research communities points back to Small and Griffith’s work in 1974 to identify academic specialties that constitute disciplinary subfields. Small and Griffith’s approach is still employed to cluster research specialties and applicable to learning more about the nature of M2 research.

Schummer’s research on patterns of research in nanotechnology, provides various rationales and descriptions of four bibliometric approaches, which include co-currence, co-classification, journal classification analysis, and citation analysis (2003). He concludes that the use of co-author, a type of co-currence analysis, allows one to map geographical, organizational, and disciplinary affiliations to “understand interdisciplinarity as a combined cognitive and social phenomena,” which is important in ambiguous fields. Similar uses of co-author analysis are used to identify and visualize M2 research groups (Perianes-Rodriguez et al, 2009).

In each of these instances co-author analysis is used to reveal social linkages among scholars across disciplines, organizations and regions. Although technically different, this method is similar conceptually to Crane’s approach to invisible colleges. Like Schummer, Crane uses individual linkages to draw social circles around groups of scholars connected across institutions and to some extent disciplines (1972).

Several articles in the May 2006 issue of *Entrepreneurship Theory and Practice* use co-citation analysis to overcome what is perceived by scholars as fragmentation of this research community and estimate the levels of convergence in research to determine whether the field is evolving into a scholarly discipline (Grégoire et al, 2006; Schildt & Zahra, 2006). This research, however, focuses largely on the use of bibliometrics to measure disciplinarity rather than the social phenomena the surrounds knowledge production around the problem of entrepreneurship.

Schwechheimer and Winterhager analyze the problem areas of climate research and retrograde amnesia in two studies that use keywords to cluster co-cited publications in order to expose new research fronts or “highly dynamic specialties,” following directly the work of Small and Griffith yet applying it to M2 problems (1999; 2001).

Heimeriks et al employ an elegant yet complex three tiered approach to studying the network and social dynamics of research areas, such as artificial intelligence and biotechnology, that are “characterized by heterogeneous collaborations between different actors, and by heterogeneous communications using an increasing number of different media.” Their methodology begins by building a journal-journal citation matrix based upon a key journal in the area to help represent the nodes, relations, and content within the field of research. Employing co-citation analysis and co-word analysis, content areas, organizational representation, and virtual linkages are then mapped to show how different organizations play the role of users, producers, suppliers and drivers of research in various networks that exist across sectors and countries (2003). This research provides a powerful model to consider, yet relies heavily upon quantitative analysis, missing opportunities to triangulate and deepen their understanding of the social dynamics and motivating factors driving this research.

The range of bibliographic or scientiographic methods employed to graph M2 knowledge production and their social milieu, allows for several routes to explore research on complex social issues. Each of the noted methods, with the exception of Crane, use almost exclusively quantitative methods to expose the social and organizational dynamic of the problems on which they focus. Studies such as these provide a framework from which to begin rationalizing collection strategies, developing bibliographies, or even identifying research communities to which target information dissemination.

CONCLUSION

Continuing to develop our understanding of interdisciplinarity and the manner by which new research communities emerge is the first step in facing the challenges that new and emerging research problems and disciplines pose to libraries and services. As Palmer notes, it is also essential to learn more about how information is used in the context of problem based research (1996). To do this librarians need to insinuate themselves into research communities to gain access to research groups as they emerge and work within these communities to develop the resources, data, and services to support new modes of inquiry and research on complex problems that reside outside of the disciplines.² By doing this, “librarians can provide essential boundary services . . . by actively disseminating work across domains and helping to link scientists to others who have complementary expertise.” (Palmer, 1996, p. 186).

Providing boundary services embeds librarians into the research process and reinforces the role of librarians as an intermediary of knowledge. It also enables librarians support what Wallerstein characterizes as “a social science that feels comfortable with the uncertainties of transition” (2001, p. 256). In essence,

it positions social science libraries to participate in the process of organizational and structural change rather than reacting to or inhibiting it.

NOTES

1. For research on interdisciplinary collection development and services see: Wilson, M. C., & Edelman, H. (1996). Collection development in an interdisciplinary context. *The Journal of Academic Librarianship*, 22(3), 195-200; Searing, S. E. (1996). Meeting the Information Needs of Interdisciplinary Scholars: Issues for Administrators of Large University Libraries. *Library Trends*, 45(2), 315-42; and Dobson, C., Kushkowsky, J. D., & Gerhard, K. H. (1996). Collection evaluation for interdisciplinary fields: A comprehensive approach. *The Journal of Academic Librarianship*, 22(4), 279-284.
2. See chapters throughout this volume on disciplinarity and organizational shifts, data services, and social networks that explore further case studies and analysis of library programs that attempt to these knowledge organization and dissemination needs that social science libraries can address.

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BIOGRAPHICAL STATEMENT

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