

Finding That Special Someone: Interdisciplinary Collaboration in an Academic Context

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As research collaboration in academia has increased over the past century, so has collaboration across disciplinary boundaries, particularly in LIS, a field that has long been viewed as highly multidisciplinary. This increase is driven by the pressures on faculty seeking career advancement and by the challenges faced by the scientific community that require teams of researchers with diverse, complementary skills. Finding solutions to today's research problems can require increased integration of research, leading to a move from multidisciplinary to interdisciplinary research. This work examines collaboration as it is studied from several disciplinary perspectives to lay the groundwork for a better understanding of interdisciplinary collaboration and the challenges it presents. It also provides a pathway for LIS educators to harness the benefits of interdisciplinary collaboration and to advance research and teaching in the field.

Keywords: academic collaboration, collaborative instruction, interdisciplinary collaboration, LIS education, literature review

We cannot order collaboration. This is not a dictatorship. Moreover, while shotgun marriages sometimes turn out surprisingly well, shotgun collaboration is a contradiction in terms. And no amount of artificial organization, no joint institutes, or combined reviewing committees, or joint directors, will come within the squirting range of a syringe of getting at the heart of the matter. (Bush, 1957, p. 53)

Introduction

From the Moon landing to mapping of the human genome to current attempts at proving the existence of Higgs boson, the ground-breaking scientific achievements of recent decades are the result of combined efforts of multiple scientists with diverse backgrounds. This is the culmination of a research paradigm that has

evolved from solitary scientists toiling alone to one where groups of scientists with different backgrounds work together in concert (Beaver & Rosen, 1979; Price, 1963).

Across the various scientific disciplines, the average number of authors per paper steadily increased from 1980–1998 (Glanzel, 2002). In science and engineering, including the social sciences, scientists are working together even more, with the proportion of single author works dropping by half from 1975 to 2005 (Jones, et al., 2008). Similarly, the field of LIS has seen a corresponding increase in multidisciplinary scholarship, with Odell and Gabbard (2008) showing a 14% increase in other fields' citations of LIS journals in the period 1996–2004 when compared to 1974–1996. This has been accompanied by an increase in the hiring of tenure-track faculty from disci-

plines not considered to be traditionally LIS focused (Bonnici, Subramaniam & Burnett, 2009). LIS has a tradition of multidisciplinary research, with strong ties with fields such as Computer Science, Business & Management, and Medicine, along with weaker ties to Psychology and Engineering (Odell & Gabbard, 2008). This change in research paradigm is influencing LIS education, shifting the focus from discipline-based to problem-based education (Druin et al., 2009; Lørring, 2007; Moss & Ross 2007; Ribiero, 2007). While LIS has a predisposition for interdisciplinarity, it has not always had the best integration within its own diverse scholarly communities (Saracevic, 1999).

Collaboration between researchers as a means of advancing scientific research is a crucial factor as the scientific community now faces what Omenn (2006) describes as *Grand Challenges*. There are research goals that require the combined efforts of several scientists and engineers from several domains, each providing complementary expertise. Examples of Grand Challenges include how to address local and regional climate variability in environmental science, how to create new vaccines in health science (Omenn, 2006), how the brain produces mental activity in neuroscience (Altevogt, et al., 2008), and of what dark matter is comprised (National Science and Technology Council, 2004). Encouragement for this kind of collaborative research has been stepped up by US federal agencies mandated to promote the growth of science. The National Science Foundation (NSF) places a strong emphasis on cross-institutional, interdisciplinary collaboration when awarding grants (National Science Foundation, 2006); one of the four pillars of the National Institutes of Health (NIH) Roadmap for Medical Research is to “change academic culture” to foster collaboration (National Institutes of Health, 2005, para. 2). LIS researchers need to be aware of this change in the funding dy-

namic, and the decrease in the funding available for pure LIS research (McNicol, 2003).

Given this move toward interdisciplinary collaboration, this article is written with the purpose of presenting collaboration both from the perspective of LIS and from that of disciplines outside of LIS. The objective is to create a common understanding of collaboration and what it means to be interdisciplinary. In addition to LIS, the main literatures examined here are organizational science, education, public policy management (PPM), sociology, and computer supported collaborative work (CSCW). The following sections present various disciplinary perspectives on collaboration, clarify what it means to do interdisciplinary research, discuss some challenges of interdisciplinary collaboration, and how to address them, and finally offer a discussion of the implications for the teaching of LIS.

Coordination, Cooperation, and Collaboration

Not all activity that involves a group of individuals can be deemed collaboration. Maienschein (1993) provides the example of museum collection development, where collectors who work together to build the museum’s collection co-labor, but as they do not participate in defining the task, the activity cannot be considered “collaboration.” Thus, to be considered a collaborator, one must, at some point in the activity, “participate in articulating the goal” (Maienschein, 1993, p. 170). Mattessich, et al., (2001) also stress “a commitment to mutual relationships and goals” (p. 59). This concept of joint authority will be one distinction that narrows the focus on the behaviors that will be considered to be collaboration in the model proposed here. Typical terms associated with individuals working together are *coordination*, *cooperation*, and *collaboration*. Table 1 highlights the

distinctions drawn in the literature among the three types of behavior.

Moving across the spectrum from coordination to collaboration, the relationship between the parties becomes more integrated. This is particularly signifi-

cant in the case of authority and benefits, which are increasingly shared. It is noted that the distinctions between these terms are largely drawn on only in an organizational science context (e.g., Himemelman, 1996; Mattessich, 2001).

Table 1: Coordination, Cooperation, and Collaboration.

		Coordination	Cooperation	Collaboration
Organizational Science	Himmelman (1996)	Exchange of information	Exchange of information	Exchange of information
		Activities for mutual benefit	Activities for mutual benefit	Activities for mutual benefit
		A common purpose	A common purpose	A common purpose
			Sharing of resources	Sharing of resources
				Enhancing the capacity of another
			Informal	More formal
Organizational Science	Mattessich et al. (2001)	Little risk	Risk	Increased Risk
		No need for common structure, mission, or planning	Some planning and division of roles	Creates a new structure
		No need for common mission	Understanding of compatible missions	Commitment to a common mission
		Information shared as needed	Communication channels are established	Requires comprehensive planning and well-defined communication channels on many levels
		Authority is retained by each organization	Authority is retained by each organization	Authority is determined by collaborative structure
		Resources separate	Resources available to all participants	Resources are pooled
		Rewards separate	Rewards are mutually acknowledged	Rewards are shared
				Shared rules, norms, and structures
				Concerted action
				Well defined relationship
LIS	Iivonen and Sonnenwald (2000)		Mutually beneficial	
			Shared meaning and goals	
Education	Hoyt (1978)		Separated	Shared responsibility
			Autonomous	Shared authority
	Montiel-Overall (2005)	Focus on logistics	Focus on responsibility	Focus on joint planning and integration

Lacking contractual definitions, the expectation might be that research on collaboration between individuals would employ less rigid definitions of collaboration than one would find in an organizational setting. This is not, however, necessarily reflected in the difference between definitions of collaboration used in research in organizational settings versus those used in academic settings. Consider that from an organizational behavior perspective, Mattessich et al. (2001) defines collaboration as “a mutually beneficial and well defined relationship entered into by two or more organizations to achieve common goals” (p. 4). Whereas, from an information science perspective Sonnenwald (2007) defines collaboration as “human behavior that facilitates the sharing of meaning and completion of activities with respect to a mutually shared superordinate goal and which takes place in a particular social, or work, setting” (p. 3). Contrasting the definitions used in these highly cited works, it can be seen that the first definition is no more rigid or constrained than the second. The lack of definable relationship can have adverse effects. Fox and Faver (1984) point out that collaboration between individuals may be “frequently stressful because relationships are informal, responsibilities unspecified and commitments uncertain” (p. 8).

On the opposite end of this spectrum, quantitative studies, such as those that use citation data to analyze collaborative behavior, use a very narrow definition of collaboration. Based on contribution to the output of the collaborative process, frequently the benchmark for what is considered collaboration is co-authorship (Bozeman & Corley, 2004; Katz & Martin, 1997). While this type of definition focuses on the end result of the collaboration, it ignores the process that brought it about. This definition is somewhat artificial, but not uncommon when working with these data. This type of research requires assumptions of this na-

ture, the foremost used in the field being that higher citation counts are associated with greater quality of research (Avkiran, 1997; Chung, et al., 2009; Herbertz, 1995; Lawani & Bayer, 1983).

Studies of collaboration among individuals do not usually make the distinction between coordination, cooperation, and collaboration. Hara (2003) notes that these three terms are used “intuitively and interchangeably” (p. 953). Thomson and Perry (2006) find no clear agreement in the literatures of organizational science or network theory on the differences between cooperation and collaboration beyond the general theme that collaboration is a “higher order of collective action” (p. 23).

Thus, there is a wide body of literature from which to choose a definition of collaboration, yet no consistent definition of collaboration has emerged (Thomson & Perry, 2006; Wood & Gray, 1991). Most studies use a definition that is suitable to their context. Even though the structure and formalization of collaboration is less explicit in some contexts than others, one theme that is consistent across these definitions is that simply working toward the same goal is a necessary, but not sufficient, condition for an activity to be defined as collaboration.

For the purpose of bounding the behaviors that will be deemed to be collaboration within this work, we use the following definition of collaboration, which combines the structure of the definition used by Sonnenwald (2007) with the contextually-relevant aspects of Katz and Martin (1997). The specifics that delimit the amount of contribution necessary to be considered a collaboration without putting limits on the nature of the collaboration beyond having a research focus is adapted from Katz and Martin (1997) to focus on the academic context: human behavior that makes a substantial contribution toward the advancement of a research project throughout its duration or for a large part of it, with respect to a mutually

shared superordinate research goal and which takes place in a research setting.

Having put forth a definition of collaboration, the next section examines what it means to collaborate across disciplinary boundaries, an endeavor that adds another level of complexity to collaborative behavior.

Interdisciplinary Collaboration

Prior to presenting a definition of interdisciplinary research, it is necessary to define what is meant by a discipline. Miller and Mansilla (2004) suggest that a disciplinary perspective is that which is "based on commitments to a theory system, profession, discipline, or discourse community" (p. 4). Repko (2008), in the context of interdisciplinarity, defines a discipline as "a particular branch of learning or body of knowledge whose defining elements—i.e., phenomena, assumptions, epistemology, concepts, and methods—distinguish it from other knowledge formations" (p. 4). However, he goes on to add that as disciplines evolve over time based on social and cultural forces, they split up or merge to form new disciplines and sub-disciplines. At any time there may exist disciplines that have clear demarcations as to where their boundaries lie and others where those demarcations are less clear. The growth of disciplines across time can be seen in the changes in the taxonomies used to classify them. The Classification of Instructional Programs (CIP) is a taxonomy used by the National Center for Educational Statistics (<http://nces.ed.gov/>) to classify academic disciplines in post-secondary educational institutions in the United States. The taxonomy was most recently revamped in 2000, increasing the number of categories from 1458 to 1580. Thus the notion of what can be considered a discipline is one that evolves over time with existing disciplines splitting by becoming more narrowly defined or with increased research across disciplinary boundaries creating

new disciplines. Keeping in mind that disciplinary boundaries are not set in stone, we next move on to discuss the nature of collaborating across boundaries.

There are several terms used to describe collaborative research that spans more than one discipline: multidisciplinary, cross-disciplinary, interdisciplinary, and trans-disciplinary. These terms are sometimes used interchangeably. However, it is useful in the context of this work to elaborate the differences. Hatterly (1986) makes the distinction that interdisciplinary research is a more integrative process than multidisciplinary research and requires more accommodation and communication on the part of its participants. Newell (2001) makes the same distinction based on integration, where interdisciplinary research is research that integrates insights across disciplines to synthesize new knowledge; if there is no integration then the research is considered to be multidisciplinary. The Committee on Facilitating Interdisciplinary Research, put together by the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, (2005, p. 26) defines interdisciplinary research as:

a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.

Thus, a defining characteristic of interdisciplinary research is that it is integrative. Multidisciplinary research takes insights from two or more different disciplines surrounding a common problem, but there is no integration of theory or methods of the two disciplines. From an educational perspective, Haynes (2005) draws the distinction between inter-, multi-, and cross-disciplinarity. For the

purposes of linguistic simplicity, the following is from the viewpoint of only two disciplines engaging in collaboration, but the ideas hold for multiple disciplines. She highlights multidisciplinary work as having less synthesis of the various disciplines, with cross-disciplinary work having a one-way integration of the methods of one discipline into the other (but not vice versa), and only interdisciplinary work truly integrating the disciplines. Trans-disciplinary is more of a philosophical approach to research and takes this level of integration to its furthest point where disciplinary boundaries are no longer a consideration and all research is considered to be problem-based (Klein, 2004). Similar to Rosenfield (1992), we present a summary of the distinctions in the various types of research in Table 2.

The purpose is to illustrate that working with someone from a different field does not automatically make one's work interdisciplinary. If there is no integration between the disciplines, embodied by a borrowing of theories, tools, models, and methods (McNicol, 2003), then the work is multidisciplinary. To meet new research challenges we need to move to a higher tier of research (Gilbert, 1998). However, this is not without its own problems and risks, and the next section describes some of the

challenges, remedies, benefits, and drawbacks associated with interdisciplinary collaboration.

Aspects of Collaborations

We now discuss some aspects of collaboration that have been shown to have impact on the outcome of interdisciplinary collaboration. We then close with implications for LIS education based on what we have learned so far.

Conflict

Differing research interests are what bring interdisciplinary collaborations into being, but they also can be a source of conflict and stress. Researchers can have difficulty in collaborating if they are unable to find a common vocabulary (Bronstein, 2003; Thargard, 2006). Chen (1994) highlights that the problem of divergent vocabularies can occur between insiders and outsiders. Jeffery (2003), from observations of a cross-disciplinary research group, suggests this problem can be exacerbated if the group size is large, as that takes more interactions to build a common vocabulary.

Differences in disciplinary paradigms may also cause conflict. Typically this occurs when disciplines with a quantita-

Table 2: Types of Research.

Multidisciplinary	Low integration between disciplines; methods and perspectives provide separate insights on a problem (Hatterly, 1986; Newell, 2001; Haynes, 2005)
Cross-disciplinary	Some integration. Methods and perspectives of one discipline are employed by another to provide insights on a common problem or issue (Haynes, 2005; Repko, 2008)
Interdisciplinary	High integration. Methods and perspectives of each discipline is employed by the others to synthesize knowledge and provide insights a problem (Hatterly, 1986; Newell, 2001; Klein, 2004; Haynes, 2005)
Trans-disciplinary	Complete integration. Different disciplines work together to create a higher framework of knowledge that is common to all (Klein, 2004)

tive focus collaborate with those with a qualitative one. Here, since such disciplinary differences are likely known beforehand, if all parties enter the relationship with open, inquiring minds, then a lot of turmoil can be avoided. However, disciplines can also have very different ideas of what it means to engage in collaboration; the established paradigm of collaboration may be that of a group of equals in one discipline, whereas in another it may be one 'star' with others in a support role (Birnholtz, 2007). Some of these same structures of collaborative relationships can be seen in the approaches of collaborative teaching in the literature covered by Nevin, Thousand, and Villa (2009). Problems may arise when the collaborators may not know that they will encounter different collaborative paradigms, and are therefore unable to prepare themselves, and conflict may arise simply because the participants cannot relate to one another.

The conflicts created can be external to the collaboration as well. Academic institutions are structured by discipline and reward the individual. This is the polar opposite of what is required for interdisciplinary research (Brewer, 1999). This divergence may create tensions when engaging in interdisciplinary research as it may not be valued as much as disciplinary work (McNicol, 2003). Co-teaching can create conflict through such mundane issues as scheduling (not just the class time, but time for the instructors to meet to discuss and plan), or more serious issues arising from instructors' perceptions of loss of autonomy (Shapiro & Dempsey, 2008).

Mediation

Jeffery (2003) notes that having a mediator with knowledge across disciplines can diffuse some of the conflict described in the previous section. Butterfield, Reed, and Lemak (2004) studied stakeholder collaboration in

complexes housing nuclear weapons. This study highlights the importance of the leadership role in getting collaborative endeavors off the ground. Similarly, Wood and Gray (1991) and Gray (1989) comment on the role of the convener in a collaboration, who serves the same leadership function, except that the convener may be eternal to the collaboration. These authors come from an organizational science perspective. The leadership aspect may be less important in an academic setting when considering *collaborations in general*. Hagstrom (1964, p. 245) defines the professional scientist as "one who freely contributes his services; his commitments to his own goals mean that he is not easily deployed by others." Furthermore, researchers are likely to have significant self-motivation to collaborate as it is in their direct interests. However, when considering moving from a multidisciplinary paradigm to an interdisciplinary one, due to the potential for conflict described earlier, there may be a greater need for this type of convener, typically a senior member, who can motivate and mediate the collaboration.

However, bringing senior members into interdisciplinary collaborations can be challenging. One concern is that there may be difficulties in getting such senior faculty engaged in collaborative projects as publication rates have been shown to have a negative relationship the further away a researcher is from when they obtained their doctorate (Hill, 2008). Additionally, as researchers advance through their careers, their goals and motivations can change; in academia this is most important when going from pre-tenure to tenured. However, tenure is but one of many goals. Faculty may have numerous goals: teaching, influencing the field (Younglove-Webb, et al., 1999), learning new techniques, and prestige (Katz & Martin, 1997). Convincing a senior member to join an interdisciplinary collaboration may be challenging, but it will likely

increase the chances of a successful outcome.

In the context of the collaborative process of team teaching, this is an area where the inclusion of a librarian may help resolve some of these issues. Van Deusen (1996) elaborates several roles a librarian took on when part of a team teaching effort that helped the calcification and decision-making. She goes on to note that the nature of the librarian as both an insider and an outsider can help mediation. This may also translate into a research setting, where a librarian can have enough breadth of understanding to clarify issues and elicit compromise when conflict arises.

Assessing the Quality of Research

Any interdisciplinary research is the child of multiple disciplines, making an evaluation of quality a difficult task. Cummings and Kielser (2007) show that from a short term perspective the difficulties associated with coordination tend to reduce the benefits when the collaboration occurs across multiple institutions when compared to single institution endeavors, with the wider spread collaborations having poorer outcomes in terms of knowledge creation, student education, and spurring new collaborations. From a more qualitative point of view, interdisciplinary research is shown to produce a well-rounded result, but unsurprisingly requires more effort (Crow, Levine & Nager 1992; Russell & Flynn, 2000). Interdisciplinary research has been shown to produce higher quality research when citation counts are used as a measure of quality (Levitt & Thelwall, 2009) although there may be diminishing returns if the research is overly broad (Larivire & Gingras, 2010). Ultimately, evaluating such projects must be done on a case-by-case basis. Mansilla and Gardner (2003, p. 5) propose the following three criteria for the evaluation of interdisciplinary work:

1. Is the work consistent with the disciplinary backgrounds of the participants?
2. Is the work a coherent whole that reflects the disciplinary perspectives of the participants?
3. Does it advance the understanding of one or more fields?

Despite the difficulty in evaluating its outcomes, the current climate is one that values collaboration and believes it should be promoted. Next we discuss collaboration's impact on LIS education.

Implications for LIS Education

As a field, LIS has a long history of fostering multidisciplinary (Saracevic, 1992). A better understanding of interdisciplinary collaboration and what is presented here can help LIS educators, researchers, and practitioners to broaden their perspectives on the role of information in society, and lead to new and diverse ways to expand current curricula and practices in today's ever-increasing collaborative nature of the work environment. Collaborative teaching and collaborative learning are both means of providing students with early exposure to working in a collaborative paradigm. From the perspective of librarianship, the goals of being an instructional partner and working collaboratively to build a learning community set forth in *Information Power* (1998) are still relevant today. Donhan and Green (2004) show that if a long term approach is taken and given sufficient support from the administration, the role of the librarian can be that of the change agent who helps bring about this move to a more collaborative paradigm.

Collaborative teaching is a way to provide students with both a complete educational experience and at the same time instill in them a mental model of collaboration being a behavior that is practiced at

all levels, not just something that is forced down on them from on high. To achieve the fullest benefits of collaborative teaching requires considerable integration of practice, a task needing significant time, effort, and planning on the part of all those involved, between teachers (Henderson, Beach, & Famiano, 2009; Krushelnitskaya & Fleshler, 2009) and teachers and librarians (Montiel-Overall, 2007). Montiel-Overall (2005) describes a continuum of such interaction that ranges from coordination, cooperation, integrated instruction, to integrated curriculum, which demonstrates the same increasing integration seen in Table 2. Muronaga and Harada (1999) show that for a truly integrative collaboration, involvement from all parties is required in all phases, from design of modules to teaching and assessment. This approach can have very significant returns, but it is a long-term process that requires trust and buy-in from all parties. To achieve success, a majority of teachers will likely need to be trained in how to collaborate, to help them break out of isolated, individualistic approaches to teaching that they may consider the norm (David, 2008). The institution also has to understand that co-teaching does not mean half the work, and adjust the teachers' loads accordingly (Henderson, et al., 2009).

What are the learning advantages of promoting collaboration in student learning? As is the case with interdisciplinary research, collaboration can increase students' learning by bringing their individual strengths together into a stronger combined force, as well as preparing students to work in an increasingly collaborative work world. Exposing students to different research paradigms early can help engender open-mindedness and respect for others' intellectual backgrounds. On the other hand, supporting collaborative learning can lead to the instructor's partial loss of control over student learning, which can require the

adjustment of teaching methods and goals. Furthermore, teaching in a problem-based environment that is conducive to interdisciplinary learning is much more challenging than teaching in a traditional discipline-based one. Interdisciplinarity is not without its hurdles for the student as well. Graduate students pursuing an interdisciplinary path have found it takes longer to get established in their chosen field (Rhoten & Parker, 2004). Thus, any student attempting such a course of study needs be apprised of the challenges and provided strong mentorship.

More and more LIS programs are moving into online teaching environments, and these environments can facilitate collaborative learning. Zach and Agosto (2009) discuss the benefits and drawbacks of using the online teaching environment to promote collaboration and knowledge sharing in the study of LIS. Educational benefits include: (1) connection to practice; (2) peer-to-learning; (3) student control; (4) teamwork skills; and (5) critical thinking skills. Drawbacks include: (1) technology overload; (2) technological learning curve; (3) technological incompatibility; and (4) student resistance.

Returning to Mattessich, et al.'s (2001) discussion of cooperation, coordination, and collaboration, a major difference among the three is the level of commitment of the individuals involved to the partnerships. The degree of formal commitment for each partner increases in order from cooperation to coordination to collaboration. In truly collaborative academic work

students discuss all parts of the assignment, adding and changing things in conjunction with one another as they come to understand more about the topic. At the end, the final product is truly a group product, in which it is difficult or impossible to identify group contributions. (Ingram & Hathorn, 2004, p. 216)

In order to promote collaborative learning among students, LIS educators should try to lead students from mere cooperation to true collaboration. This means moving beyond providing assignments that enable students to divide up work tasks and work on them individually, to providing assignments and other learning activities that require the shared construction of understanding and meaning. A range of tools, such as wikis and discussion boards can help instructors monitor and evaluate collaborative work (Mader & Smith, 2009). This can mean longer-term projects that students design themselves, with the guidance of the instructor. A good way to begin to create such projects is to work together with students to devise learning goals and outcomes, and then to give student pairs or groups the latitude necessary for determining their paths toward reaching those goals.

Conclusions

Interdisciplinary research collaboration is marked by increased integration, where collaborators meld their various disciplinary backgrounds to produce outputs that offer a perspective than cannot be obtained through the lens of a single discipline. This increased integration can create conflict due to clashes in research and collaborative paradigms. These problems can be ameliorated by entering into such collaborations with openness to new thought, the expectation that it will take time to build understanding between collaborators, and the willingness to accept different research philosophies. Due to the increased potential for conflict, the role of the mediator takes on more importance than would otherwise be expected in academic collaborations.

For LIS educators, focus on increased integration, both in teaching and learning, can provide students with a well-rounded education and prepare students for success in an increasingly collaborative and interdisciplinary world.

Success in collaborative teaching does not come easy; co-teaching a class can take almost as much effort as teaching it individually. It requires commitment on the part of all involved and institutional support. In both research and education, the benefits of interdisciplinarity will not come quickly, but the field of LIS is uniquely positioned to be at the forefront of this new paradigm.

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