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Quantifying Interdisciplinarity: Connections@Illinois

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Abstract. Interdisciplinary approaches must become predominant in the area of problem-solving for successful policy development to treat the issues we are facing in a highly globalized world. Recent publications on the topic of interdisciplinary studies argue that we are seeing an expansion in these areas of research. This paper explores several methods by which the librarian and information scientist can assess the growth of interdisciplinary studies, both at their institutions and in the academy as a whole. We will explore several recent studies in the area and introduce tools that we are using to determine who is publishing where and with whom to better understand the evolution of interdisciplinary studies.

Keywords. Interdisciplinary studies, citation analysis, multi-disciplinary, clickstream analysis, BibApps, classification studies, integrative research……..

1. Introduction

Interdisciplinarity is not an altogether new concept. The borders of the topic have been explored almost since the disciplines began to take shape in the 18th century. At that time the growth of knowledge was becoming so rapid that ostensibly no one individual could emulate effectively the "Renaissance Man" who was well versed in many areas and curious about even more. The development of the western concept of the University also encouraged the division of areas of knowledge into distinct compartments which fell under three general categories. Generally acknowledged areas were the sciences, the social sciences, and the humanities. The emphasis was on the development of ever deeper pools of knowledge about the environment and the societies in which we live. Problems were perceived as discrete in many ways, and the lack of interaction between disciplines led to what is seen today in our departmental structures in the University. There exist many Liberal Arts Colleges well

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outside of the realm of the University, but most of these also require students to articulate a specific field of study at some point in their enrollment.

The way the academy is structured seems to place disciplines both as a continuum and at conflict. For students, the emphasis in the earliest years is on sampling a little of everything, without fully articulating a relationship between everything and then immersing themselves in their chosen topic. Young scholars of interdisciplinary studies are tasked to weave a variety of interests into a fabric that makes sense. Often these efforts are discounted because the student is perceived to be avoiding the rigor of delving deeply into any one discipline. For the scholar and researcher, the downside of interdisciplinary study is even more stark. In writing about the condition of interdisciplinarity in the social sciences late in the last century, Dogan indicated, "Presently, it is no longer possible for anyone to have a thorough knowledge of more than one discipline. It is utopian thinking to master two or more whole disciplines. Given that this implies the ability to be familiar with, and combine, entire disciplines, the idea of interdisciplinary research is illusory."Dogan (1996) At the same time, others were arguing that interdisciplinarity was a "natural event in the development of knowledge." Bordons (1996)

There are five common elements that define the academic discipline in broad terms. These include the specific methodologies chosen for the production of knowledge in the discipline; a shared vocabulary for members of the discipline; inculcating the young scholar in the knowledge, methodology and vocabulary of the discipline; competition with other disciplines for resources; and the attempt to assure dissemination of the knowledge produced by the discipline. All of these characteristics combine to enhance the development of a field of study and provide a justification of the work it produces. Rudasill (2010)

The disciplines in many ways reflect the world as it appeared to be in an earlier day. Boundary lines were clearly drawn for each academic "tribe" and problems were approached for the most part without regard developments in other fields. Creber (2009) Academia was a Westphalian construct with sovereign subject areas reflecting the sovereign state. But as our perception of the world begins to change, so does the perception of the problems and challenges that face us. Globalization has been part of the human experience since the earliest of times, but the advent of wide reaching information technology and markets bring to the fore the urgency of the human condition. It is not enough to discover, discoveries need to have application to the real world.

The problems that we are recognizing in our daily living are more and more interconnected. The "butterfly effect" of globalization has more import than ever before. The movement of textile related jobs from the industrialized world provides jobs for individuals in developing countries who then move to urbanized areas to find work (poorly paid as it may be in comparison to the wages of those who were previously doing the job). This in turn impacts the economies of both countries, the environment (through additional carbon emissions used in the transport of materials), and agriculture (taking human labor from agricultural work to factory work). Another way of looking at the problems that need to be solved is grounded in the "law of unintended

consequences." An example of this might be found in airline travel. Once the airlines began charging for checked baggage, more people began bringing carry-on luggage on their trips. This had perhaps two of these unintended consequences – first, overhead storage became more scarce and then it began to take longer to board the flights because individuals were trying to find room for their luggage. This resulted in earlier boarding times and/or delayed take offs.

These examples are two of thousands of problems that result from our interconnectedness. The simply application of one technology is not adequate to provide the answers to most of the problems we encounter today. This is most apparent in the financial crisis that brought on a worldwide recession. Although there remains a great deal to be discovered in the separate fields of the recognized disciplines, interdisciplinary problem solving is essential to find the answers to the questions that affect all of us on a very basic level.

2. Defining Interdisciplinarity

How do we define the concept of interdisciplinary scholarship if it is indeed possible to do so? There are several basic approaches to this type of scholarship. First, there is multi-disciplinary work. In this, scholars from diverse fields or departments might join forces to look at a specific problem, each from their own point of view. The biologist remains the biologist and the sociologist remains a sociologist. In the end the discoveries they produce are done in tandem with separate methodologies and separate results that are then combined in publication. Another permutation is the interdisciplinary approach. In this, scholars from different fields borrow and adjust methodologies and theories from their disparate fields to approach problems in somewhat of a hybridized way. Their results are "normalized" and presented in a manner that might be fully understandable by scholars from any of the fields the researchers are associated with. Examples of this type of work might include the research results on climate change or global markets. The next division would be integrative research. In this scholars not only work with different methodologies from disparate fields, the work that they do is fully integrated. The work of these scholars is so completely in harmony that it often results in entirely new methodologies and approaches to problems. The medical community is an area where this appears to be happening most frequently, especially in public health research.

Kline, one of the most recognized scholars writing about interdisciplinarity and related transdisciplinarity has created a research matrix that gives us a higher level view of the various forms of research. She indicates that basic, free, applied and oriented research still have their places in the growth of knowledge and information. However, she places transdisciplinary research at the center of the matrix and defines it as "the concept of taking up concrete problems of society and working out solutions in cooperation with scientists and other actors." Klein (2001)

3. Explorations of Interdisciplinarity

Several methodologies have been employed in the study interdisciplinarity. These include citation analysis, classification analysis, and clickstream analysis. The first two are more traditional, but the third is something that has only become available recently through the use of the information technology so familiar to all of us.

Traditionally, citation analysis has been used to determine the degree of cross-boundary publications and research. Citation maps are extremely labour intensive to create, requiring the researcher to carefully follow the thread of references and classifying the discipline from which they were produced. Both the Web of Science and Scopus databases can be very useful in identifying citation patterns of scholars and these tools can also identify the subject areas assigned to each journal. But this does not tell the whole story of interdisciplinary research. Some authors have pursued this avenue of research to determine the collaborations within specific research departments and programs. Bordons (1999)Others have applied qualitative methods to research proposals to determine the degree of interdisciplinarity that exists in them. Huutoniemi (2010)

The newest approach to exploring interdisciplinarity is clickstream analysis. The figure re-created here is from a project that analyzed the user interactions through scholarly portals to various publishers and other research resources. "The resulting model was visualized as a journal network that outlines the relationships between various scientific domains and clarifies the connection of the social sciences and humanities to the natural sciences." Bollen (2009) The authors indicate that over 1 billion interactions were recorded to develop the dataset for this research over the course of a year. Few libraries are able to afford a project of this magnitude, but it may become possible to do something similar, if less elegant, with tools like Google Analytics.

Map of Science Derived from Clickstream Data

Other new tools provide further possibilities, not only to measure interdisciplinary research, but to encourage it as well. The University of Illinois is currently working on a tool that provides all researchers information about what we are doing on this campus. The resource "Connections@Illinois" is based on a program developed at the University of Wisconsin – Madison known there as BibApps. Our goal is to add the publications of our entire faculty into this database. It then provides us with a great deal of information. At the outset you will find access to new works, groups, individuals, publications and the publishers our scholars are found in. The user can search on specific terms such as "interdisciplinary" and retrieve information on those authors who have included the term in the keywords associated with their works. Selecting an individual, one can see the co-authors from across our campus, the predominant types of publication for the scholar, a

word cloud for their publications, and a timeline of their publications. One can also select the full list of the scholar's works and groups that they belong to. Another interesting aspect of this database is the ability to follow publication timelines for a specific individual. This will provide a look at the types of publications the scholar has used as well a providing a word cloud of the topics the individual has written about. Since this database is open to all, it should be a good tool for the invisible college to use to discover others either writing in their area or interested in doing some interdisciplinary research.

In addition to supporting the current scholar, tools like these may be of assistance to young scholars just beginning to explore interdisciplinary approaches to problem-solving. As we move further into the area of global problem-solving, one of the concerns articulated is, "Despite the proliferation of interdisciplinary graduate programs designed to fill this need, there is virtually no archival literature identifying learning outcomes, methods, or benchmarks for assessing interdisciplinary graduate programs and associated student learning." Borrego (2010) More research is indeed needed to discover the type of research we need – a conumdrum that needs close attention if we are going to create policies, support, action and technology to answer the growing questions of today.

4. Conclusions

The expansion of knowledge that created the disciplines as we know them today will not stop any time soon. What is needed now is a way to apply this knowledge in a rational, naturalistic way that promotes the discovery of new ways of handling the problems that are presented to us. Academic departments are being created that will require the ability to work in an interdisciplinary and cooperative manner. A look at the job postings for new scholars underlines the need for fewer silos and more shared ground. Public health, environmental studies, urban planning, sustainable development, and global studies are all examples of emerging disciplines that will need theoretical and practical support from knowledge workers such as librarians. In addition, many of us need to learn and understand the tools that our scholars are using. Especially in the social sciences, the use and deposit of datasets is becoming the norm. Open access publications produced by scientists is becoming the norm. Visualization of date and knowledge is becoming the norm for our changing populations.

Librarians will need to identify the scholars who are working in the new interdisciplinary, transdisciplinary, and integrative world. We need to assure these scholars that we have some understanding of the varied methods they are using, the varied results they are retrieving, and in addition, we need to be able to guide them, not only to knowledge, but to other knowledge producers. Technology has expanded our abilities to reach out to users. We will need to use these technologies to expand the "invisible college" and provide the resources needed to solve today's problems.

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