Analysis of the Factors Affecting Interdisciplinarity of Research in Library and Information Science

Chizuko Takei[1], Fuyuki Yoshikane[2] and Hiroshi Itsumura[3]

naoe.chizuko@ynu.ac.jp, fuyuki@slis.tsukuba.ac.jp, hits@slis.tsukuba.ac.jp

[1]University of Tsukuba, Graduate School of Library, Information and Media Studies, 1-2 Kasuga, Tsukuba, Ibaraki (Japan)

[2]University of Tsukuba, Faculty of Library, Information and Media Science, 1-2 Kasuga, Tsukuba, Ibaraki (Japan)

Introduction

In recent years, there has been a growing recognition of the necessity for interdisciplinary research that crosses disciplinary boundaries to deal with increasingly complex social issues (Rafols & Meyer, 2010). The relationship between the changes in interdisciplinarity of research over the years and researchers' attributions has rarely been investigated. Understanding the relationship between them will make it possible to gain useful information to foster interdisciplinary research, career-development of researchers, and development of research institutions. Thus, considering different periods, this study examines interdisciplinarity of research and the transdisciplinarity of researchers (targeted researchers themselves and their co-authors).

Methodology

This study targeted full-time faculty members of 2 iSchools, University of Pittsburgh (Pitt) and Syracuse University (SU), as of August 2014. The following data were employed: (1) information about targeted researchers and their co-authors, such as academic degrees or biographies, extracted from web pages; (2) bibliographic data of articles published by targeted researchers, which were extracted from Web of Science (WoS); (3) the title lists of WoS by subject categories acquired from the web site of Thomson Reuters; and (4) a matrix of the distance between categories of WoS, which was computed by Leydesdorff using Stirling's distance (http://www.leydesdorff.net/overlaytoolkit/stirling.htm). The procedure of this study was as follows: First, we examined transdisciplinarity of targeted researchers on the basis of the numbers of different disciplines where they had been engaged. We estimated their disciplines by several points of view such as belonging departments and academic degrees. As for their co-authors, though disciplines were estimated in the same way, we counted only disciplines that were different from those of the targeted researchers who had published the co-authored articles. Next, for each article of (2), by relating its reference list to (3) and (4), we computed indexes regarding interdisciplinarity that were used in later studies. This study applied the following indexes to the distribution of WoS categories assigned to the articles and their citing literature:

a. Total number of categories;
b. Simpson's Index (I);
c. Shannon's Index (entropy, H);
d. Distance between categories; and
e. The proportion of literature cited from different disciplines.

Indexes b and c evaluate the degree of diversity, taking into account both variety and equality in the frequency distribution. Index d indicates the distance between the categories of the articles and their citing literature. It ranges from −1 to 0, multiplying Stirling's distance by −1. As interdisciplinarity grows, their values become higher. Index e indicates the ratio of literature cited from different disciplines. Here, a different discipline is defined as a category with a distance over −0.7. Then, we performed a principal component analysis using these indexes and observed the correlation between the transdisciplinarity of targeted researchers or their co-authors and the interdisciplinarity of their articles along with its time-series variation. We discussed factors affecting the interdisciplinarity of research.

Results

Tendencies of indexes

Table 1 shows the basic statistics regarding transdisciplinarity of researchers and interdisciplinarity of their articles. We targeted 57 researchers, out of 73 faculty members, whose disciplines could be identified on the basis of information from university web sites and WoS.

The result of a principal component analysis for 5 indexes (C to G) revealed that the cumulative contribution rate of the first 2 principal components (PC1 and PC2) is 0.873. The characteristics of the 5 indexes can largely be explained by the first and second principal components. In Table 2, the principal component loading of PC1 suggests strong relationships between all 5 indexes. On the other hand, PC2 is characterized by large negative values of indexes F and G. Figure 1 is a plot of the first and second principal components and indicates that the 5 indexes can be divided into two groups (C, D, and E) and (F and G). It also implies that

highly interdisciplinary articles are remarkably diverse and rarely have common tendencies. In addition, we separated articles into two groups that were roughly equal in size (from 1981 to 2005 and from 2006 to 2014) to investigate the time-series variation related to the transdisciplinarity of researchers and the interdisciplinarity of research. The values of indexes concerning the interdisciplinarity of research (C to G) increased, while there were almost no changes in indexes concerning the transdisciplinarity of targeted researchers and their co-authors (A and B).

Table 1. Basic statistics regarding interdisciplinarity and transdisciplinarity.

		Pitt	SU	ALL
Targeted researchers/all faculties		23 / 30	34 / 43	57 / 73
Number of articles		267	259	526
Number of articles/targeted researchers	median	8	5	6
	range	1-33	1-31	1-33
A: Transdisciplinarity of targeted researchers	median	2	1	2
	range	1-2	1-3	1-3
B: Transdisciplinarity of co-authors	median	1	1	1
	range	0-6	0-4	0-6
C: Total number of categories	median	13	15	14
	range	1-79	1-59	1-79
D: Simpson's Index	median	0.781	0.767	0.777
	range	0-0.949	0-0.934	0-0.949
E: Shannon's Index	median	2.383	2.383	2.383
	range	0-4.385	0-4.061	0-4.385
F: Distance between categories	median	−0.438	−0.413	−0.424
	range	−1–−0.005	−1–−0.013	−1–−0.005
G: Proportion of literature cited from different disciplines	median	79%	79%	79%
	range	0%-100%	0%-100%	0%-100%

Table 2. Principal component loading for 5 indexes.

	PC1	PC2	PC3	PC4	PC5
C	−0.648	0.536	−0.540	0.002	−0.032
D	−0.876	0.301	0.345	0.037	−0.148
E	−0.898	0.350	0.202	−0.051	0.168
F	−0.717	−0.652	−0.089	−0.229	−0.031
G	−0.750	−0.610	−0.093	0.236	0.029

The relationship between transdisciplinarity of researchers and interdisciplinarity of their research

We computed Spearman's rank correlation coefficient for indexes A to G to survey the relationship between transdisciplinarity of researchers (A and B) and interdisciplinarity of their research (C to G) (Table 3). No strong correlation was found between them. However, comparing index A with B, we observed stronger and significant correlation between index B and the indexes concerning interdisciplinarity of research (C to G). In addition, we compared the articles before 2005 with those after 2006 to examine the time-series variation of correlation between indexes. Although there was no distinguished distinction between them, the degree of correlation tended to become stronger and the number of significant coefficients was increased for indexes A and B.

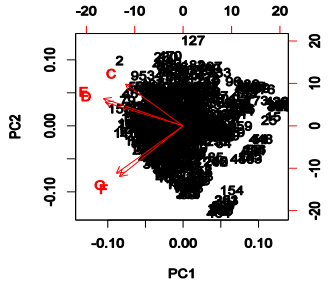

Figure 1. Plot of the first and second principal components.

Table 3. Rank correlation ρ among 7 indexes for all articles.

	A	B	C	D	E	F	G
A	1	0.23*	0.12*	0.17*	0.18*	0.05	0.06
B		1	0.21*	0.20*	0.21*	0.07	0.14*
C			1	0.69*	0.76*	0.17*	0.16*
D				1	0.99*	0.37*	0.30*
E					1	0.37*	0.30*
F						1	0.88*
G							1

*Significant ($p < 0.05$)

Discussion and Conclusions

This study computed indexes for interdisciplinarity of research in library and information science and performed principal component analysis to clarify the relationship among the indexes. The results indicate that the indexes considering the distance between subject categories of WoS have characteristics very different from the indexes considering only the number of categories and their frequency distributions. This suggests that we should consider a more multidimensional approach. Furthermore, we investigated changes over time in the indexes of interdisciplinarity, and observed the progress for interdisciplinarity of research in library and information science. As the results of the correlation analysis between interdisciplinarity of research and transdisciplinarity of researchers, stronger and significant correlations were seen with the transdisciplinarity of co-authors than with that of the targeted researchers themselves. This suggests that interdisciplinarity of research might be more affected by the transdisciplinarity of co-authors than by that of the researchers themselves. We will conduct further investigations with more samples.

Reference

Rafols, I., & Meyer, M. (2010). Diversity and network coherence as indicators of interdisciplinarity: case studies in bionanoscience. *Scientometrics*, *82*, 263-287.