

Digital humanities

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Published in:
Portal

DOI:
[10.1353/pla.2016.0046](https://doi.org/10.1353/pla.2016.0046)

Published: 01/10/2016

Document Version:
Peer reviewed version

[Link to publication](#)

Citation for published version (APA):
WONG, R. S. H. (2016). Digital humanities: What can libraries offer? *Portal*, 16(4), 669-690.
<https://doi.org/10.1353/pla.2016.0046>

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FEATURE: GLOBAL PERSPECTIVES

Digital Humanities: What Can Libraries Offer?

Shun Han Rebekah Wong

Abstract: The collaborative aspect of digital humanities is one of the core values of the field. Specialists and organizations involved in digital humanities partnerships may include individual scholars focusing on a particular area, multiple scholars across disciplines, computer scientists, or digital humanities centers. Through a quantitative analysis of authorship in international digital humanities journals, this article demonstrates that libraries also have unique advantages that make them well positioned to contribute to digital humanities.

Introduction

The collaborative aspect of digital humanities is one of the core values of the field. Collaborative approaches can draw on the strengths and expertise of various specialists, thus bringing out the full potential of a research program and producing larger and longer-lasting impacts. Specialists and organizations involved in digital humanities partnerships may include individual scholars focusing on a particular area, multiple scholars across disciplines, computer scientists, and digital humanities centers. Many information science scholars and librarians have noted that libraries have an important role to play in digital humanities. Their arguments are usually taken from a theoretical or case study approach; the literature review will summarize several of these arguments. Nevertheless, the question remains, could libraries serve as one of the core contributors to the development of digital humanities? This article will try to answer that question through an authorship study of five international journals. New insights into the structural advantages of libraries will provide additional evidence encouraging librarians worldwide to embrace this new calling.

Literature Review

A substantial amount of literature emphasizes the importance of libraries in digital humanities and shares insights into how to further strengthen this interdisciplinary collaboration. Since previous studies have already cited and reviewed many older publications, the current literature review will

focus on more recent publications to avoid duplication and to capture the latest ideas and arguments.

Micah Vandegrift and Stewart Varner suggest an interesting connection between the humanities and libraries: “They are tasked with collecting, organizing and preserving our shared, collective memory . . . They are also both experiencing an extremely challenging historical moment where external critics are questioning their value.”¹ The authors further comment that libraries have inherent strengths that can “mirror and complement the needs at the core of the digital humanities,” making digital humanities and libraries “natural partners.” This collaboration can bring benefits to both parties; therefore, librarians should overcome their resistance and embrace such partnering.

Chris Alen Sula emphasizes that libraries are well positioned to (and already do) contribute to digital humanities. He says, “A search for ‘digital humanities’ within library and information science (LIS) literature reveals a steady increase in publications since 2005 . . . It is remarkable that publications on digital humanities have nearly doubled in 2012.”² Sula further suggests that among the 100 or more digital humanities centers listed in a crowdsourced spreadsheet in November 2012, “nearly half are located within libraries and another quarter maintain some informal relationship with libraries.”

Jennifer Edmond argues that cooperation is an essential component in digital humanities, but an unprepared collaborative approach may do more harm than good to the potential partnership. For example, if the differences of perspective between digital humanities researchers and digital librarians remain unacknowledged and unmanaged, a team’s trust, morale, and effectiveness can be diminished.³ Other challenges include faculty’s hesitancy to share their research discoveries and misguided reasons for collaboration, such as, an assumption that collaborative digital humanities programs can produce economic benefit, obtain political gains, or attract non-specialist users. As a scholar, Edmond emphasizes that successful digital humanities collaboration requires “the interweaving of very different intellectual positions and working cultures.” These positions and cultures cover not only humanists and computer scientists but also “a branch of information management or library science,” with a goal to “broaden and deepen areas of knowledge, and to connect them more efficiently and effectively into the wider ecosystem.”

Although many publications have explained the importance of libraries in digital humanities, little quantitative analysis of library involvement has been done through authorship studies. The author found two past authorship studies in digital humanities, but they focused more on overall collaborative patterns rather than on the particular involvement of libraries. For example, Lisa Spiro compares the number of coauthored articles of two Oxford University Press journals, *American Literary History* (ALH) and *Literary and Linguistic Computing* (LLC), published between 2004 and

2008.⁴ She discovers a strong coauthorship pattern in LLC, where 48.28 percent of articles are written by two or more authors. In ALH, on the other hand, just 1.93 percent of articles list two authors (and none have more than two). In another publication, Spiro sees other indicators of collaborative approaches in digital humanities; for example, “at the Digital Humanities 2010 Conference, a number of papers, posters, and workshop sessions addressed collaboration.”⁵ Digital humanities centers, digital humanities networks, and many digital humanities funding programs also explicitly support, encourage, or require interdisciplinary collaboration.

Julianne Nyhan and Oliver Duke-Williams performed a statistical analysis of collaborative publishing patterns in the journals *Computers and the Humanities* (CHum) (1966–2004), *Literary and Linguistic Computing* (LLC) (1986–2011), and the *Annals of the Association of American Geographers* (AAAG) (1966–2013).⁶ While single authorship predominated and held steady in CHum, there was a significant increase over time in dual- and triple-authored articles. In LLC, single authorship was predominant with a major upsurge in triple-authored articles. In AAAG, single authorship was also predominant with substantial growth in all forms of collaborative publishing. According to Nyhan and Duke-Williams, “Surprising is that a journal such as AAAG shows more significant increases in multi-authorship.” Their author connectivity analysis showed that all three journals shared similar characteristics: “There is a relatively small cadre of authors who co-publish with a wide set of other authors, and a longer tail of authors for whom co-publishing is less common.”

Authorship Study

Journal Selection

A handful of digital humanities journals cover all aspects of the field, including theoretical analyses, methodologies, technical approaches, research findings, project developments, and reviews, among other topics. The author of this study considered various journal listings on the Web and determined that the annotated bibliographies provided by the City University of New York’s “CUNY Academic Commons”⁷ (<http://commons.gc.cuny.edu/wiki/index.php/Journals>) and the University of California, Berkeley’s “Digital Humanities”⁸ (<http://digitalhumanities.berkeley.edu/resources/digital-humanities-journals>) were particularly useful.

Five international journals were selected for this study: *Digital Humanities Quarterly* (DHQ), *International Journal of Humanities and Arts Computing* (IJHAC), *Journal of Digital Humanities* (JDH), *Journal of the Text Encoding Initiative* (JTEI), and *Literary and Linguistic Computing* (LLC). They were selected because they fulfill all of the following criteria:

- The journal is dedicated to or covers digital humanities as one of its major themes;

- The coverage of the journal is broad and not discipline-specific (for example, only English studies) nor country-specific and is not focused on only one type of project (for example, multimedia projects);
- Scholars commonly select the journal as a core or recommended reading. This is determined by scanning through the reading lists recommended by several famous digital humanities scholars, such as, Miriam Posner (<http://miriamposner.com/blog/digital-humanities-and-the-library/>), Lisa Spiro (<https://digitalscholarship.wordpress.com/2011/10/14/getting-started-in-the-digital-humanities/>), etc.;
- The journal is peer-reviewed and currently active; and
- Author information is freely accessible on the Web.

Table 1 summarizes these five journals in alphabetical order. *IJHAC* was first published in 1994 but did not provide author biographies until volume 13, number 3, published in 2001. The journal was also inactive for four years between 2003 and 2006. To produce a more comparable result, this journal was assessed starting from 2007, when the publisher renumbered it as volume 1. *LLC* provides no detailed author biographies at all. Most author backgrounds were researched through the Internet. Because it was difficult to retrieve accurate backgrounds for the earlier period, the current study analyzed this journal starting from 2011 even though it was first published in 1986.

Table 1: Summary of Journals Covered in the Authorship Study

Journal Description & URL	Coverage	No. of Issues	No. of Articles	Articles Excluded from the Study	Duplicated Count of Authors
<i>Digital Humanities Quarterly (DHQ)</i>					
http://www.digitalhumanities.org/dhq/ “An open-access, peer-reviewed, digital journal covering all aspects of digital media in the humanities.” ⁱ Published by the Alliance of Digital Humanities Organizations, an umbrella organization with six regional member organizations developed for the research communities in Australia and New Zealand, the United States, Canada, Europe, and Japan.	2007 Vol. 1 Iss. 1 2015 Vol. 9 Iss. 4	26	213	Editorials, Front Matter	374
<i>International Journal of Humanities and Arts Computing (IJHAC)</i>					
http://www.eupublishing.com/loi/ijhac Formerly named as <i>History and Computing</i> , it is a “multi-disciplinary, peer-reviewed forums for research on all aspects of arts and humanities computing.” ⁱⁱ Published by Edinburgh University Press, with an international mix of editors from the North America, Europe, Oceania, and Asia.	2007 Vol. 1 Iss. 1 2015 Vol. 9	15	158	From the Editors, Editors’ Note, Forum	316

ⁱ “*Digital Humanities Quarterly: About DHQ*,” Alliance of Digital Humanities, accessed February 18, 2016, <http://www.digitalhumanities.org/dhq/about/about.html>

ⁱⁱ “*International Journal of Humanities and Arts Computing*,” Edinburgh University Press, accessed February 18, 2016, <http://www.eupublishing.com/journal/ijhac>

	Iss. 2				
Journal of Digital Humanities (JDH)					
http://journalofdigitalhumanities.org/volumes/ "A comprehensive, peer-reviewed, open access journal that features scholarship, tools, and conversations produced, identified, and tracked by members of the digital humanities community through <i>Digital Humanities Now</i> ." ⁱⁱⁱ Published by PressForward.	2011 Vol. 1 Iss. 1 2014 Vol. 3 Iss. 2	9	118	Introduction, Institutional Guides	225
Journal of the Text Encoding Initiative (JTEI)					
http://jtei.revues.org/274 "It publishes the proceedings of the annual TEI Conference and Members' Meeting" and issues about TEI. It also provides discussion of "the role of technological standards in the digital humanities, including digital scholarly editing, linguistic analysis, corpora creation, and newer areas such as mass digitization, semantic web research, and editing within virtual worlds." ^{iv} An official journal of the Text Encoding Initiative Consortium, a nonprofit organization composed of academic institutions and scholars from around the world.	2011 Iss. 1 2015 Iss. 8	8	54	Editorial, Introduction, Guest Editors' Note	132
Literary and Linguistic Computing (LLC)					
http://llc.oxfordjournals.org/content/by/year It is "an international [and peer-reviewed] journal which publishes material on all aspects of computing and information technology applied to literature and language research and teaching." ^v Published by Oxford University Press.	2011 Vol. 26 Iss. 1 2014 Vol. 29 Iss. 4	16	197	Editorial, Introduction	420

The current study acknowledges the potential methodological risks of aligning authorship patterns with actual collaborative relationships. Project partners may not choose to publish their work together, or listed coauthors may not have directly participated in the work. Furthermore, capturing only digital humanities journals may underestimate the involvement of librarians and information science scholars. Many authors publish digital humanities articles in library journals, for example. Nevertheless, this authorship analysis can provide a good starting reference point.

This study assessed 740 original articles over a nine-year period from 2007 to 2015. The number of unique authors among these five journals was 1,148, with a total of 1,467 authors including duplicates.

Methodology

The first step was to visit the website of each selected journal and copy all necessary information into a separate spreadsheet for each journal. Information such as publication years, volume numbers, issue numbers, author names, job titles of authors, institutional or organizational affiliations, and article types if available (for example, articles, reviews, conversations, and the like) were recorded.

ⁱⁱⁱ "Journal of Digital Humanities: About," PressForward, accessed February 18, 2016, <http://journalofdigitalhumanities.org/about/>

^{iv} "Journal of the Text Encoding Initiative: Editorial Policies," Text Encoding Initiative Consortium, accessed February 18, 2016, <http://jtei.revues.org/274>

^v "Literacy and Linguistics Computing: About the Journal," Oxford Press, accessed February 18, 2016, http://www.oxfordjournals.org/our_journals/litlin/about.html

If an article had multiple authors, the information for all coauthors was recorded. On occasions where an author’s biography was missing or an author’s latest job title could not be clearly identified, the investigator tried to find and confirm the missing or ambiguous information from the websites of the author’s affiliated organizations or from his or her LinkedIn account. The current study also located the country information of all affiliated organizations, so that geographic distribution of relevant organizations could be generated.

At the same time, the author developed a list of 13 types of professions, covering all major professions engaged in digital humanities initiatives. Table 2 provides a full list with descriptions. Each author was matched with from one to three professions, based on his or her latest career information. The five spreadsheets were then consolidated into two lists, one with duplicated author names and one with duplicate names removed. It is possible for different authors to have the same name, so the matching process took their complete biographies into consideration. In a few cases where the same author changed his or her profession over time, only the most recent description was used in the analysis.

Table 2: Profession Types Used in the Authorship Study

Type of Profession	Description
Students	Covers all student authors, who may be hired as project assistants or engage in a research. Student assistants are not grouped by their employers (e.g., library, digital humanities center, etc.), because their work mode can be very unstable, and they may take up several paid or unpaid jobs at the same time <i>Examples:</i> PhD candidate, Master’s student
Archival Centers / Museums	Covers all positions hired by an archival center or a museum, except student assistants who are grouped under “Student” <i>Examples:</i> Archivist, Curator, Conservation studio manager
Digital Humanities Centers	Covers all positions hired by a digital humanities center, except student assistants who are grouped under “Student” <i>Examples:</i> Faculty member, Project manager, Software architect, Research fellowship
IT Departments	Covers all positions hired by an IT department, usually affiliated with an university, except student assistants who are grouped under “Student” <i>Examples:</i> Director, Faculty technology coordinator
Libraries	Covers all positions hired by a library, except student assistants who are grouped under “Student” <i>Examples:</i> Library director, Digital humanities librarian, Programmer
Scholars – Digital Humanities	Covers all ranks of university teachers and independent scholars in digital humanities, humanities computing, or related fields, except those hired by Digital Humanities Centers <i>Examples:</i> Professor, Lecturer, Independent scholar
Scholars – Computer Science	Covers all ranks of university teachers and independent scholars in computer science or related fields <i>Examples:</i> Professor, Lecturer, Independent scholar
Scholars – Information Science	Covers all ranks of university teachers and independent scholars in information science or related fields

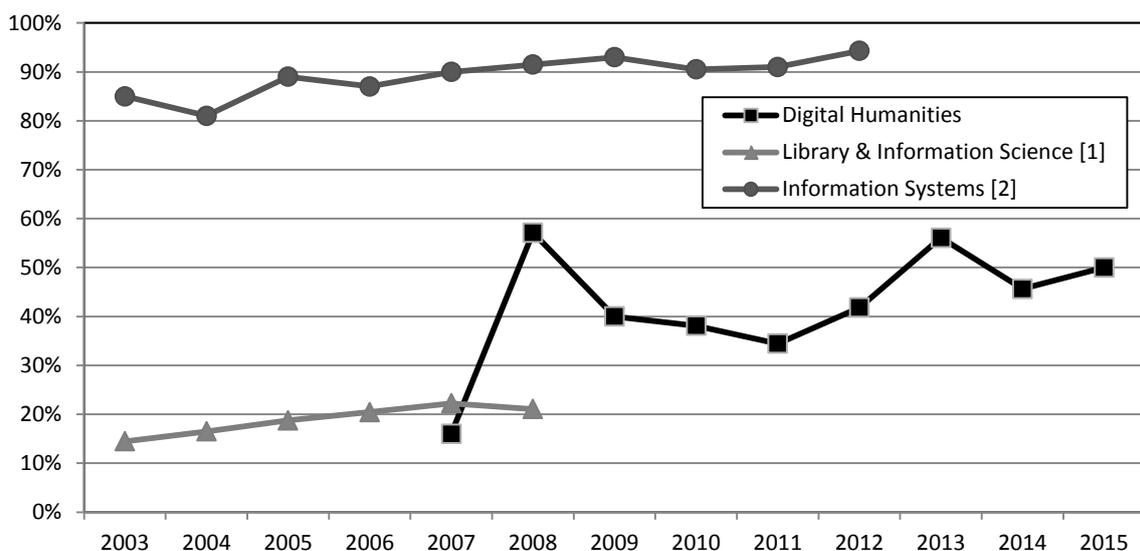
	Examples: Professor, Lecturer, Independent scholar
Scholars - Other	Covers all ranks of university teachers and independent scholars in all other fields Examples: Professor, Lecturer, Independent scholar
Researchers	Independent researchers or researchers hired by an organization or a project, except those work in a library, archival center / museum, digital humanities center, or IT department of an university Examples: Research assistant, Postdoctoral fellow
Computer Programming Specialists	Computer programming specialists hired by an organization or a project, except those work in a library, archival center / museum, digital humanities center, or IT department of an university Examples: Lead programmer, Software engineer, Freelance web developer
Other	All other professions Examples: Associate Provost, Managing Editor, Artist
Unknown	<Neither the journal nor general searches from the internet could yield background information of the particular author. >

Results

Coauthorship Trends

David Laband and Robert Tollison recommended that two components be observed when analyzing coauthorship trends: (1) the incidence of coauthorship, named “collaboration rate” in this study—that is, the percentage of articles with multiple authors; and (2) the extent of coauthorship, named “collaboration extent” here—that is, the average number of authors per coauthored article.⁹ The collaboration rate in digital humanities varies over time, from a low of 16 percent in 2007 to a high of 57.14 percent in 2008. The average collaboration rate for nine years is 44.73 percent. Figure 1 compares the changes in the collaboration rate in digital humanities, information systems,¹⁰ and LIS.¹¹

Figure 1: The Collaboration Rate (Percentage of Co-Authored Articles) in Three Fields



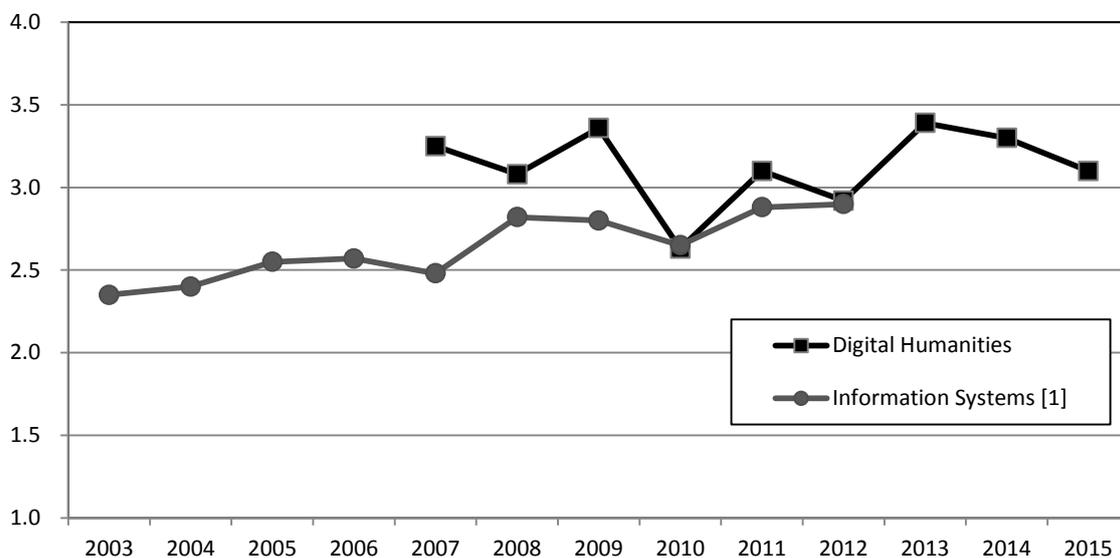
Notes:

¹ Data taken from Danesh et al. (2009)^{vi}

² Data taken from Xu, Chau, & Tan (2014)^{vii}

The collaboration extent in digital humanities ranges from 2 (47.13 percent of all coauthored articles) to 15 (0.3 percent). The average collaboration extent for nine years is 3.2. Figure 2 compares the changes in the collaboration extent in digital humanities and information systems.¹² Interestingly, the collaboration rate and collaboration extent in digital humanities do not display steady growth as in some other disciplines.¹³ This lack of steady growth may result from the comparative youth of digital humanities journals, causing them experience many uncertainties.

Figure 2: The Collaboration Extent (the Number of Authors per Co-Authored Articles) in Two Fields



Notes:

¹ Data taken from Xu, Chau, & Tan (2014)^{viii}

Francisco Acedo, Carmen Barroso, Cristóbal Casanueva, and José Luis Galán performed a coauthorship study in the field of management and developed a descriptive comparison table among seven fields by collecting data from other literature.¹⁴ The current study added new data and re-created the comparison in Table 3. Although the number of assessed articles and the study period differ among various studies, this comparison can serve as a useful reference. From Table 3, the average collaboration rate in digital humanities (44.73 percent) ranks third among the seven fields where the corresponding data can be found. Its average collaboration extent (3.2) ranks second among the eight fields with corresponding data.

^{vi} Danesh et al., “Correlation between Scientific Output and Collaboration Among LIS Scholars Around the World.”

^{vii} Xu, Chau, and Tan, “The Development of Social Capital in the Collaboration Network of Information Systems Scholars.”

^{viii} Xu, Chau, and Tan, “The Development of Social Capital in the Collaboration Network of Information Systems Scholars.”

Table 3: Descriptive Comparison among Ten Fields

	Digital Humanities	Business		Science			Information Technology		Social Sciences	
		Management ¹	Economics ²	Biomedical Research ³	Mathematics ³	Physics ³	Computer Science ⁴	Information Systems ⁵	Sociology ⁶	Library & Information Science ⁷
Time Period	2007 - 2015	1980 - 2002	1960 - 2010	1995 - 1999	1940 - 2004	1995 - 1999	1995 - 1999	1980 - 2012	1963 - 1999	2003 - 2008
Number of Articles	543	11,022	20,321	2,163,923	---	98,502	13,169	3,821	281,090	8,320
Number of Unique Authors	844	10,176	---	1,520,251	253,339	52,909	11,994	4,174	197,976	10,760
Articles per Author	1.24	2.04	---	6.4	6.9	5.1	2.55	---	2.08 ^{6a}	---
Collaboration Rate (Percentage of Co-authored Articles)	45%	---	38%	79%	34% ^{3a}	---	---	81%	33%	19%
Collaboration Extent (Authors per Co-authored Article)	3.20	1.88	---	3.75	1.45	2.53	2.22	2.38	2.4 ^{6b} – 2.7 ^{6c}	---

Notes:

¹ Data taken from Acedo, Barroso, Casanueva, and Galán (2006)^{ix}

² Data taken from Kosnik (2015)^x

³ Data taken from Newman (2004)^{xi} ; ^{3a} Data taken from Newman (2004), but originally generated from Grossman (2002)^{xii}

⁴ Data taken from Newman (2001)^{xiii}

⁵ Data taken from Xu, Chau, and Tan (2014)^{xiv}

⁶ Data taken from Moody (2004)^{xv} ; ^{6a} Estimated value ; ^{6b} 1975-85 ; ^{6c} 1989-99

⁷ Data taken from Danesh et al (2009)^{xvi}

^{ix} Acedo et al., “Co-authorship in Management and Organizational Studies: An Empirical and Network Analysis.”

^x Lea-Rachel Kosnik, “What have Economists been Doing for the Last 50 years?: A Text Analysis of Published Academic Research from 1960-2010,” *Economics: The Open-Access, Open-Assessment E-Journal* 9, 2015-13 (2015): 1-38, doi:10.5018/economics-ejournal.ja.2015-13

^{xi} M. E. J. Newman, “Coauthorship Networks and Patterns of Scientific Collaboration,” *PNAS Early Edition* 101, 1 (2004): 5200-5205, doi:10.1073/pnas.0307545100

^{xii} Jerrold W. Grossman, “The Evolution of the Mathematical Research Collaboration Graph,” *Congressus Numerantium* 158 (2002): 202-212.

^{xiii} M. E. J. Newman, “Scientific Collaboration Networks I: Network Construction and Fundamental Results,” *Physical Review E* 64, 016131 (2001): 1-8, doi:10.1103/PhysRevE.64.016131.

^{xiv} Xu, Chau, and Tan, “The Development of Social Capital in the Collaboration Network of Information Systems Scholars.”

^{xv} James Moody, “The Structure of a Social Science Collaboration Network: Disciplinary Cohesion from 1963 to 1999,” *American Sociological Review* 69, 2 (2004): 213-38.

^{xvi} Danesh et al., “Correlation Between Scientific Output and Collaboration Among LIS Scholars Around the World.”

Geographic Distribution

Table 4 shows the geographic distribution of all affiliated organizations of sole authors and coauthors. A total of 41 countries are represented, with the United States (35 percent) ranking highest, followed by the United Kingdom (14 percent), Canada (8 percent), Germany (6 percent), Netherlands (5 percent), Taiwan (5 percent), Japan (4 percent), Australia (3 percent), and France, Ireland, Italy, and Spain (2 percent each). By continent, North America accounts for the largest proportion with 43.81 percent, then Europe (40.18 percent) and Asia (11.6 percent).

Table 4. Geographic distribution of affiliated organizations (by countries)

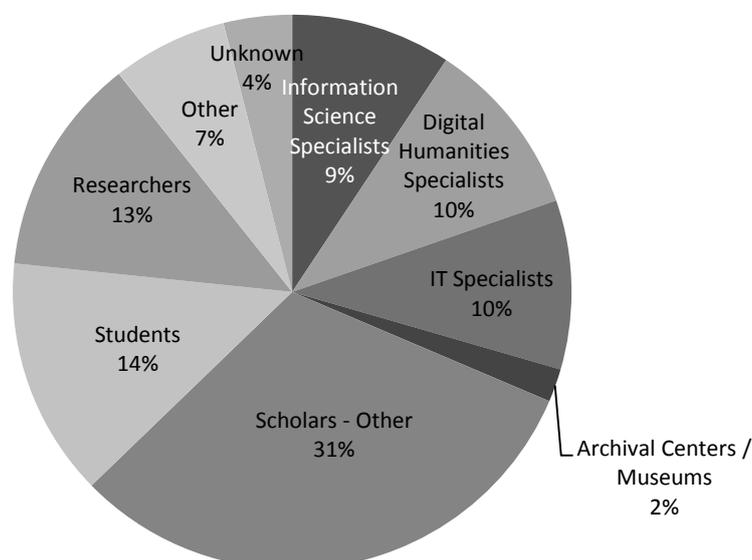
Countries	Percentage
Algeria	0.09%
Australia	2.61%
Austria	0.61%
Azerbaijan	0.09%
Belgium	1.05%
Botswana	0.09%
Brazil	0.09%
Canada	7.84%
China	0.61%
Croatia	0.09%
Cyprus	0.17%
Denmark	0.17%
Estonia	0.26%
Finland	0.78%
France	1.66%
Germany	6.10%
Greece	1.05%
Hong Kong	0.17%
Hungary	0.09%
Iran	0.44%
Ireland	1.66%
Israel	0.44%
Italy	2.44%
Japan	3.75%
Malaysia	0.35%
Mexico	0.52%
Netherlands	4.88%
New Zealand	0.35%
Norway	0.44%
Philippines	0.09%
Poland	0.35%
Portugal	0.78%
Serbia	0.09%
Slovenia	0.44%
Spain	1.66%
Sweden	0.78%
Switzerland	0.43%
Taiwan	5.49%
Thailand	0.17%
United Kingdom	14.20%
United States	35.45%
Unknown	1.22%

Types of Contributors

Figure 4 displays the distribution of the predefined profession types listed in Table 2. For simplicity, digital humanities centers and scholars in digital humanities are grouped under “digital humanities specialists”; information technology (IT) departments, computer programming specialists, and scholars in computer science are gathered under “IT specialists”; and librarians and scholars in information science are classified as “information science specialists.”

Scholar authors of the studied journals come from a broad spectrum of academic backgrounds, including accounting and management, animation and game design, archaeology, art and design, cultural studies, education, engineering science, environmental and earth science, geography and geospatial sciences, history, languages and literature, linguistics and translations, mathematics, media and communications, philosophy, religion and theology, and town and regional planning, among other fields. The largest proportion of authors are “scholars—other” (31 percent). Scholars of different fields are the most important source of original research data and primary resources to be used (visualized, digitized, and made available) in digital humanities projects. They can also provide a concrete and real research context for the materials and develop a strong linkage between the materials and potential future research directions. The South and South-East Asia Documentary Film Research Website developed by Hong Kong Baptist University Library (<http://digital.lib.hkbu.edu.hk/documentary-film/search.php>) can illustrate this point. After completing a series of research projects on South and South-East Asia documentary film, a film scholar at the University selected 1,787 pages of the official documents archived in the National Archives in the United Kingdom to be digitized and shared on the Research Website. On top of the digitized documents, the scholar also shares a detailed description of the research program, potential uses of the documents, and a complete list of related publications and presentations for user reference.

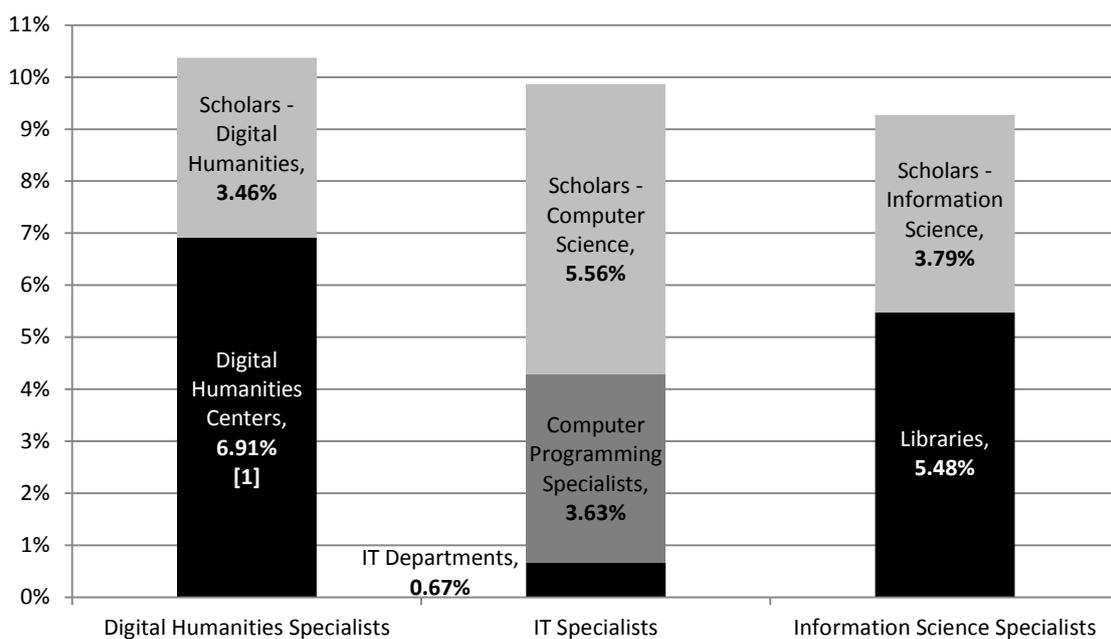
Figure 4: Distribution of Profession Types of Unique Authors



Students (14 percent) and researchers (13 percent) rank second and third in the distribution of professions. As a convenient and affordable source of research assistance, most student authors appear to be employees of individual projects or faculty, digital humanities centers, or libraries. These students are usually coauthors. A smaller group of students are sole authors who write research articles or project reviews. Across all five journals, 68 percent of student authors are doctoral students, 6 percent are master’s students, 4 percent are undergraduates, and 21 percent did not specify their level of study. Research staff have a similar description, but usually with more research experience and a more consistent work schedule. They contribute widely to the articles and the corresponding projects. The 13 percent calculated in this study covers only independent researchers or those hired by individual projects or faculty. Researchers employed by archival centers, digital humanities centers, IT departments, or libraries are grouped under their employers.

The most interesting part of the current study is the comparison of the involvement of digital humanities specialists, IT specialists, and information science specialists, as illustrated in Figure 5. Although these professionals give different impressions to others based on their individual level of activity (they may be seen as “advocators,” “collaborators,” or simply “support resources”), they provide important support for digital humanities development and share some common roles. Authors working in archival centers or museums are not included in this comparison, because these organizations tend to focus on providing primary materials for digitization and offering subject knowledge of the materials.

Figure 5: Involvement among Digital Humanities Specialists, IT Specialists, and Information Science Specialists



Note 1: Faculty members (scholars) hired by digital humanities centers also fall into this category

The black bars in Figure 5 indicate the functional units of digital humanities centers, IT

departments, and libraries established at a national, institutional, or organizational level. Most of these authors are practitioners who provide actual project support. The proportions of digital humanities centers (6.91 percent) and libraries (5.48 percent) are similar. The proportion of IT departments is particularly low (0.67 percent). Even after adding computer programming specialists—individuals who are employed by projects or faculty to provide IT support—the total proportion of IT practitioners (4.3 percent) is still much lower than the other two.

The light gray bars expand the comparison to include scholars of respective areas, generating an overall picture of these three special areas. Compared with practitioners, scholars usually have stronger theoretical knowledge yet good project experience. Digital humanities specialists (10.37 percent) form the largest of the three groups, followed by IT specialists (9.87 percent) and information science specialists (9.27 percent).

Discussion

The Collaborative Element of Digital Humanities

The notion that collaboration is often associated with digital humanities is strongly reflected in this study. Nearly 45 percent (44.73 percent) of digital humanities articles are written by multiple authors (average collaboration rate), ranking third among seven fields following biomedical research (79 percent) and information systems (81 percent, see Table 3). This figure is much higher than that of LIS (19 percent), and higher than those of theoretical disciplines such as sociology (33 percent), mathematics (34 percent), and economics (38 percent).

An average of 3.2 authors per coauthored articles (average collaboration extent) is found in digital humanities, ranking second among eight fields. According to M. E. J. Newman, collaboration extent may reflect how research is done in a field. Purely theoretical papers tend to have fewer coauthors, and experimental or partly experimental papers tend to have more.¹⁵ It is understandable that biomedical research ranks highest (3.75) because many laboratory projects require large groups of scientists. That digital humanities ranks second may prove its experimental aspect, as Spiro theorizes.¹⁶

Having considered both collaboration rate and collaboration extent, it seems reasonable to infer that digital humanities can provide more coauthorship and collaborative opportunities for librarians and scholars in theoretical areas (including arts, business, humanities, information science, and social sciences). This inference is backed up by Spiro, who suggests that “collaborative authorship is more common in digital humanities” than in “traditional humanities.”¹⁷

Another interesting finding is that among all coauthored articles, 26.28 percent involve cross-country collaboration. One article was written by nine coauthors from eight countries: Australia, Canada, Denmark, Germany, Greece, Ireland, the Netherlands, and Serbia. Libraries and

individual librarians should explore and consider global opportunities for collaboration in digital humanities and beyond.

The Global Development of Digital Humanities

The wide spectrum of geographic distribution demonstrates that digital humanities is a global movement. North America (predominantly the United States) and Europe have led the efforts, but Asia and Oceania are catching up, especially Taiwan (which ranks number five), Japan (number seven), and Australia (number eight).

However, it may not be easy to popularize digital humanities among Asian, African, and South American academics. The most obvious reasons include weak IT infrastructure, deficient electric power, and government control of the Internet in the developing countries of these continents. Even though Asia has several wealthy and well-developed countries and cities, including Japan, South Korea, Singapore, Taiwan, and Hong Kong, it also has many developing countries. The difficulties in analyzing and handling the diverse languages and characters used in these continents also form a major barrier. Take Asia as an example. According to a 2014 study, people in Asia speak 2,200 different languages, although many of them are minority or endangered languages; Europe has a mere 260.¹⁸ Even though the Chinese, Japanese, and Korean languages are commonly used in the region, today's computer technology still cannot index, sort, and extract these characters at a satisfactory level. Extra efforts to solve specific technical problems faced by these continents are necessary for the overall global development of digital humanities.

The Role of IT Departments

It is difficult to explain the involvement of IT departments in digital humanities simply by looking at the data of the current study. IT departments are usually indirectly involved in academic digital humanities initiatives through maintenance of the university's technological infrastructure. They may also participate in the overall institutional planning of the efforts, without directly engaging in the publishing process. Nevertheless, a few IT departments do provide direct project support. For example, the digital humanities program of the University of Oxford in the United Kingdom is a collaborative effort among five departments, including IT Services. According to the program's website, IT Services offers "help with the technical aspects of a funding [digital humanities] proposal, support for making audio/video presentations, [and] help to scope and design web applications and websites for research projects."¹⁹ Tracing the degree of involvement of IT departments will require further research.

Digital Humanities Centers and Libraries: Pedagogical Service

This authorship study shows that digital humanities centers generally have a higher involvement in digital humanities projects than libraries have had over the past years. The top digital humanities centers that most frequently appear in the dataset include the Maryland Institute for Technology in the Humanities of the University of Maryland in College Park (United States); the Roy Rosenzweig Center for History and New Media of George Mason University in Fairfax, Virginia (United States); the CulturePlex Lab of the University of Western Ontario in London (Canada); Matrix, the Center for Digital Humanities and Social Sciences of Michigan State University in East Lansing (United States); the Bruno Kessler Foundation in Trento (Italy); the Electronic Textual Cultures Lab of the University of Victoria in British Columbia (Canada); the Humanities Research Institute of the University of Sheffield (United Kingdom); and the UCL Centre for Digital Humanities of University College London (United Kingdom).

Diane Zorich surveyed 32 digital humanities centers in the United States.²⁰ Most of these centers operate in a university, and some are nonprofit organizations developed for a specific discipline or theme. Tim Bryson, Miriam Posner, Alain St. Pierre, and Stewart Varner surveyed 126 members of Association of Research Libraries (ARL) asking their involvement in digital humanities.²¹ Sixty-four libraries responded, for a response rate of 51 percent. Based on these two survey reports, with the addition of personal observations, Table 5 summarizes the support for digital humanities provided by digital humanities centers and libraries.

Table 5: Service Scopes of Digital Humanities Centers and Libraries in Terms of Digital Humanities Support

	DH Centers	Libraries
Major Services		
Digital humanities consultation – <i>providing expertise in national trends, best practices, peer review for DH projects, digitization, project management, etc.</i>	✓	✓
DH research projects – <i>project planning, grant seeking, actual development, etc.</i>	✓	✓
Facilities management – <i>managing DH lab, digital research lab, media lab, etc.</i>	✓	✓
Technical Services		
Technical infrastructure support – <i>building & maintaining the overall IT management system, servers, etc.</i>	✓	✓
Web site support – <i>developing and hosting websites, storage space, site mirroring, etc.</i>	✓	✓
Preservation assistance – <i>archiving paper and digital materials, developing migration plans, etc.</i>	✓	✓
Technical assistance – <i>metadata encoding, digital resource design, statistical analysis, hardware/software support, media digitization, etc.</i>	✓	✓
Pedagogical Activities:		
Academic programs – <i>offering certificate, undergraduate, and/or postgraduate degrees in DH</i>	✓	---
Courses – <i>teaching courses in DH for diverse disciplines, train-the-trainer programs, etc.</i>	✓	✓
Internships – <i>assigning students to a particular project / research with academic credit and / or pay given</i>	✓	✓
Fellowships – <i>offering fellowship opportunities to support research, project development, teaching, etc.</i>	✓	---
Training events – <i>organizing lectures, conferences, and / or seminars to promote DH, provide training on the use of self-developed or other resources, discuss instructional or research technologies, etc.</i>	✓	✓
Other Contributions:		
Tool development – <i>developing plug-ins, conversion tools, media annotation tools, authoring tools, digital libraries software, etc.</i>	✓	✓
Publications – <i>publishing e-journals, textbooks, white papers and articles, standards, etc. regarding DH</i>	✓	✓
Grant administration – <i>providing and administrating seed grants to assist in DH project start-ups</i>	✓	✓

Copyright – <i>handling copyright and liaising with copyright holders</i>	---	✓
Publication assistance – <i>providing researchers with advice and assistance of publishing</i>	---	✓

Digital humanities centers and libraries each have their own strengths; for example, digital humanities centers may have a stronger academic and research background, while libraries are in general better suited for information management and metadata encoding. However, both entities offer similar services. Table 5 shows a specific advantage of digital humanities centers over libraries, their strength in pedagogical service. Many large digital humanities centers offer academic programs in digital humanities and support various kinds of internships and fellowships. The Center for Digital Humanities (<http://www.cdh.ucla.edu/>) at UCLA in Los Angeles in the United States; the UCL Centre for Digital Humanities (<http://www.ucl.ac.uk/dh/>) in the United Kingdom; the McGill Digital Humanities (<http://digihum.mcgill.ca/>) at McGill University in Montreal, Canada; and the Digital Humanities Center for Japanese Arts and Cultures at Ritsumeikan University (<http://www.arc.ritsumeikai.ac.jp/lib/GCOE/e/>) in Kyoto, Japan, are some of the many successful examples of such programs. Although the Research Center for Digital Humanities at National Taiwan University (<http://www.digital.ntu.edu.tw/en/>) in Taipei, Taiwan, does not directly offer academic programs, this university-wide center provides sponsorships to encourage postgraduate students of different fields to engage in digital humanities research.

Digital Humanities Centers and Libraries: User Groups

Libraries, however, have their own strong suits. First, libraries are usually established for a wider user group. National libraries serve a whole nation, and academic libraries serve an entire institution, without tilting toward one or two specific groups of users. Digital humanities centers, on the contrary, are more often established to serve specific users, as Zorich notes:

The directors of DHCs [digital humanities centers] under university governance most often report to an academic or administrative dean of a school, college, or division at the university. The next most frequent “direct report” is to a university vice president or provost, followed by the chair or faculty of the department in which a center is physically located . . . Of the two DHCs that are independent organizations, one director reports to a board of trustees, and the other to the center’s funders.²²

For example, the Humanities Computing unit of the University of Chicago (<https://humanitiescomputing.uchicago.edu/>) was developed under the university’s Division of the Humanities to meet the needs of the division. The Center for Literacy Computing of West Virginia University in Morgantown (<http://literarycomputing.wvu.edu/>) is a special unit within the English Department. Broadly speaking, libraries could reach and serve more researchers across disciplines, whereas digital humanities centers (particularly those with a smaller scale) tend to serve a specific

school within a university or a group of scholars sharing the same research interests.

Digital Humanities Centers and Libraries: Staffing Model

Libraries supporting digital humanities usually perceive it as one of their core services and are generous in providing staff resources. Bryson, Posner, St. Pierre, and Varner's survey shows that 35 percent of libraries have staff dedicated to digital humanities service.²³ This percentage has likely increased since that report was released in 2011. On the American Library Association's JobLIST (<http://joblist.ala.org/jobseeker/search/results/>), job seekers can find numerous digital humanities positions offered under different titles, for example, "digital humanities librarian," "director of technology and data management," "director of digital scholarship commons," "digital initiatives coordinator," "librarian for research data," and "GIS (geographic information service) librarian," not to mention an array of support positions that include computer programmers, research assistants, library assistants, and others. Taking the author's library (Hong Kong Baptist University Library) as an example, the unit that supports digital humanities has doubled its staff in two years, from one professional librarian and three support personnel to two professional librarians and six support personnel.

Job openings posted on the "Job Announcements" page of the Web publication "Digital Humanities Now" (<http://digitalhumanitiesnow.org/category/news/job/>) also continue to increase in number, although some of these postings are actually library positions. However, the phenomenon of "shared appointments" mentioned by Zorich is still common in digital humanities centers. She says:

Ninety-two percent of university-based centers have staff with faculty appointments in other academic departments . . . Of 47 joint positions identified, 88 percent are fully funded by the academic department (not the center) . . . shared appointments also occur between the centers and various administrative departments and research centers . . . Senior scholars and research scientists (the latter often from campus computing centers) may also have joint arrangements.²⁴

Shared appointments are evidenced in the current study. Thirty-five percent of authors who work at digital humanities centers take other job commitments, an arrangement that has pros and cons. The positive side is that it may be easier for the center to get buy-in from the sharing departments and their faculty. The negative side is that shared appointments may bring unnecessary distraction and confusion to staff, especially when job priorities are not clearly stated or firmly implemented.

Digital Humanities Centers and Libraries: Resources

According to Bryson, Posner, St. Pierre, and Varner, 90 percent of libraries that support digital

humanities fund these activities through the library's operating budget; 52 percent of libraries allocate library space for digital humanities development.²⁵ By contrast, digital humanities centers at universities receive support, Andrew Prescott says, in the form of "annual budget lines or . . . funding provided by individual schools or departments working with the centers . . . [as] baseline operating funds or startup funds, universities frequently subsidize staff salaries, student support, and infrastructure (such as office space or technology)."²⁶ The same author also stresses that many digital humanities centers find it difficult to keep going after 10 or 20 years. "Most digital humanities centers are established following some successful research grants, and 'soft' research funding is generally the lifeblood of the center," he explains. "[Their] pressing issues of sustainability are . . . securing reliable long-term funding to keep the center's staff in place."²⁷

In universities, libraries are a standing department, and a library's operational budget is part of the daily expenses of the university. By building digital humanities support into the infrastructure of a library, a university can use existing financial, physical, and human resources to promote this new initiative. This arrangement can ensure stable, persistent support for digital humanities. Nevertheless, the "sacrifice" made by these libraries should be recognized. Most often, when libraries shift their priorities to support digital humanities, they must give up or scale down other services, mainly those related to physical collections, such as, shelf management, collection management, and counter services.

Study Limitations

The present study has several limitations. A lack of standards for author biographies within the same journal and across five journals could lead to misinterpretation of an author's profession. It is increasingly common for an individual to hold several roles within an institution. An author may work in a university library, serve in the university's digital humanities center, and hold a faculty appointment in another academic department simultaneously. Unfortunately, this information is often vaguely described, without specifying which roles are primary and which are secondary or part-time. This study counted all roles described in an author's biography.

The complicated connection between digital humanities centers and other units at some universities could potentially cause another type of misinterpretation. For example, a university's digital humanities center may be established by, and belong to, the university library. In this case, the current study gives credit to the higher level of management and classifies that particular author as belonging to "libraries." If a digital humanities center is built and managed under the collaborative effort of two or more departments that include an IT department and a library, the author's profession type is then determined case by case.

Conclusion

Digital humanities centers are important to the development of digital humanities, particularly with their efforts in pedagogical service. Libraries can also make valuable contributions to collaborative partnerships because of the inherent structure of a library as well as the skill sets of individual librarians. Libraries have a nationwide or institution-wide purpose, staff dedicated to digital humanities services, and stable financial and physical resources, enabling them to support collaboration in digital humanities. Both large and small libraries may become part of this exciting and promising opportunity.

Because collaboration is the key to success in digital humanities, libraries and digital humanities centers should continue to explore collaborative opportunities between them, and offer their strengths and expertise for the development of digital humanities and the overall benefits of the academy. Some libraries establish or sponsor digital humanities centers, and other libraries appoint their staff to digital humanities centers to support collaborative projects. Building on the success of these structures would be one feasible direction for collaboration between these two parties. In any case, libraries have proved themselves as core contributors to digital humanities, and they should continue to engage in and contribute to this development.

Acknowledgments

The author thanks Eugenia Kim for proofreading help and Steve Wong for assistance in retrieving part of the author data from the Web.

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