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An Investigation in the Interdisciplinary Nature of Digital Humanities: A Bibliometric Analysis

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ABSTRACT

The disciplinary structure and dimensions of digital humanities is evolving for many years. Even though several journals focus solely on digital humanities, the interdisciplinary nature of digital humanities remains a fact. The current study is an endeavor to understand the linkage of the digital humanities with other disciplines in the universe of knowledge so that researchers from multiple subject backgrounds can carry out research on digital humanities in a more vivid manner. The present research will prove valuable for researchers, authors, and decision-makers of research and development organisations and other institutions to carry out collaborative research activities on individual and organisational levels. The research results and discussions of this research publication will enlighten the researchers from the digital humanities subject field to take a decision in a better way regarding the evolution and interdisciplinary research activities in digital humanities and the incorporation of methods and techniques from library and information science and computer science to expand the horizons of the subject field (digital humanities). The author conducted a bibliometric analysis focusing on the objectives to discover linkages and an interdisciplinary approach to digital humanities. The results infer that the highest number of authors active in research activities in the digital humanities belong to computer science followed by art and humanities and library and information science disciplines. The journals preferred for publication of research on digital humanities are also analysed, and it is found that the highest number of journals are from the literature discipline, followed by art & humanities, computer science, history, and library and information science. The publication productivity of journals is also studied, and it is found that "Digital Scholarship in the Humanities" is the most productive journal and that it belongs to the humanities discipline. In the list of the top ten most productive journals, five belong to the discipline of Library and information science. The study of citation and bibliographic coupling displays that the journals "Journal of Documentation" and "Digital Scholarship in the Humanities" are the most cited journals. During this research endeavor, emphasis is given to the subject affiliation of authors, journals and publications. It's been found that digital humanities research is actively related to the disciplines of library and information science and computer science.

Keywords: Digital humanities; Library & information science; Bibliometrics, Web of science

1. INTRODUCTION

Digital humanities though broadly accepted as the intersection of computer technology with the traditional humanities disciplines, doesn't have a very accurate subject definition yet. The nature of this discipline has remained changing from time to time. On one hand, the application of computers to humanities and arts disciplines is been practiced for many decades, and on the other hand, a new discipline called "digital humanities" is in the making without any clear subject definition yet.

Bibliometric studies are conducted to carry out quantitative analysis of research publications on a given topic/field/scientific idea. In present times several tested and tried reliable statistical/bibliometric tools and indexing databases are available for more precise research to analyse the trends in research activities in a given field and or topic. Every new area of research is being analysed by bibliometricians to give concrete tabulated results regarding progress in that particular subject field/topic of research using a wide variety of widely accepted parameters and based on reliable data. Digital humanities is not an exception and hence a lot of bibliometric studies have already been done to understand the research trend in the area. And the use of bibliometric/statistical/scientific tools and techniques is regarded as one of the factors for the transformation of humanities to digital humanities.

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Bibliometric studies, in addition to having a lot of potential for measuring the quantitative aspect of knowledge creation, also show a lot of information about the relationships between different subject disciplines. A bibliometric analysis of the publication productivity of the digital humanities provides a wealth of information about researchers' research activities and affiliations with subjects and institutions. The researchers producing research publications on digital humanities may have different backgrounds as far as their discipline is concerned. A bibliometric study of research production in the digital humanities will give a clearer idea about the subjects in which the research production is published. On the other hand, the bibliometric analysis of journals with a concentration of publications in the digital humanities can also give an idea of a "cross-disciplinary inscription pattern". The citation pattern can be used as another measure to see how publications on digital humanities are cited to understand the links between different disciplines. This study focuses on the bibliometric analysis of publication productivity in the digital humanities, as well as the subjects to which these scientific publications are related and to which subjects the most productive authors and journals belong. Researchers with library and information science backgrounds have done a number of bibliometric studies of digital humanities in order to understand the research trend in "Digital Humanities" visa vis chronological and nation-wise productivity, authorship pattern, journal and author-wise productivity, and many more.

2. REVIEW OF LITERATURE

Liu, A.[1] is of the view that a rapid state of expansion is seen in the field of digital humanities and the present Digital Humanities and "humanities computing" is an older concept which is getting overlapped with the current concept of digital humanities. According to Liu, digital humanities have become more integral and expansive in five ways which include unification of foundational concepts, integration with the past, rejoining the social, scaling up and expanding the paradigm. Drucker, J.[2] is of the view that digital humanities is actually the study of role of digital humanities in the transformation of teaching, thinking and writing.

Schreibman, *et al*.[3] advocates the digital humanities as an established field because of presence of its own journal and conferences.Smith, M.N.[4] discovered that Index Thomisticus was one of the first ever source of humanities in electronic form. Dalbello, M.[5] while tracing the genealogy of digital humanities found that it started around 1950's with the beginning of Index Thomisticus followed by the technological advances in 1980's. Wang, X. and Inaba, M.[6] noted that digital humanities is "methodological in nature and interdisciplinary in scope". In an endeavor to analyse the evolution of digital humanities. They carried out a co-word analysis and correspondence analysis. They discovered how the digital humanities is evolving for the last four years. They also studied the disciplinary structure and semantic dimensions of digital humanities. Sula[7] studied the relation between digital humanities and libraries by studying publications of library science specific journals. They studied the publication related to digital humanities in "Library, information science and technology abstract" and found an increase in the publication related to digital humanities from 2005 onwards which almost got doubled in 2012.

Ma, R. & Li[8] studied publication of articles in journals and found that most of the articles are published in the journal "Digital Scholarship in Humanities" (82 publications) followed by "International Journal of Humanities and Arts Computing" (37 publications) and "Journal of computing & cultural heritage" (33 publications).Wang, Q. (2018)[9] carried out a bibliometric analysis of publications on digital humanities. They found a positive growth in publication productivity on digital humanities with 1 publication in 1968 and 229 in 2016 with more than 90 % of publication in english language. King's College London, University College London and Indiana College USA are the three top contributors in digital humanities research. the authors also studied the journal wise distribution of digital humanities research and found that "Literary and Linguistic Computing" is the most productive journal with 48 articles followed by "Computers& The Humanities" (26 articles), "Digital Humanities Quarterly" (23 articles) and "Digital Scholarship in the Humanities" (20 articles).

Robinson, L. *et al.* (2015)[10] displays that new journals specific to the digital humanities are being published but its seen that many research articles on digital humanities appears in journals and other sources which are regarded as sources of library and information science. In the research paper the authors have made displayed extensive knowledge regarding the inter-linkage of library and information science and digital humanities.

A scientometric study was carried out by Gupta, N. & Chakravarty, R.[11] and found the literature on digital humanities show a positive growth and USA is the leading nation in digital humanities research. They found that of the top three most productive documents are conference proceedings and book series followed by journals on from the subject area of computer science, arts and humanities and library and information science. The authors summarised their research findings with the note that most of the publications on digital humanities appeared in social science field followed by computer science and Arts & Humanities fields. Spinaci, G., Colavizza, G. & Peroni, S. (2022)[12] made an extensive study to map the research productivity on digital humanities using five different bibliographic sources. Similarly, Amanullah A (2022a)[13], (2022b)[14], (2022c)[15] carried out scientometric studies on publication productivity of Gastritis research and used a number of scientometric tools. Amanullah A (2019)[16] compared the publication productivity of two universities by bibliometric analysis. Amanullah A (2021)[17] made a scientometric study on research communications on "Ladakh". Amanullah A (2018)[18] made a bibliometric study on research output on "E-Learning".

3. OBJECTIVES OF THE STUDY

In view of the interdisciplinary scope of digital humanities the main objective of this research is to identify the relation of digital humanities with other subject fields so that it can be known that to which subject field this disciplinebelongs to or more related to. For achieving this very objective the researcher carried out the scientometric analysis of the digital humanities research output and pinpointed some objectives as under:

- To identify the major research areas (Subject Field) where extensive research on digital humanities is carried out.
- To identify the major sources where the publications on digital humanities appear so that subject affiliation of the sources publishing can be ascertained in order to find out the relation of digital humanities with other subject disciplines.
- To identify the author's subject affiliation who are contributing to digital humanities research.
- To find out the applicability of Bradford's law so that the concentration of articles in the core zone journals can be ascertained which will help understand the biasness of digital humanities to certain subjects.
- To identify the top contributing journals in digital humanities research visa vis their subject affiliations.
- To find out the author keyword Co-occurrence network and bibliographic coupling network of sources.

4. METHODOLOGY

For the current study data has been extracted from one of the popular indexing database "Web of Science". Web of Science core collection has been used and the search term "Digital Humanities" was put in the search box as topic. Time period filtration was used and the data was extracted for 15 year from 2008- 2022. Scientometric tools like bibexcel and HistCite was used in order to extract accurate and needful data in the form of tables for further comparison and analysis so that objectives could be achieved. The visualisation software VOSviewer was used for displaying visualisation maps besides making use of microsoft office tools also.

5. LIMITATIONS OF THE STUDY

This study is being carried out using one of the available indexing databases Web of Science. More Indexing databases can be used in order to include a large number of journal articles for such studies. By using only one database, a comparative study based on databases could not be carried out. The scope of this study is thus limited to the research publications indexed in the web of science database as well as for a limited period of 15 years (2008-2022). Only those scientometric tools and techniques are used which were necessary to attain the objectives of the study and is focused on understanding the interdisciplinary nature of "Digital Humanities".

6. ANALYSIS AND DISCUSSION

To understand the publication productivity and interdisciplinary nature of digital humanities and to carry out a bibliometric analysis to achieve the said objectives of this research the author used one of the popular indexing databases "Web of Science" by using the term "Digital Humanities". It was found that for the time period of 2008- 2022 a total number of 4297 authors contributed 2079 publications in 813 different journals, 20 different languages and 16 different document types from 91 different countries.

6.1 Analysis of Publications by Research Area (Subject Field)

Around 95 subject areas are identified in which publications on digital humanities appear. Data in the table 1shows the list of top 20 Research areas (Subject fields) in which the digital humanities research output appeared. Arts & humanities subject ranks on the top with 384 publications followed by literature, computer science and library and information science with 339, 333 and 329 publications respectively. The appearance of research publications on digital humanities in diverse subjects informs us that it is an interdisciplinary subject. The top five subjects in which the publications appear share almost same number of publications each thus defines the interdisciplinary nature of the field of digital humanities.

Table 1. Publication productivity on digital humanities by subject

S. No.	Research area (Subject)	No. of publications
1	Arts & Humanities	384
2	Literature	339
3	Computer Science	333
4	Information Science & Library Science	329
5	Linguistics	280
6	History	167
7	Social Sciences - Other Topics	109
8	Communication	93
9	Education & Educational Research	63
10	Science & Technology - Other Topics	61
11	Business & Economics	54
12	Engineering	54
13	Geography	54
14	Environmental Sciences & Ecology	47
15	Psychology	46
16	Cultural Studies	41
17	Music	39
18	History & Philosophy of Science	37
19	Religion	34
20	Archaeology	33

6.2 Subject Wise Affiliation of the Sources

The publications on digital humanities appeared in more 813 journals affiliated to diverse subject fields. The analysis of the sources/journals visa viz their subject affiliation gives an idea about the publication trend in digital humanities research. The data given in the table-2 shows the top 20 subject fields to which the sources belong to. Data shows that highest number of journals in which publications appeared on digital humanities belongs to literature subject (115 journals) followed by arts and humanities, computer science, history, information science & library science with 79, 77, 73 and 58 journals respectively. The record wise analysis shows that despite being on 5th rank with 58 sources/journals in the information science and library science subject it ranks third in number of publications contributed on digital humanities. Source wise subject affiliation shows that research publications on digital humanities appeared in sources of diverse subject backgrounds thus informing that digital humanities is interdisciplinary in nature.

Table 2. Subject wise number of sources contributing to digital humanities research

S. No.	Subject	Source	Records
1	Literature	115	329
2	Arts & Humanities	79	373
3	Computer Science	77	279
4	History	73	182
5	Information Science and Library Science	58	320
6	Education and Education Research	32	53
7	Linguistics	32	116
8	Engineering	28	47
9	Communication	25	85
10	Archeology	22	42
11	Psychology	22	31
12	Social Science, Sociology	22	46
13	Music	20	38
14	Religion	19	31
15	Cultural Studies	18	35
16	Environmental Science	18	23
17	Business & Economics	17	23
18	Anthropology	14	20
19	Geography	14	21
20	Philosophy	14	26

6.3 Subject Field Wise Number of Authors

A total of 4297 authors contributed in digital humanities research for the given period. The analysis of subject affiliation of the authors displayed in table 3 show that highest number of authors are affiliated to computer science subject (1224 authors) followed by Art, Arts and Humanities (849 authors), Information Science & Library Science (787 authors) and Linguistics (630 authors). This implies that authors from diverse subject background contributed to digital humanities research in diverse sources.

Table 3. Subject field wise number of authors contributing to digital humanities research

S. No.	Subject area	No. of authors
1	Computer Science	1224
2	Art, Art and Humanities	849
3	Information science library science	787
4	Linguistics	630
5	Literature	497
6	History	304
7	Science and Technology	263
8	Environmental Science	196
9	Archeology	129
10	Education	117
11	Social and Sociology	94
12	Psychology	80
13	Anthropology	44
14	Geography	37
15	Chemistry	35

6.4 Bradford's Law and Subject Wise Affiliation of Journals in the Core Zone

SC Bradford[19] caried out a research to understand the article scattering in journals on a given topic. He found that most of the articles on a given topic is concentrated in fever journals. He then proposed a phenomena that if 1/3rd of the articles are produced by n number of journals and the next 1/3rd is produced by n^2 Journals and so on.

The analysis and the data in table-4 shows that Bradford's law is not applicable to the current study. The ratio of journals for each 1/3rd of the article is 36:178:599 which show that the core zone is very much extended, the second zone is also concentrated. This means that there is a dearth of core journals for digital humanities subject which on the other hand supports the proposition that digital humanities is interdisciplinary in nature.

6.5 Author Keyword Co-occurrence Analysis

Author keywords used in digital humanities research publications are analysed using BibExcel and VOSviewer software. The most frequent author keyword is digital humanities followed by humanities, digital history, cultural heritage, big data, digital library, artificial intelligence and digital. The VOSviewer map in the figure 1 gives an apt display of author keyword co-occurrence network visualistion.

Table 4. Bradford's zone wise distribution of digital humanities output

S. No.	Zone	No. of journals	No. of articles
1	Zone-1	36	695
2	Zone-2	178	692
3	Zone-3	599	692

6.7 Top Productive Journals and Their Subject Affiliation

From the data displayed in the table 5 we can deduce that of the top ten most productive journals one belongs to both Arts and Humanities and Linguistics subject, one belongs to both Arts and Humanities and Computer Science, one belongs to Linguistics and Literature, one belongs to History and Social Science and one belongs to science and technology, two belongs to both computer science and information and library science and three belongs to information science and library science. This analysis shows that five of the top ten most productive journals are from the information and library science field. From this we can say that there is a closer relation of "Digital Humanities" with Library and information science subject. Though highest number of publications appeared in the journal "Digital Scholarship in Humanities" which belongs to arts and humanities subject. Out of the

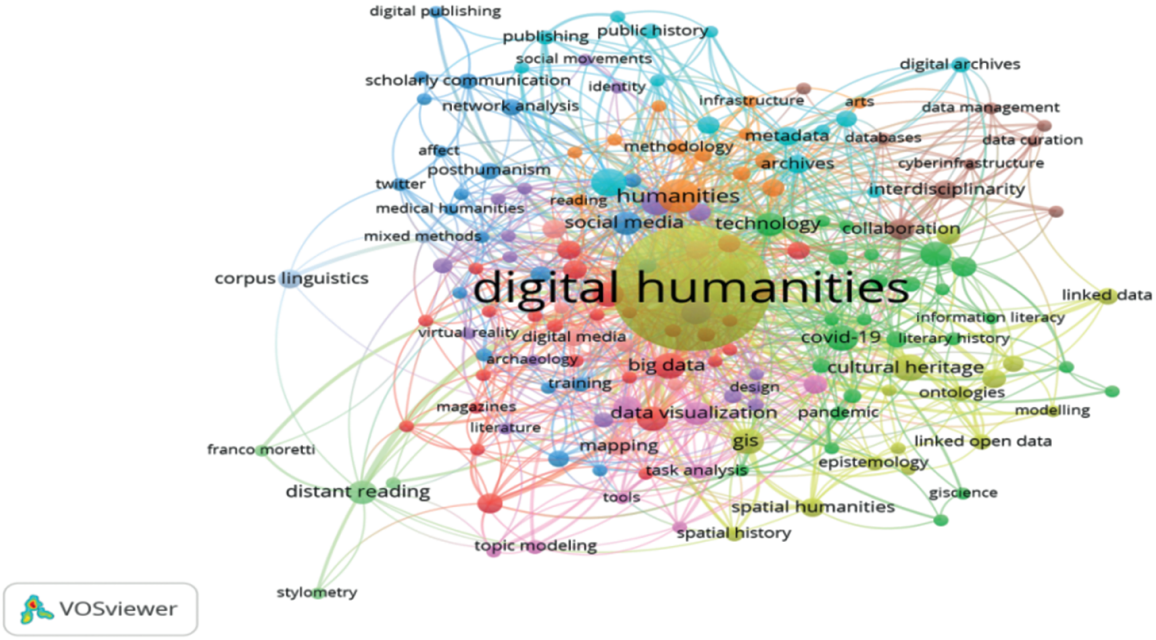

Figure 1. Network visualization of author keyword co-occurrence analysis.

6.6 Visualising Bibliographic Coupling of Sources Where Publication on Digital Humanities Appeared

The network visualisation on bibliographic coupling of journals is given in figure 2. Six clusters can be seen in the map where the journal "Digital Scholarship in Humanities" and "Journal of Documentation" show very heavy network. The study of the data shows that journals of subject fields of humanities and information and library science are highly cited and have heavy networks.

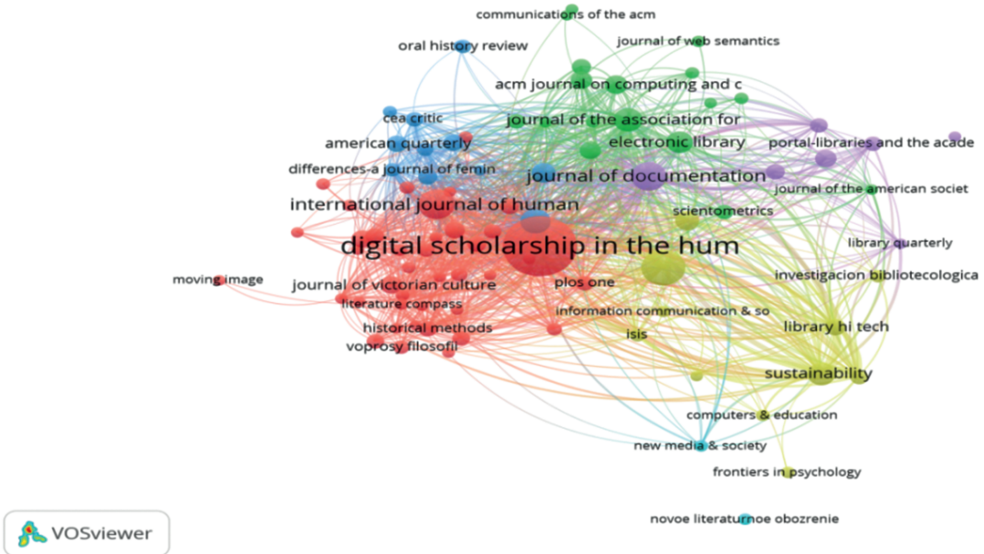

Figure 2. Network visualisation showing bibliographic coupling of sources.

Table 5. Top productive journals and their subject affiliation

S. No.	Source title	No. of records	Subject area
1	*Digital Scholarship in the Humanities*	156	Arts & Humanities - Other Topics; Linguistics
2	*Literary and Linguistic Computing*	56	Linguistics; Literature
3	*International Journal of Humanities and Arts Computing- A Journal of Digital Humanities*	38	Arts & Humanities - Other Topics; Computer Science
4	*Historical Social Research*	27	History; Social Sciences - Other Topics; Business & Economics
5	*Sustainability*	22	Science & Technology - Other Topics; Environmental Sciences & Ecology
6	*Journal of the Association for Information Science and Technology*	114	Information Science & Library Science Computer Science;
7	*Journal of Documentation*		
8	*Electronic Library*		
9	*Profesional De la Informacion*		Information Science & Library Science
10	*Library Trends*		

top ten most productive journals "Digital Scholarship in Humanities" journal produced 154 articles while as five journals from library and information science subject together produced 114 articles.

7. CONCLUSION

This study was focused on finding out the subject affiliation of the research publications on digital humanities along with the subject affiliation of the authors and sources. The bibliographic coupling of sources, the co-occurrence of author keywords, and the applicability of Bradford's Law were also studied. From this study, it's found that "Digital Humanities" is an interdisciplinary subject to which researchers from diverse subject specialties are actively contributing. Aside from one journal from the humanities, five journals from the library and information fields are listed among the top ten most productive journals. In terms of publication productivity on digital humanities, the discipline of library and information science ranks fourth. Library and information science subjects rank third in the list of the number of authors contributing to digital humanities research. The Journal of Documentation (A library and Information Science field journal) ranks second in the list of top cited journals. From the study of the applicability of Bradford's law of journal productivity, it was found that the core zone is more extended, which in turn implies that digital humanities is interdisciplinary in nature. From the above study, it can be deduced that digital humanities have a close relationship with the subject of library and information science.

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