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ZBIGNIEW OSIŃSKI
Maria Curie-Skłodowska University in Lublin

DEVELOPMENT OF DIGITAL CULTURE RESEARCH— BIBLIOMETRIC ANALYSIS USING CITESPACE

INTRODUCTION

Since the mid-twentieth century, cross-sectoral competition for public financial resources has been increasing in Europe. The level of financing of public institutions, including universities and research institutes, is increasingly dependent on social attitudes towards what these institutions contribute to society and the economy. In order to win the competition for public funding, the higher education and science sector must be more competitive in its arguments. It must show in more detail and an objectively measurable way what it brings to society and the economy. Many countries have adopted the principle that the objective measures of this contribution include the position of universities in international rankings and the number of publications in journals indexed in the most prestigious bibliographic databases (Kwiek 2015). As a result, interest in both bibliographic databases and the data they contain has increased. Using bibliographic data, quantitative research is carried out on the development of scientific disciplines and specialties (Opaliński 2017a, 2017b). The increasing availability of digital data on scholarly outputs offers unprecedented opportunities to explore the structure and

Adres do korespondencji: zbigniew.osinski@mail.umcs.pl; ORCID: 0000-0003-4484-7265

evolution of science. The science of science (SciSci) offers a quantitative understanding of the interactions between institutions, publishers, journals, publications and authors (Fortunato et al. 2018).

However, it is not a common practice or one covering all fields of science to the same degree. In the humanities, there are specialties neglected in terms of quantitative analyses of their development. Most of the research on the development of these specialties boils down to qualitative and personalised analyses of the scientific literature. An example could be analyses of the development of digital culture research. Several important publications on this subject can be mentioned. Mark Deuze (2006) described discussions on the essence of digital culture and its components: participation, remediation and bricolage. Stacey Koosel (2011) presented a discourse in digital culture research using the philosophy of scientific revolution (Thomas S. Kuhn) as a key source for understanding the current state of the field of science. Jing Yuan and Zheng Jianming (2017) analysed digital culture research based on papers published in the field of library and information science since 2000. David M. Berry and Anders Fagerjord (2017) characterised discussions that touched upon the problem of digital culture as a subject of research in digital humanities. One of the most recent reviews of digital culture debates was prepared by Grant Bollmer (2018).

Scientometrics, a journal specialising in quantitative research on phenomena occurring in science, has published only four articles that the journal's internal search engine associated with the term "digital culture". However, none of them dealt with quantitative research on the development of digital culture. After using the terms "digital culture" AND "quantitative research" and the Search: Topic (Title, Abstract, Keywords) function, the Web of Science database returned three publications (none of them concerned quantitative research on the development of digital culture), and the Scopus database did not show any publication. The Google Scholar search engine did not return any results after using the search terms "quantitative studies of digital culture" or "quantitative research on digital culture".

Getting to know the state of research on the relatively new issue that digital culture is may be important not only for the humanist. This is because the development of contemporary culture, the main research area of representatives of many academic specialties, has been greatly influenced by digital techniques and information and communication technologies creating (or being created by) the phenomenon called digital culture. More and more works of culture are being produced in a digital version,

and a significant part of the human mind's creations from past centuries has been digitised. Many people's culture-making activities, education, social contacts, media, libraries, archives, museums, computer games, and even religious and sexual activities are all part of the on-line reality. In the virtual space, time and geographical borders are disappearing, convergence of the media is taking place, both remix culture and communication based on memes and emoticons are developing, and the phenomenon of self-publishing has become popular. Many works are available on an open access basis, but at the same time copyright is being violated on a large scale. The Covid-19 pandemic has seen actors, visual artists, musicians and performers presenting their works on-line. Blogs, video blogs, social media profiles and YouTube channels are growing in popularity. There is therefore good reason to conduct analyses of the state of digital culture research, and not only qualitative but also quantitative—which can affect the scientific objectivity of the knowledge obtained. Knowledge based on quantitative data is more compelling to decision makers.

DEFINING DIGITAL CULTURE

So far, a relatively small group of researchers has undertaken the development of the definition of the term "digital culture". The definitions present various approaches to the reality known as digital culture. However, for the purposes of this article, it is sufficient to provide a few of the more recent definitions. According to Charlie Gere (2008), the existence of a distinct digital culture can be inferred from the cultural trends described above. Digitality can be seen as a determinant of this culture, as it encompasses artefacts and communication as well as meaning-making systems that clearly separate contemporary ways of living from earlier, pre-digital and pre-internet ones. In doing so, Gere challenges two popular beliefs about digital culture. One of them suggests that such culture represents a decisive break with what preceded it, while the other suggests that digital culture derives from and is determined by the existence of digital techniques and technology. Gere implies that digital technology and techniques are products of digital culture, and not the other way around. He argues that digitality, in the context of culture, refers not only to the effects and possibilities of a given technology because it defines and covers the ways of thinking and acting that are embodied in that technology, and enables its development. According to Gere (2008), techniques and technology are only one of many factors that have contributed to the development of digital culture. Other factors embrace

technoscientific discourse on information and information systems, avant--garde artistic practices, countercultural utopianism, critical theory and philosophy, and even subcultural formations such as punk. In his opinion, these phenomena have become co-creators of the paradigm of abstraction, codification, self-regulation, virtualisation and programming that underlies digital culture, just as much as the computer and the internet. Digital culture in turn is a result of complex interactions and dialectical engagements between the aforementioned phenomena.

Stacey Koosel (2011) considers that digital culture derives from the technological development of interactive and social media, which enable internet users to create online communities, establish relationships, and construct and use digital identities. According to Koosel, the term "digital culture" also refers to the study of information age culture, including online cultural heritage.

Tula Giannini and Jonathan P. Bowen (2019) in turn assume that the digital revolution has created cultural cyberspace and blurred the boundaries between real and virtual life and between real and digital culture. These researchers include the following factors among the most significant changes leading to the evolution of culture towards digital culture: changes in people's consciousness and attitudes brought about by the internet, digitalisation and convergence of the media, digital and global social interactions, the creation of digital art, widespread culture-making expression (e.g. the phenomenon of the selfie, remixing, blogging, sharing and liking), the sharing of digital versions of cultural works, as well as virtual and augmented reality and artificial intelligence.

In one of the newest definitions Vincent Miller (2020) highlights the crucial importance of information and telecommunication infrastructure for transforming people's cultural activity in the information age. He links cultural transformations with the innovative character of the new media. Miller sees technology impacting cultural transformations and culture influencing the development of technology. Digital culture, in his definition, is a factor co-creating the information society and at the same time being its product. He includes among the most important manifestations of digital culture the emergence of new cultural products closely related to digital technologies (e.g. electronic performance and computer games), the convergence of media, the development of participatory media, the presence of digital divisions and inequalities, the undermining of traditionally understood privacy, network civic activity, cybersex, as well as social and economic relationships in the reality of networks reaching beyond temporal and spatial barriers.

Nelson Chuquihuanca and others (2021) consider digital culture a phenomenon where technology and the internet significantly shape the way in which individuals act, behave, think and communicate as human beings. Thus, digital culture is a product of the presence of technologies (virtual reality, the internet and mobile devices, among others) in society.

RESEARCH GOALS AND METHODS

The aim of the research described in this article was to conduct a quantitative analysis of the development of digital culture research based on bibliographic data. The method used goes beyond the traditional counting of publications and citations as well as drawing conclusions based on reading the content of academic papers. It assumes the use of bibliographic data and the CiteSpace program to identify and visualise the co-citation network, thematic structure, turning points and dynamics of digital culture research. It also involves the detection of authors, journals and scientific publications that have contributed to the development of research on specific aspects of digital culture. I would like to promote quantitative indicators used in CiteSpace analyses—such as co-citation network, network thematic homogeneity, modularity, and betweenness centrality—in the humanities and social sciences. Implementing this intention should objectify knowledge on the development of digital culture research, which will be useful for researchers potentially interested in knowing what they should read in order to understand the foundations and turning points of digital culture research. It could be helpful for all those who want to find publications that have had a real and significant impact on the development of research on specific aspects of digital culture. It will also help scholars identify topics whose research is developing or, on the contrary, disappearing. This type of knowledge could have a significant impact on the perception of both the digital culture itself and research in this sphere of human activity by political and scientific decision-makers.

To achieve the aforementioned goals, bibliometric analyses were carried out based on the bibliographic data from 1996 to 2022 extracted from the Scopus database (27.05.2022). The Scopus database was chosen as the source of bibliographic data because it is one of the two largest global multidisciplinary bibliographic databases. This database, compared to the Web of Science, indexes a dozen or so percent more publications, both journals and books. In 2019, it included 23,700 active journals,

over 8 million conference proceedings, and more than 150,000 books (Tabacaru 2019).

Bibliographic data was collected for the term "digital culture" (Search within: Article Title, Abstract, Keywords; Document type: Article, Conference Paper, Book, Book Chapter; Subject area: Arts and Humanities, Social Sciences; Export: RIS Format—Citation information + Affiliation + Abstract & Keywords + Include references).

The complete bibliographic datasets were employed to advanced analyses carried out in the CiteSpace program (https://citespace.podia.com/). This application is employed to visualise and analyse bibliographic data downloaded from certain scientific databases. Based on the bibliographic data of different scientific texts and the list of citations included therein, CiteSpace generates interactive visualisations of networks of links from which various trends, regularities, and patterns, as well as the structure and dynamics of the knowledge domain, can be inferred.

CiteSpace analyses are based on the detection of co-citation networks. Co-citation is the frequency with which two documents are cited together by other documents. The more co-citations two documents receive, the higher their co-citation strength, and the more likely they are semantically related (Small 1973). The strategy of co-citation analysis of document titles rather than author names was adopted because it enables more detailed and reliable patterns to be noticed, and offers less ambiguous interpretations (Chen, Ibekwe-SanJuan, Hou 2010). It also bypasses the problem of multi-author texts, because CiteSpace considers only data on the first author. The foundation for clustering in CiteSpace is provided by the analysis of noun phrases extracted from documents' bibliographic data (document titles, keywords, abstracts) and analysis of the co-citation network of these documents (Chen 2020).

For further work, the following information sets and visualisations generated by CiteSpace were used: networks of document co-citation; critical points for the development of research on digital culture; topic clusters and their contents; temporal development of clusters; "citation burst" (rapid rise) in citations of scientific papers—an indicator based on Jon Kleinberg's (2002) burst detection algorithm; networks of journals co-citation; the most used keywords in the co-citation network; keywords with the strongest "citation burst". Information collections and visualisations have been interpreted in order to achieve the research objective.

RESEARCH RESULTS

Using the above-mentioned criteria, 1,324 bibliographic records were collected from the Scopus database, which contained 74,251 citations. The CiteSpace program converted the RIS file format to TXT format, losing 5% of citations that the program's algorithms found defective (71,272 remain). When starting the visualisation, a few standard settings in the CiteSpace program were changed: Link Retaining Factor—set to −1, i.e. all citations included; Look Back Years—set to −1, i.e. no citation age restriction. For data from 1996–2022, CiteSpace created a co-citation network containing 848 nodes, i.e. cited documents and 6,246 co-citation links connecting them.

The first visualisation generated by CiteSpace (Fig. 1) shows the network of document co-citations for the term "digital culture". The points (nodes) are the equivalents of the cited documents, and the lines connecting them are the citation links. The larger the point diameter, the more citations the publication received in other publications in this network.

This visualisation indicates the existence of key publications (critical points) for the development of digital culture research, linking research trends and generating networks of co-citation. The following publications belong to this group (Table 1).

The CiteSpace citation network describes three important indicators:

1. Network thematic homogeneity (Silhouette)—is useful in estimating the uncertainty involved in identifying the nature of a citation network (Rousseeuw 1987). The higher the score (max. 1), the more thematically consistent the documents forming the network, and thus the easier it is to determine the nature of the network, as long as the network is not small (e.g. only a few documents). The closer the score is to −1, the greater the uncertainty in interpreting the themes of the network. For the term "digital culture", CiteSpace reported a value of 0.8656. This means that the publications included in the co-quoting network are characterised by high thematic consistency. Therefore, the conclusions from the analyses for which these publications were used should accurately reflect the state of research studies on digital culture.

2. Modularity Q—the extent to which the network of co-cited documents can be divided into independent, thematic modules (value range 0–1). Low modularity suggests that document networks cannot be divided into modules with clear boundaries. Modularity close to 1 does not always imply the existence of modules with clear boundaries.

Fig. 1

Co-citation network for the term "digital culture"

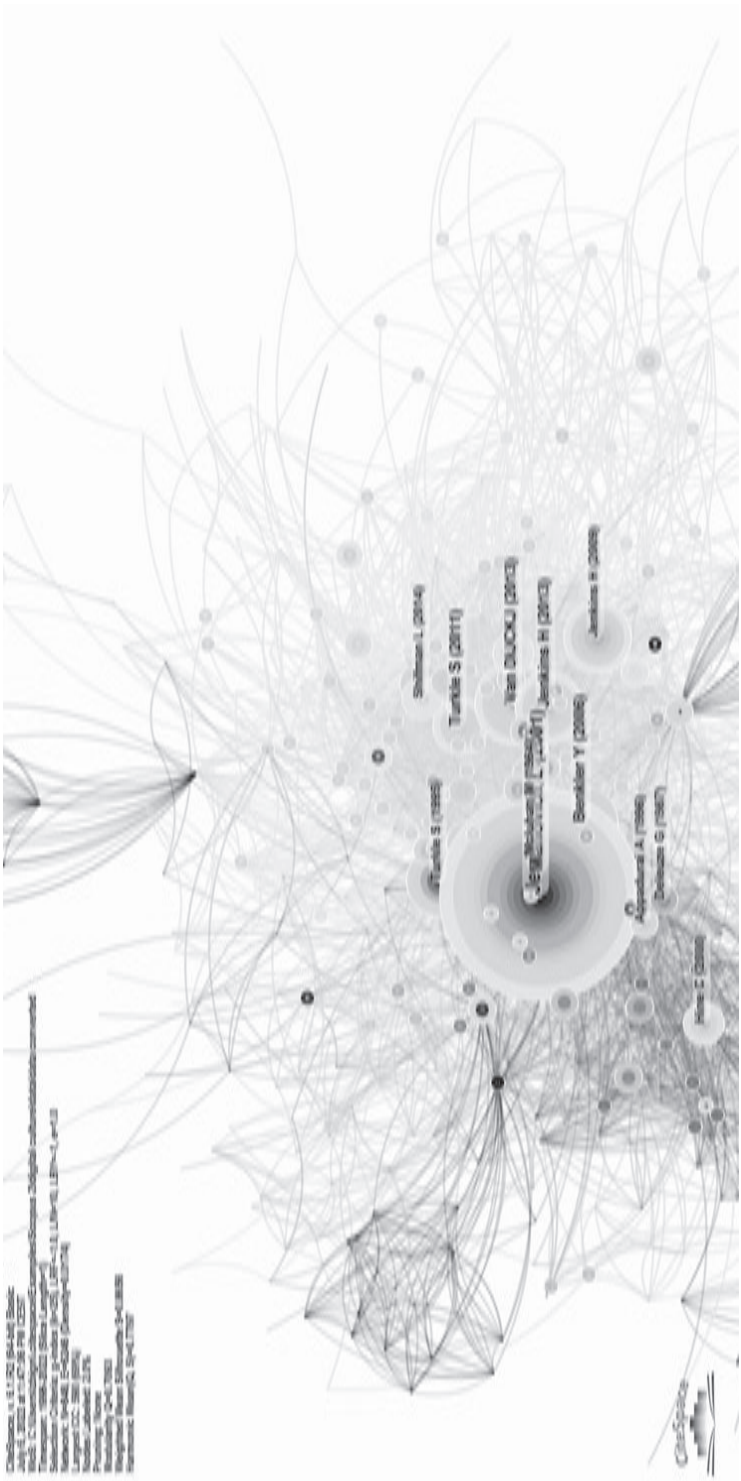

Table 1

Key papers (critical points) for the development of research on digital culture

No.	Bibliographic data of the publication
1	Jenkins H., 2006, Convergence Culture: Where Old and New Media Collide, New York: New York University Press
2	Manovich L., 2001, The Language of New Media, Cambridge: MIT Press
3	Van Dijck J., 2013, The Culture of Connectivity: A Critical History of Social Media, New York : Oxford University Press
4	Benkler Y., 2006, The Wealth of Networks: How Social Production Transforms Markets and Freedom. New Haven and London: Yale University Press
5	Jenkins H., Ford S., Green J., 2013, Spreadable Media. Creating Value and Meaning in a Networked Culture, New York: New York University Press
6	Turkle S., 2011, Alone Together Why We Expect More from Technology and Less From Each Other, New York: Basic Books
7	Jenkins H., 2009, Confronting the Challenges of Participatory Culture. Media Education for the 21st Century, Chicago: MacArthur Foundation
8	McLuhan M., 1964, Understanding Media, New York: Routledge
9	Turkle S., 1995, Life on the Screen: Identity in the Age of the Internet, Cambridge: MIT Press
10	Deleuze G., 1987, A Thousand Plateaus: Capitalism and Schizophrenia. Minneapolis: University of Minnesota Press
11	Hine C., 2000, Virtual Ethnography, London: SAGE
12	Shifman L., 2014, Memes in Digital Culture, Cambridge: MIT Press
13	Appadurai A., 1996, Modernity at Large: Cultural Dimensions of Globalization, Minneapolis: University of Minnesota Press
14	Goffman E., 1959, The Presentation of Self in Everyday Life, New York: Doubleday
15	Burgess J., Green J., 2009, YouTube: Online Video and Participatory Culture, Cambridge: Polity Press

In special cases (few documents in a network), it may indicate that individual documents are isolated from each other. For the term "digital culture", CiteSpace reported a value of 0.7093. This means that the modules consisting of the network for co-citing the term "digital culture" have relatively clear boundaries. Inference based on the generated visualisations (see Fig. 1, 2, 3) is therefore quite justified, because a relatively high Q index is not the result of generating a network consisting of not very numerous and separated documents.

3. Betweenness centrality—an indicator normalised to the unit interval of 0 to 1—measures the extent to which the node is part of paths

that connect an arbitrary pair of nodes in the network. A node of high betweenness centrality is usually one that connects two or more large groups of nodes with the node itself in-between. For all publications that make up the co-citation network of the term "digital culture", CiteSpace showed Centrality = 0. So none of them were included in the scientific works linking separate groups of publications (thematic clusters) in the co-citation network.

Subsequently, clusters of scientific documents linked by co-citations were identified. For this, the Find Clusters function was used in combination with Label Clusters from Titles + Keywords + Abstracts. The selection criteria set by the creator of CiteSpace were used as a default, adopting this reasoning (Chen 2020). In this way, it was possible to distinguish 83 clusters. The clusters mentioned are visible in the second visualisation (Fig. 2).

Each of them can be characterised by the following information (see Table 2):

1. Number of cited documents (Size)
2. Network thematic homogeneity (Silhouette)—the meaning is the same as for Silhouette of the whole network
3. Average year of publication in the cluster (Mean/Year)—indicates whether it is formed more by newer or older papers
4. Key terms selected by the selection algorithms: LSI (Latent Semantic Indexing) and LLR (Log-Likelihood Ratio), indicating the dominant topic (the creator of CiteSpace suggests that the LLR algorithm gives the best result in terms of uniqueness and term coverage—Chen 2020: 45).

In the set of 83 clusters, 6 clusters are relevant for research purposes (identification of the dominant issues) due to the number of documents being greater than 45—containing at least 5% of the publications (Table 2).

Using the Cluster—Cluster Explorer function, we obtain data indicating documents that had the greatest impact on the development and subject matter of each cluster. We obtain two lists: a) cited documents included in a given cluster together with the number of citations—the intellectual background of the knowledge domain; b) documents citing scientific works included in a given cluster—the research front of the knowledge domain (Table 3).

The next visualisation—Timeline View—allows you to determine the temporal development of clusters. In addition to the term indicating the dominant theme in the cluster, it is possible to read from the graphic in

Fig. 2

Co-citation clusters for the term "digital culture"

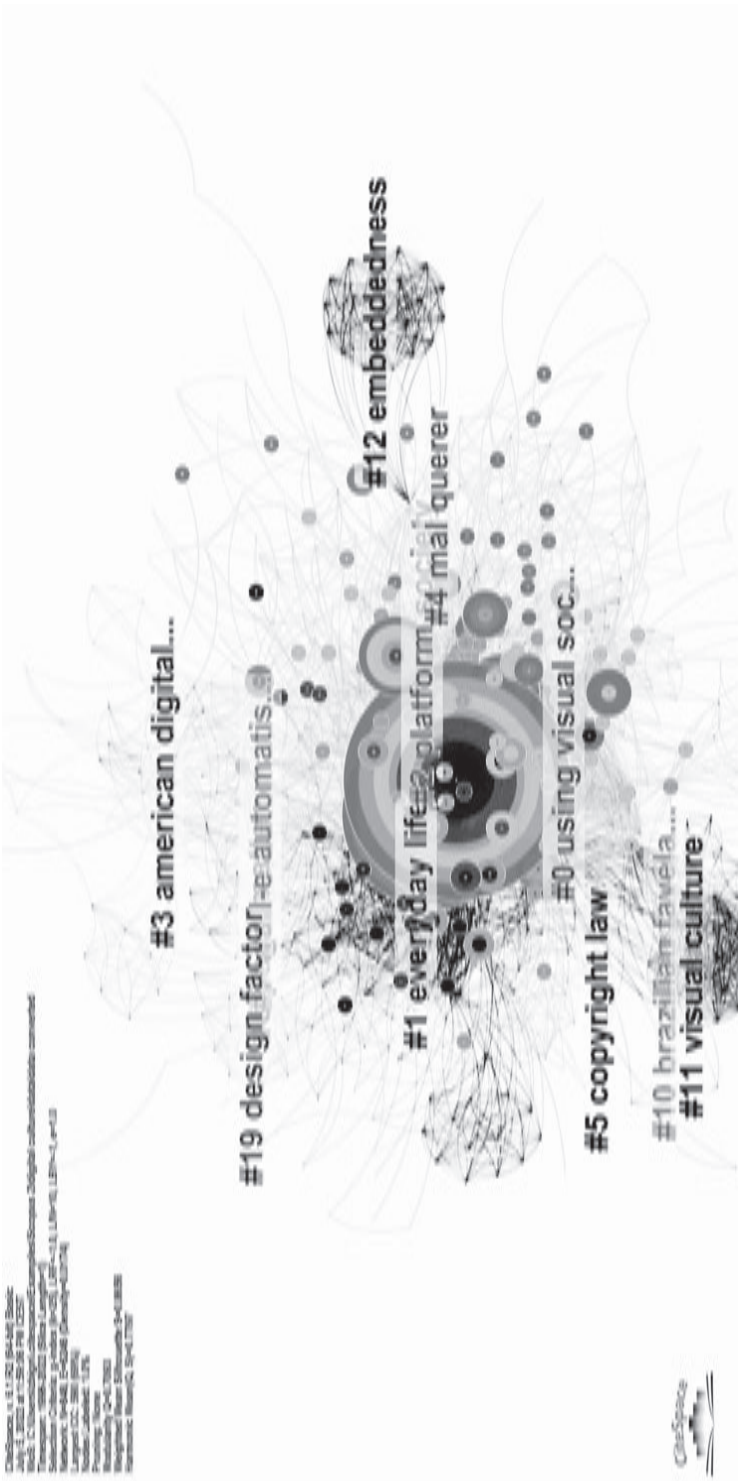

Table 2

Largest clusters in "digital culture" topics

Cluster ID	Size	Silhouette	Mean (Year)	Top terms LLR	Top terms LSI
0	101	0.828	2017	using visual social media; digital media sharing;	social media; using visual social media; digital method; social capital; YouTube meme;
1	99	0.824	2012	everyday life; critical digital studies; cinematic perspective; emerging paradigm; digital media culture;	popular music; critical digital studies; making digital culture; cinematic perspective; video game;
2	92	0.749	2018	platform society; profiles identities data; transmedia work; digital modernity;	digital media; transmedia work; digital modernity; platform society; digital amateur activist;
3	54	0.888	2014	american digital culture; american net art; social change; digitized live; internet era;	digitized live; internet era; social change; digital critical edition; formal learning boundaries; american digital culture;
4	52	0.899	2019	mal querer; vulva--positive social media; digital age;	digital age; mal querer; cultural production;
5	45	0.922	2010	copyright law; intellectual property; night elf priest; anthropological account	copyright law; intellectual property; night elf priest; anthropological account;

which period the cluster developed and when this development was most intensive.

Using the Visualization—Citation/Frequency Burst History function, a list of documents with a relatively large increase in citations over a short period was created. This indicates that these papers, by attracting the attention of the scientific community, had a significant impact on the development of scientific research on the topic under study. The CiteSpace program detects "bursts" of citations based on Kleinberg's (2002) algorithm. Table 4 presents a list of such documents for the term "digital culture".

If we use Node Types—Cited Journal in the CiteSpace settings (other settings as for the first visualisation—see Fig. 1), we will get a list of

Table 3

Documents which had the greatest impact on particular "digital culture" clusters

Cluster ID	Most cited documents	Citation count	Documents most often citing other documents from the cluster	Percentage of cited documents from the cluster
0	Benkler Y., 2006, The Wealth of Networks: How Social Production Transforms Markets and Freedom	24	KENNEDY J. (2018) Digital media, sharing and everyday life	25
	Jenkins H., Ford S., Green J., 2013, Spreadable Media. Creating Value and Meaning in a Networked Culture	23	CASSIDY E. (2018) Gay men, identity and social media: a culture of participatory reluctance	17
	Turkle S., 2011, Alone Together Why We Expect More from Technology and Less From Each Other	21	KANAI A. (2018) Gender and relatability in digital culture: managing affect, intimacy and value	16
1	Jenkins H., 2006, Convergence Culture: Where Old and New Media Collide	69	RICHARDSON J. (2012) An eye for music: popular music and the audiovisual surreal	21
	Manovich L., 2001, The Language of New Media	53	KROKER A. (2013) Critical digital studies: a reader	19
	Deleuze G., 1987, A Thousand Plateaus: Capitalism and Schizophrenia	14	HAND M. (2012) Making digital cultures: access, interactivity, and authenticity	13
2	Van Dijck J., 2013, The Culture of Connectivity: A Critical History of Social Media	28	DELFANTI A. (2019) Introduction to digital media	20
	McLuhan M., 1964, Understanding Media	18	FAST K. (2019) Transmedia work: privilege and precariousness in digital modernity	12
	Appadurai A., 1996, Modernity at Large: Cultural Dimensions of Globalization	13	SZULC L. (2019) Profiles, identities, data: making abundant and anchored selves in a platform society	10
3	Turner F., 2006, From Counterculture to Cyberculture	6	TAYLOR C. (2014) Place and politics in latin Spanish digital culture: location and latin Spanish net art	10
	Palfrey J., 2008, Born Digital: Understanding the First Generation of Digital Natives	6	REED T. (2014) Digitized lives: culture, power, and social change in the internet era	10
	Carr N., 2010, The Shallows: What the Internet Is Doing to Our Brains	6	APOLLON D. (2014) Digital critical editions	8
4	Jenkins H., 2009, Confronting the Challenges of Participatory Culture. Media Education for the 21st Century	20	HEARN A. (2020) The beguiling: glamour in/as platformed cultural production	8
	Braun V., 2006, Using Thematic Analysis in Psychology	8	TERRASA R. (2021) Framing and production of stardom in the digital age. Case study: rosalía's el mal querer in the Spanish written press (2018–2020)	6
	Dawkins R., 1976, The Selfish Gene	8	MOWAT H. (2020) "for myself and others like me": women's contributions to vulva-positive social media	6
			RICO M. (2021) Stardom as mythology of the digital age: hyperculturality and rosalía's el mal querer	6
5	Rheingold H., 1993, The Virtual Community: Homesteading on the Electronic Frontier	11	REYMAN J. (2009) The rhetoric of intellectual property: copyright law and the regulation of digital culture	16
	Jenkins H., 2006, Fans, Bloggers, and Gamers. Exploring Participatory Culture	10	NARDI B. (2010) My life as a night elf priest: an anthropological account of world of warcraft	6
	Lessig L., 2004, Free Culture: How Big Media Uses Technology and the Law to Lock Down Culture and Control Creativity	9		

Fig. 3

Temporal development of "digital culture" clusters

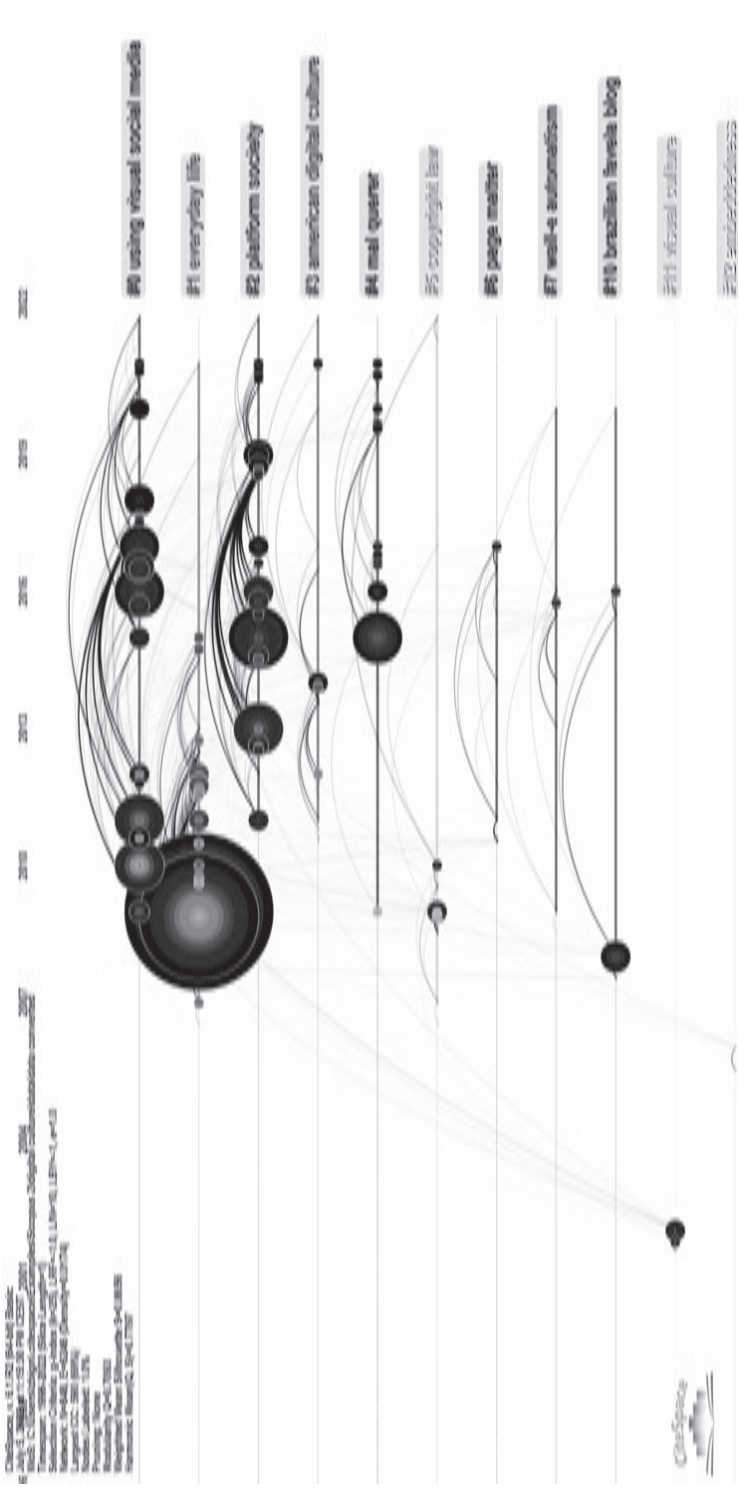

Table 4

Documents with the strongest "citation burst" rate for the term "digital culture"

No.	References	Impact indicator	Period of strongest impact	
			begin	end
1	Van Dijck J., 2013, THE CULTURE OF CONNECTIVITY	5.93	2017	2019
2	Jenkins H., 2009, CONFRONTING THE CHALLENGES OF PARTICIPATORY CULTURE	5.39	2015	2018
3	Turkle S., 2011, ALONE TOGETHER	5.36	2017	2022
4	Zuboff S., 2019, THE AGE OF SURVEILLANCE CAPITALISM	4.56	2020	2022
5	Noble S.U., 2018, ALGORITHMS OF OPPRESSION	4.44	2019	2022
6	Jenkins H., 2013, SPREADABLE MEDIA	4.43	2016	2019
7	Berlant L.: 2011, CRUEL OPTIMISM	4.41	2016	2018
8	Braun V., 2006, USING THEMATIC ANALYSIS IN PSYCHOLOGY	4.33	2020	2022
9	Lessig L., 2004, FREE CULTURE	4.27	2009	2013
10	Barad K., 2007, MEETING THE UNIVERSE HALFWAY	4.09	2019	2022
11	Hayles N.K., 1999, HOW WE BECAME POSTHUMAN	3.97	2007	2013
12	Jenkins H., 2006, CONFRONTING THE CHALLENGES OF PARTICIPATORY CULTURE	3.71	2011	2013
13	Braidotti R., 2013, THE POSTHUMAN	3.68	2017	2019
14	Latour B., 1993, WE HAVE NEVER BEEN MODERN	3.63	2012	2015
15	Bolter J.D., 1999, REMEDIATION	3.61	2012	2015
16	Castells M., 2001, THE INTERNET GALAXY	3.55	2010	2015
17	Frosh P., 2015, THE GESTURAL IMAGE	3.54	2017	2018
18	Miller D., 2000, THE INTERNET	3.50	2012	2016
19	Terranova T., 2000, FREE LABOR	3.43	2016	2019
20	Rheingold H., 1993, THE VIRTUAL COMMUNITY	3.16	2009	2012
21	Lyotard J-F., 1984, THE POSTMODERN CONDITION	3.13	2012	2014
22	Manovich L., 2001, THE LANGUAGE OF NEW MEDIA	3.12	2010	2013
23	McLuhan M., 1964, UNDERSTANDING MEDIA	3.02	2013	2019
24	Palfrey J.: 2008, BORN DIGITAL	2.93	2011	2014
25	Tapscott D., 1998, GROWING UP DIGITAL	2.84	2010	2012

Table 5

Journals that published the most papers in the co-citation network generated by CiteSpace

No.	Journal name	Number of articles published in the period 1996–2022
1	New Media & Society	93
2	Cultural Studies	38
3	Convergence	31
4	Critical Inquiry	31
5	International Journal of Cultural Studies	27
6	Computers in Human Behavior	26
7	Annual Review of Anthropology	24
8	Feminist Media Studies	23
9	Journal of Computer Mediated Communication	17
10	Science	17
11	American Journal of Sociology	16
12	Journal of Communication	16

journals that published the most papers in the co-citation network for the term digital culture (see Fig. 4 and Table 5).

If we use Node Types—Keywords in the CiteSpace settings (other settings as for the first visualisation—see Fig. 1), we will get a list of most used keywords in the co-citation network for the term digital culture (see Fig. 5).

Using the Visualisation—Citation / Frequency Burst History function, a list of keywords for which a large increase in the frequency of use was noted in a relatively short period of time was created (see Table 6).

DISCUSSION

The list of key publications (critical points) for the development of digital culture research (see Table 1) is completely different from the list of the most cited publications (see Table 7). The difference is due to the method of citations analysis. The Scopus database lists the total number of citations obtained by a given publication in other publications indexed in this database. The CiteSpace analyses the citations obtained by the publication in the co-citation network found in the Scopus bibliographic dataset. In the first case, we deal with the impact of publications on

Fig. 4 Journals that published the most papers in the co-citation network for the term "digital culture"

Fig. 5

The most used keywords in the co-citation network for the term “digital culture”

Table 6

Keywords with the strongest "citation burst" rate for the term "digital culture"

No.	Keywords	Impact indicator	Period of strongest impact	
			begin	end
1	digitalization	3.60	2019	2022
2	new media	2.77	2011	2014
3	human	2.75	2017	2020
4	digital media	2.67	2020	2022
5	art	2.64	2011	2013
6	ethics	2.55	2011	2014
7	literacy	2.50	2009	2017
8	media	2.50	2015	2018
9	influencer	2.44	2020	2022
10	digital humanity	2.44	2019	2020
11	information and communication technology	2.42	2017	2018
12	digital art	2.38	2019	2020
13	technology	2.38	2018	2020
14	semiotics	2.35	2014	2015
15	video game	2.34	2018	2019
16	higher education	2.28	2020	2022
17	mediatization	2.25	2016	2019
18	student	2.24	2019	2022
19	information technology	2.16	2012	2015
20	web 2.0	2.14	2012	2013
21	political economy	2.13	2018	2019
22	citizenship	2.08	2010	2014
23	history	2.07	2017	2018
24	gender	2.04	2010	2012
25	curriculum	2.03	2014	2015

the development of science in general, regardless of the subject of the research. In the second case, the impact of a given publication concerns research the results of which are described in publications connected by a network of co-quoting, i.e. having smaller or larger thematic relationships.

The list of fifteen publications crucial for the development of digital culture research generated by the CiteSpace algorithms (Table 1) includes

Table 7

The most frequently cited scientific papers listed by the Scopus database after using the search term "digital culture"

No.	Author	Title	Source	Number of citations
1	Van Dijck, J.	Users like you? Theorizing agency in user-generated content	Media, Culture and Society, 2009, 31(1), pp. 41–58	653
2	Nardi, B.	My life as a Night Elf Priest: An anthropological account of World of Warcraft	2010	352
3	Greenhow, C., Lewin, C.	Social media and education: reconceptualizing the boundaries of formal and informal learning	Learning, Media and Technology, 2016, 41(1), pp. 6–30	235
4	Deuze, M., Bruns, A., Neuberger, C.	Preparing for an age of participatory news	Journalism Practice, 2007, 1(3), pp. 322–338	235
5	Shifman, L.	An anatomy of a youtube meme	New Media and Society, 2012, 14(2), pp. 187–203	223
6	Parikka, J.	A geology of media	2015	221
7	van Dijck, J., Nieborg, D.	Wikinomics and its discontents: A critical analysis of Web 2.0 business manifestos	New Media and Society, 2009, 11(5), pp. 855–874	193
8	Duffy, B.E.	The romance of work: Gender and aspirational labour in the digital culture industries	International Journal of Cultural Studies, 2016, 19(4), pp. 441–457	182
9	Mihailidis, P., Viotty, S.	Spreadable spectacle in digital culture: Civic expression, fake news, and the role of media literacies in "post-fact" society	American Behavioral Scientist, 2017, 61(4), pp. 441–454	173
10	Dourish, P.	Algorithms and their others: Algorithmic culture in context	Big Data and Society, 2016, 3(2)	172
11	Ilomäki, L., Paavola, S., Lakkala, M., Kantosalo, A.	Digital competence—an emergent boundary concept for policy and educational research	Education and Information Technologies, 2016, 21(3), pp. 655–679	160
12	Wiggins, B.E., Bowers, G.B.	Memes as genre: A structurational analysis of the memescape	New Media and Society, 2015, 17(11), pp. 1886––1906	149
13	Area, M., Pessoa, T.	From solid to liquid: New literacies to the cultural changes of web 2.0	Comunicar, 2012, 19(38), pp. 13–20	134
14	Lupton, D.	Digital sociology	2014	127
15	Thumim, N.	Self-representation and digital culture	2012	123

the books themselves. On the other hand, the list of fifteen most cited publications generated by the Scopus database (Table 7) contains only three books. This list is dominated by articles published in nine journals, of which only two appeared on the list of journals identified by the CiteSpace algorithms as being key to research on digital culture (Fig. 4, Table 5).

The above conclusion indicates a significant limitation of inference based on bibliographic data, especially on the basis of the number of citations. The second limitation that should be mentioned stems from the fact that Scopus indexes only part of the scientific output. Thus any analysis, regardless of the methods and tools used, omits many journals and books. According to experts in this field (Mongeon, Paul--Hus 2016; Prins et al. 2015), the representation of journals and books from the humanities and social sciences in the largest bibliographic databases is numerically weak. In the Scopus database it does not exceed a dozen or so percent from the humanities and twenty-odd percent from the social sciences. When analysing the state of digital culture research using the CiteSpace program, one should bear these limitations in mind.

The publications that the Scopus database associated with the term "digital culture" through titles, keywords and abstracts date back to 1996. Among the 15 most cited documents in the co-quotation network, we find single books from 1959 and 1964. However, 10 books from this list, equated by CiteSpace with turning points in digital culture research, date back to the 21st century. The average year of publication of scientific papers included in the six most numerous thematic clusters varies from 2010 to 2019, depending on the cluster. The beginning of the quantitative development of these clusters falls in 2007. The most visible increase in the number of citations of works classified as Top 25 in terms of "citation burst" occurred after 2007. As for the rapid increase in the category of Top 25 keywords "citation burst", that began in 2009. These data clearly prove that digital culture research is a relatively young research specialisation.

There are many thematic clusters in the co-quoting network, of which only six can be considered numerically significant, as they contain at least 5% of the publications (45 items) included in the network. Each of these clusters thrives on different "critical points" and other publications with a strong "citation burst". Thus, in fact, none of the publications relatively frequently cited in the studied network connects separate groups of nodes in the co-quoting network, or contributes to the development

of several different research directions within the framework of digital culture research.

The previously mentioned clusters are identical to the group of publications presenting similar research topics. The keywords used by CiteSpace to name each of the clusters (Fig. 2, Fig. 3) and the keywords in Table 2 (Top terms LLR, Top terms LSI) indicate the dominant research topic of the cluster. Further information on this subject is provided by two visualisations — the most frequently used keywords (Fig. 5), and the keywords with the strongest citation bursts (Table 6). Moreover, two visualisations indicate the period in which the given research topic was the most popular: Fig. 3—cluster development period, and Table 6—interest in keywords measured by citation bursts.

The names of key researchers were shown by the CiteSpace program in Fig. 1 and Table 1—the authors of the most cited documents in the co-citation network; in Table 3—authors of publications most often cited in individual thematic clusters and authors of works most often citing publications from a given cluster; in Table 4—authors of documents with the strongest "citation burst", indicating when a given work gained the greatest popularity.

Fig. 4 and Table 5, on the other hand, contain information about the journals with published articles related to digital culture and which were cited in the co-citation network. The numbers of articles shown in Table 4 prove that in the area indexed by the Scopus database, digital culture research is conducted by a relatively small group of researchers publishing mainly (apart from books) in a dozen or so journals. This is confirmed by the data from the database—in the case of the humanities and social sciences, it is 161 researchers (at least two publications on "digital culture" indexed in the Scopus database), of which only 31 are authors of more than two publications (the search criteria are the same as those used when collecting data for analysis in the CiteSpace program). Only in 33 journals and conference materials at least 5 articles on digital culture were published in the period 1996–2022.

CONCLUSIONS

Systematic scientometric reviews, empowered by computational and visual analytic approaches, offer opportunities to improve the timeliness, accessibility, and reproducibility of studies of the literature in a field of research. Effectively and adequately identifying the most representative body of scholarly publications as the basis of subsequent analyses

remains a common bottleneck in current practice. One of the methods of identifying the most representative publications is to create co-citation clusters in CiteSpace.

The basic conclusion from the analysis of bibliographic data obtained from the Scopus database for the term "digital culture" is as follows: the state of research on this issue depends on the method of data analysis used.

The state of digital culture research (in the area indexed in the Scopus database; using the analysis of bibliographic data using the CiteSpace program) can therefore be characterised by the following information:

— it is a new research subject, which has been developing more intensively for about 15 years;

— systematic research is conducted by a small group of approximately 160 researchers;

— they publish their research results in a small group of journals (there are a dozen or so that really count) and in books;

— books (mainly over a dozen of the most popular) have the greatest impact on the development of research;

— the subject of research covers mainly such problems as: copyright law, critical digital studies, digital art, digital humanity, digital media, digital modernity, digital technology, digitalization, digitized live, influencer, information and communication technology, internet era, memes, new media, platform society, social media, social networks, video game, visual culture, and visual social media.

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Abstract

The article contains a bibliometric analysis conducted on the basis of bibliographic data from the years 1996–2022, extracted from the Scopus database (May 2022). The method used involved steps beyond the traditional counting of publications and citations as well as drawing conclusions based on reading the content of academic papers. Complete biographic datasets were used for advanced analyses performed in the program CiteSpace. The state of research into digital culture may be described as follows: (1) it constitutes a new area of research that has seen particularly intensive development for the last 15 years or so; (2) systematic research is conducted by a small set of researchers; (3) they publish the findings of their research in a small selection of journals (around a dozen) and in books; (4) books contribute most to the development of such research (mainly around a dozen of the most popular ones); (5) the subject-matter of this research embraces mainly such issues as: copyright law, critical digital studies, digital art, network society, digital media, digital modernity, information technology, digitalisation, influencers, the internet era, memes, new media, social media, social networks, video games, and visual culture.

key words: digital culture, bibliographic data, Scopus, CiteSpace, bibliometric analysis, data visualisation

ROZWÓJ BADAŃ KULTURY CYFROWEJ — ANALIZA BIBLIOMETRYCZNA Z WYKORZYSTANIEM PROGRAMU CITESPACE

Zbigniew Osiński
(Uniwersytet im. Marii Curie-Skłodowskiej w Lublinie)

A b s t r a k t

Artykuł zawiera analizę bibliometryczną przeprowadzoną na podstawie danych bibliograficznych z lat 1996–2022 wydobytych z bazy Scopus (maj 2022). Zastosowana metoda wykracza poza tradycyjne liczenie publikacji i cytowań oraz wyciąganie wniosków na podstawie lektury treści artykułów naukowych. Kompletne zbiory danych bibliograficznych zostały wykorzystane do zaawansowanych analiz przeprowadzonych w programie CiteSpace. Stan badań kultury cyfrowej można scharakteryzować następująco: (1) jest to nowy obszar badawczy, który rozwija się intensywniej od około 15 lat; (2) systematyczne badania prowadzone są przez niewielką grupę badaczy; (3) publikują oni wyniki swoich badań w niewielkiej grupie czasopism (jest ich kilkanaście) oraz w książkach; (4) największy wpływ na rozwój badań mają książki (głównie kilkanaście najpopularniejszych); (5) przedmiot badań obejmuje głównie takie zagadnienia jak: prawo autorskie, krytyczne studia cyfrowe, sztuka cyfrowa, społeczeństwo cyfrowe, media cyfrowe, cyfrowa nowoczesność, technologia informacyjna, digitalizacja, influencer, era internetu, memy,

nowe media, media społecznościowe, sieci społecznościowe, gry wideo, kultura wizualna.

słowa kluczowe: kultura cyfrowa, dane bibliograficzne, Scopus, CiteSpace, analiza bibliometryczna, wizualizacja danych