



EMERGING TRENDS OF DIGITAL PUBLIC SPACES: A BIBLIOMETRIC ANALYSIS BASED ON VOSVIEWER

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Abstract: This paper investigated the emerging trends of research related to digital public spaces through a bibliometric analysis based on the VOSviewer software. Digital public spaces have become a hot topic of conversation lately due to possible influencing factors like the development of advanced Industry 4.0 technologies, the introduction of Society 5.0, the growth of smart city concept, the manifestation of the digital universe as known as metaverse, and the COVID-19 pandemic. A total of 610 publications obtained from the Scopus database were analysed in three different ways including research development trends analysis, publications productivity analysis, and knowledge topic area analysis. The results pointed out that from 2012 to 2021, digital public spaces have attracted the significant attention of researchers in various scientific fields, mostly in western countries. From 7 clusters of knowledge topic areas detected, public space, social media, human-computer interaction, urban planning, and digital technologies have established the research hotspot to date. In addition, as the research focus is enriching, the potential novelty for further digital public spaces research may likely be related to more comprehensive and humane aspects. It is also possible that linking unrelated topics between different clusters is also highly considered to obtain the novelty of future research.

Keyword: bibliometric analysis, digital public spaces, Scopus, VOSviewer

Abstrak: Makalah ini menyelidiki tren penelitian yang muncul terkait dengan ruang publik digital melalui analisis bibliometrik berdasarkan perangkat lunak VOSviewer. Ruang publik digital menjadi perbincangan hangat akhir-akhir ini karena faktor-faktor yang berpotensi mempengaruhi seperti perkembangan teknologi maju Industri 4.0, pengenalan Society 5.0, pertumbuhan konsep kota pintar, manifestasi dunia digital yang dikenal sebagai metaverse, dan pandemi COVID-19. Sebanyak 610 publikasi yang diperoleh dari database Scopus dianalisis dengan tiga cara berbeda meliputi analisis tren pengembangan penelitian, analisis produktivitas publikasi, dan analisis area topik pengetahuan. Hasil penelitian menunjukkan bahwa dari tahun 2012 hingga 2021, ruang publik digital telah menarik perhatian yang signifikan dari para peneliti di berbagai bidang ilmiah, terutama di negara-negara barat. Dari 7 kluster bidang topik pengetahuan yang terdeteksi, ruang publik, media sosial, interaksi manusia-komputer, perencanaan kota, dan teknologi digital telah menjadi pusat topik penelitian hingga saat ini. Selain itu, seiring dengan bertambahnya fokus penelitian, potensi kebaruan untuk penelitian ruang publik digital lebih lanjut berkaitan dengan aspek yang lebih komprehensif dan manusiawi. Menghubungkan topik-topik yang tidak terkait antar kluster yang berbeda juga dapat dipertimbangkan untuk mendapatkan kebaruan penelitian masa depan.

Kata Kunci: analisis bibliometrik, ruang publik digital, Scopus, VOSviewer

INTRODUCTION

Society 5.0 was officially introduced to the global public in early 2019. This concept, promoted by the Japanese government, is expected to solve various social and economic issues that are not limited only to the manufacturing sector but also to people's lives through human-centered development and the support of physical and digital spaces integration (Fukuyama, 2018; Government of Japan, 2018). Deguchi, et al (2020) correctly added that in addition to improving the industry by integrating Industry 4.0 technologies, Society 5.0 tends to transform public living spaces. Technology enables cities to provide more effective and efficient ways to deal with their problems in multiple fields including government,

tourism, health, education, and others, through the concept of a smart city. Not to mention many endeavors to construct responsive urban public spaces have been done so far through the creation of digital public spaces. Leguina et al. (2021) highlighted that inequality of access to public spaces can be minimised via digital services that respond to several user groups with different levels of culture and digital knowledge.

Recently, the manifestation of the digital universe which is called metaverse has also been a hot topic of conversation, even though the term has been around for a long time. It enables people to experience all activities in a shared simulated 3D environment where a person can create and explore

with other internet users who are not in the same physical space as that person (Damar, 2021). This kind of digital public space incorporates greater technologies like augmented reality, virtual reality, and 3D holographic avatars so that it can offer a “second life” within a digital world. To be accessible for all, however, a great deal of work is still expected to be done.

The development of concepts and research on the topic of digital public spaces has been progressing following trends in existing issues. It can have either overlapped or unconnected issues between studies. As the interest of researchers on the subject of digital public space has likely increased, understanding previous research is essential for determining the potential direction of further research which was never conducted before. This paper, hence, investigated the emerging trends of research about digital public spaces by conducting a bibliometric analysis based on the VOSviewer software.

LITERATURE REVIEW

Digital Public Spaces

Whilst advanced technology has been constantly growing in Industry 4.0 and Society 5.0, many people most likely alter their activities online, particularly during the COVID-19 pandemic. As a result, an increasing number of digital public spaces has been inevitable. It could be in the form of cyberspace or a combination of physical and digital spaces (phygital space).

Public cyberspace offered facilities that were mostly related to social media networking and digital services, but now with the presence of the metaverse, the meaning of public cyberspace will go beyond that. Moreover, the usage of advanced technologies offers opportunities for a place-maker to integrate the spatial quality of physical space and the socio-cultural potential of the space through digital content (Abdel-Aziz et al., 2016; Tomitsch et al., 2015). Stokes et al. (2021) also mentioned how the integration of digital elements and urban furniture can be an approach for cities to build the social content for digital placemaking that still prioritises local needs and culture.

Ghani et al. (2018) specifically asserted that virtual reality technologies enable to encourage exceptional interactions within its surrounding environments, allowing users to obtain a deeper understanding of a place. Meanwhile, location-based technologies can also enrich the visitors' experience – particularly people with disabilities – through digital storytelling as mentioned by Radwan et al. (2018). Furthermore, the embodiment of phygital space in the smart museum concept is considered capable of attracting more visitors, increasing access to heritage content, and increasing the efficiency of exhibition layouts (Lo Turco & Giovannini, 2020). All these studies simply point out how digital public spaces are thriving whilst providing benefits for people's lives.

Bibliometric Analysis Based on VOSviewer

Bibliometric analysis is one type of citation analysis that uses citations data in scientific publications,

patent documents, and book reports, from Web of Science, Crossref, PubMed, or Scopus as variables to be analysed (Yaniasih, 2020). There are two terms in bibliometric analysis, namely co-citation (analysing attributes of cited documents) and bibliographic coupling (analysing attributes of citing documents) (Cobo et al., 2011). According to Ulfa et al. (2019), bibliometric analysis has benefits that are to find out the previous research, to know the current trend of certain research topics, to identify research with related topics, and to find out the potential novelty of further research.

VOSviewer software can be a tool to analyse and visualise the enormous volumes of the literature data in the bibliometric analysis. This technology allows researchers to understand the network of keywords, researchers, and publications based on co-citation, coupling, and co-authoring relationships (Meng et al., 2020). If needed, the number of keywords can be modified and less compatible keywords can be eliminated (Hamidah et al., 2020).

METHODS

This paper conducted two main steps to achieve the research aim, as follow:

1. Collecting the data from the Scopus database

Data were collected on 30th December 2021 with the following conditions in particular:

- The search keywords were (digital AND “public spaces”).
- The source type was limited to journal and conference proceedings, published in the last 10 years (2012-2021).
- A CSV file was exported.

2. Visualising and analysing the data based on VOSviewer

The dataset obtained from Scopus was imported to VOSviewer by creating maps based on bibliographic data with co-authorship and co-occurrence as the type of analysis. Subsequently, three different kinds of visualisation – network visualisation, overlay visualisation, density visualisation – were used depending on what kind of data that want to be conveyed. Lastly, this paper discussed three different aspects including research development trends, publication productivity, and knowledge topic area.

RESULTS AND DISCUSSION

Research Development Trends Analysis

A total of 610 articles were retrieved. There has been a rise in the amount of literature in the last ten years as shown in Figure 1. In 2012 particularly, there were only 25 published articles. Year by year, the number has been growing. When the number of publications has escalated slightly in 2012-2018, it has begun to increase more throughout 2019-2020 (around 20-25 articles per year). The number of publications in 2021, however, did not improve.

The significant growth in the digital public spaces research which occurred in 2019 and 2020 was possibly caused by several things, such as the greater awareness of the use of technology for better

living spaces through the introduction of Society 5.0 in early 2019 and the COVID-19 pandemic at the beginning of 2020. At that time, the COVID-19 pandemic began to spread to various countries which caused people to shift their activities online so that the digital world has become a new headline. Overall, the results indicate the growing attention towards digital public spaces.

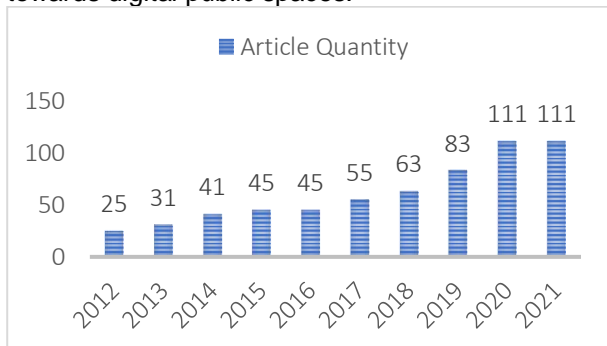


Figure 1. Document quantity development
Source: Author, 2022

Publications Productivity Analysis

According to the number of published articles regarding digital public spaces, the top 10 countries can be seen in Table 1. The United States has the greatest number of publications with 100 articles, followed by the United Kingdom with 89 articles. As Asian countries, Japan and China were ranked 9th and 10th. It appears that the topic of digital public spaces may still be popular only among western countries, thus can be a challenge for eastern countries.

Meanwhile, based on co-authorship analysis in VOSviewer, the cooperation and influence of the country could be explored. The threshold was set by 5 and 32 of 74 involved countries reached this threshold. Indonesia was detected, yet unfortunately, had no connection with other countries, therefore was excluded from the map (Figure 2). The United States apparently has the most notable cooperative influence. Lately, India, Malaysia, South Africa, Poland, and China have attempted to give an influence too in this research field of digital public spaces, collaboratively with the forerunner countries.

Table 1. Top 10 Countries Ranks with the Most Amount of Publications Related to Digital Public Spaces

Country	Amount of Publications
United States	100
United Kingdom	89
Spain	51
Australia	43
Germany	28
Canada	24
France	24
Italy	19
Japan	18
China	17

Source: Author, 2022

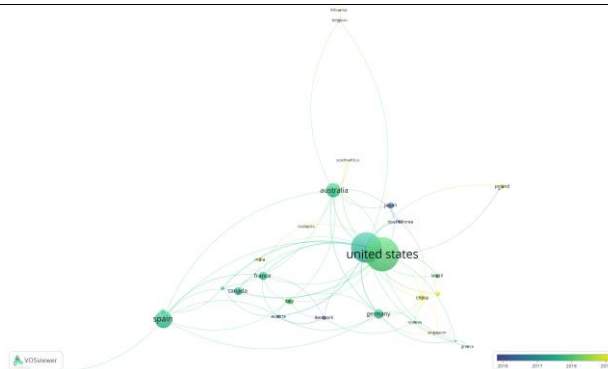


Figure 2. Influence map of countries cooperation using overlay visualisation
Source: Author, 2022

Knowledge Topic Area Analysis

There were top 10 subject categories for the digital public spaces research. Social sciences (347) have become a predominantly subject, followed by computer sciences (206), arts and humanities (140), engineering (97), environmental science (44), business, management, and accounting (26), medicine (24), earth and planetary sciences (23), energy (20), physics and astronomy (19). It seems that multi fields of science have been interested in studying this topic.

For the co-occurrence analysis, the number of occurrences of a keyword was set by 5 and of the 3726 keywords, 128 met the threshold. Different colours in Figure 3 illustrate the 7 clusters with 125 items and 1138 links that were detected. The clusters show the closeness between the keywords, for instance, digital placemaking and architecture are in the same cluster (green) which means they have a close relationship. The size of the circles and letters indicates the word frequency. The more frequent a keyword used, the greater of their size. The density of keywords can also be found in Figure 5. The top 15 high-frequency keywords in the last ten years were public space, social media, human-computer interaction, urban planning, digital technologies, augmented reality, digital media, internet, human, design, digital devices, smart city, urban design, architecture, and virtual reality (see Figure 3 and 5). Figure 4 displays the trend from year to year regarding the research area. It is evident that during 2012-2017 the research area of digital public spaces has been mostly about human-computer interaction. Subsequently, from 2017 to the middle of 2018, the research has started to explore wider topics mainly related to digital technologies, architecture, urban design, urban planning, and social media. Lately, the interest of research has begun to be more comprehensive and humane by mostly looking into digital storage, smart city, architectural design, COVID-19, human, and cultural heritage. Further research might consider getting a deeper understanding in regards to these topic areas.

Another possibility to find novelty in future research is to connect topics that are not connected yet in different clusters. For instance, architectural design is not directly linked yet to digital placemaking and humans (see Figure 6). Hence, future research may

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