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Mapping and Analysis of Literature on Spatial Legibility Research in Scopus Database (1981-2023)

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ABSTRACT

The purpose of this article is to examine the literature on spatial legibility. The data of the study were obtained from the Scopus database. Publications related to spatial legibility were searched by keywords. The research covers the publications between 1981-2023. The analysis of the data consists, firstly, of the graphics and frequencies presented by the Scopus database, and secondly, the analysis of the data obtained from the R Studio Biblioshiny software program. According to the research findings, the most documents belong to the United States of America. There are publications in the most article types. Most global cited document is by Weisman. The most relevant words in the titles of reviewed publications are urban, legibility and city. The most relevant words in the keywords of reviewed publications are "urban legibility", "space syntax", "legibility", "spatial legibility", "way finding", "cognitive map", "intelligibility", "urban design", "virtual environment", "Eskisehir", "image", "landmark", "navigation", "perception" and "Shanghai". In conclusion, this article presents a detailed literature on publications on spatial legibility. In the research, the spatial legibility research, which started with Kevin Lynch, has been examined in the process until today and reveals their mapping with R Studio-Bibliosiny software. As a suggestion, future research on spatial legibility could focus on specific years and periods. In addition, different databases or different bibliometric analysis software can be used for analysis.

KEYWORDS

Spatial Legibility, Scopus database, Bibliometric Analysis, R Studio-Biblioshiny, Mapping,

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INTRODUCTION

> *"At every instant, there is more than the eye can see, more than the ear can hear…*
> *Nothing is experienced by itself, but always in relation to its surroundings,*
> *the sequences of events leading up to it,*
> *the memory of past experiences."* (Lynch, 1960, p. 1)

Lynch (1960, p. 9) defined legibility as "*the ease with which its parts can be recognized and organized into a coherent model".* Following Lynch, Wiseman (1981, p. 189) defined the legibility of the medium as *"the extent to which it facilitates the way-finding process".* These criteria of legibility, the physical environment of an environment's qualities, and subsequent way finding behavior can all have an impact on the creation and correctness of the cognitive map (Figure 1). According to this definition perceived legibility of an urban environment will reflect the degree of completeness and accuracy of cognitive maps *"describing physical elements of the environment"* and accuracy of recognition tests *"accuracy of recognizing pictures".* (Evans, 1984; Haq, 2003). In addition, spatial cognition ability of perception is evaluated in spatial legibility studies.

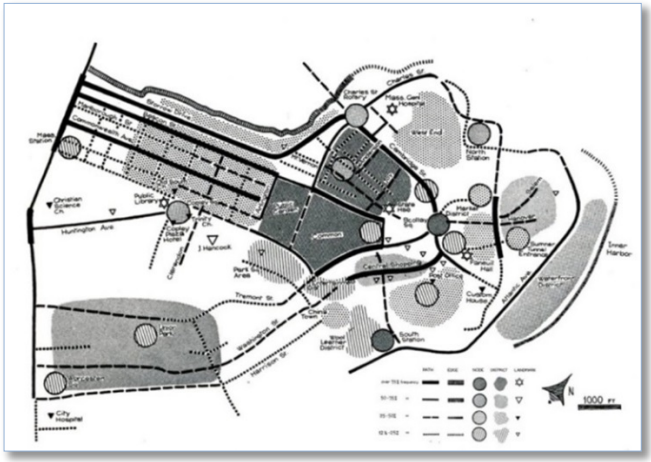

Figure 1. *City images (Lynch, 1960).*

Lynch explains that, *"we are not simply observers of this spectacle, but are ourselves a part of it, on the stage with the other participants"* (Lynch, 1960, p. 2). The coherence of our surrounds, our understanding of and connections to place, and the physical qualities that help in our navigation all contribute to our individual views of our lived environments - the individual imagery. These are the *"product both of immediate sensation and of the memory of past experience"* (Lynch, 1960, p. 4).

Wiseman claimed that environmental elements like as signs and numbers, architectural distinction, perceptual access, and plan arrangement influence the legibility of the environment in complex structures. (Weisman, 1981).

LITERATURE REVİEW

Legibility is an important aspect of urban design (Koseoglu & Onder, 2011) and is clearly related to spatial cognition (Long et al, 2007) and particularly wayfinding performance (Weisman, 1981). In researches in the field of Architecture and Urban Planning, it is stated that people always seek a

hierarchical organization of space and the street model as the basis for constructing a coherent mental image of the environment. Spatial legibility studies in the field of "Architecture" and "Urban and Regional Planning" are shown in List of chronological list of researches Table 1 and most cited publications Table 2.

The following tables contain a citation and chronological list of publications related to spatial legibility. These tables provide original data for academicians, students and those who are interested in literature research.

Table 1. *A chronological list of researches on spatial legibility by year (created by author).*

Authors, Year	Article Title	Source Title
Lynch, 1960	**The Image of City**	**MIT Press**
Weısman, 1981	"Evaluating **Architectural Legibility** - Way-Finding in the Built Environment"	"Environment and Behavior"
O'Neill, 1991	"Evaluatıon of A Conceptual-Model of **Architectural Legibility**"	"Environment and Behavior"
Lawton et al., 1996	"Individual- and Gender-Related Differences in Indoor Wayfinding"	"Environment and Behavior"
Abughazzeh, 1996	"Movement and Wayfinding in The King Saud University Built Environment: A Look at Freshman Orientation and Environmental Information"	"Journal of Environmental Psychology"
Raubal & Egenhofer, 1998	"Comparing the Complexity of Wayfinding Tasks İn Built Environments"	"Environment and Planning B-Planning & Design"
Ramadier & Moser, 1998	"Social **Legibility**, the Cognitive Map and Urban Behavior"	"Journal of Environmental Psychology"
Nenci et al., 2003	"Social and **Architectural Legibility** of the City"	"People, Places and Sustainability"
Cubukcu & Nasar, 2005	"Relation of Physical form to Spatial Knowledge in Large-Scale Virtual Environments"	"Environment and Behavior"

Koseoglu & Onder, 2011	"Subjective and Objective Dimensions of **Spatial Legibility**"	"2nd World Conference on Psychology, Counseling And Guidance-2011"
Topcu & Topcu, 2012	"Visual Presentation of Mental Images in Urban Design Education: Cognitive Maps"	"World Conference on Design, Arts and Education (Dae-2012)"
Demir et al., 2016	"Collaborative 3d Design with Bdmud Method: The Effects of Building on Cityscape Reflections on Urban Planning"	"Ace-Architecture City and Environment"
Belir, 2018	"Independent Movement Experience with The Other Senses"	"Iconarp International Journal of Architecture and Planning"

Table 1. *(continued) A chronological list of researches on spatial legibility by year (created by author).*

Authors, Year	Article Title	Source Title
Ozturk, 2018	"Studies on Reading The Urban Centre Via Cognitive Maps: The Example of Eskisehir, Turkey"	"Sustainable Development and Planning IX"
Ogce & Demir, 2020	"Evaluating The City Image of Istanbul Historic Peninsula Through Academicians' Perspective"	"Chinese Journal of Urban and Environmental Studies"
Belir, 2021	"The Effect of the Landmark on the Symmetry Axis to the **Spatial Legibility** of The Visually Impaired"	"Megaron"
Topcu et al., 2021	"Syntactic **Legibility** of Image Elements: Eskisehir Case"	"Megaron"
Askarizad et al., 2022	"The **Legibility** Efficacy of Historical Neighborhoods in Creating A Cognitive Map for Citizens"	"Sustainability"
Köseoğlu & Yilmaz, 2023	"Examining the interaction of perceived **legibility** and sense of familiarity in the streets of Hasköy, Beyoğlu"	"Lokum Journal of Art and Design"
Haghlesan, 2023	"Analyzing the **legibility** of the spaces of urban metro stations using the method of space syntax (case study: El Goli and Kohen stations in Tabriz)"	"Journal of Transportation Research"

Table 2. *List of the most cited published studies on spatial legibility in the Web of Science database (URL-1).*

Author	Title	Citations
Weisman, 1981	"Evaluating Architectural Legibility: Way-Finding in the Built Environment"	227
Lawton et. al., 1996	"Individual- and Gender-Related Differences in Indoor Wayfinding"	121
O'Neill, 1991	"Evaluation of a Conceptual Model of Architectural Legibility"	104
Raubal & Egenhofer, 1998	"Comparing the Complexity of Wayfinding Tasks in Built Environments"	68
Frith, 2013	"Turning Life into a Game: Foursquare, Gamification, and Personal Mobility"	68
Raubal & Worboys, 1999	"A Formal Model of the Process of Wayfinding in Built Environments"	58
Cubukcu & Nasar, 2005	"Relation of Physical Form to Spatial Knowledge in Large-Scale Virtual Environments"	50
Abu Ghazzeh, 1996	"Movement and Wayfinding in the King Saud University Built Environment: A Look at Freshman Orientation and Environmental İnformation"	38

Moreover, the sources that can be accessed after the literature research (in addition to Table 1 and Table 2 are as follows: (Zmudzinska-Nowak, 2003; Long, 2008; Dehghan, 2012; Mahdzar & Saferi, 2014; Kang et al., 2017; Koseoglu & Camas, 2017; Köseoğlu, 2018; Ahmadpoor & Smith, 2020; Akgün et al., 2023; Ateş, 2022; Burkut, 2022; Haghlesan, 2023; Köseoğlu & Yilmaz, 2023).

METHODOLOGY

The methodology of this article is the bibliometric analysis method. The research was designed in two steps. In the *first step*, publications on spatial legibility were accessed in the Scopus database (URL-2). Graphs and frequencies in the Scopus database were examined and analysis tables were created. In the *second step*, the analyzes and visual maps of the publications in the database were created in the R Studio-Biblioshiny software program (URL-3). Thanks to the results of these analyzes, a comprehensive literature review and increasing the visibility of the publications were aimed. All steps of the research methodology are shown in Figure 2.

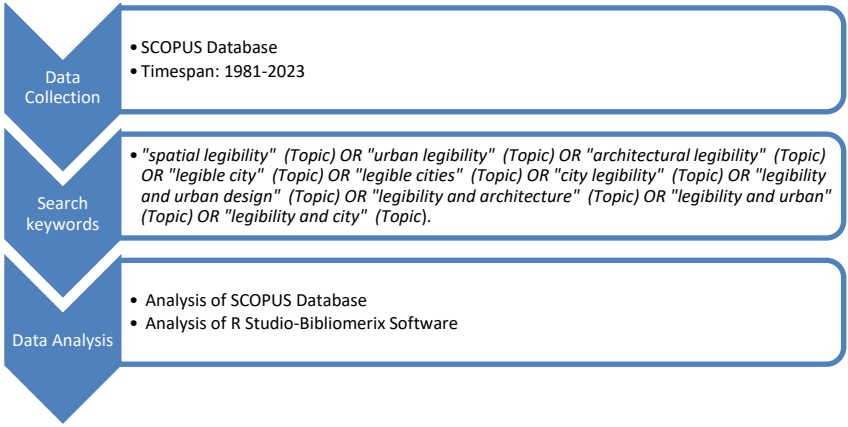

Figure 2. *Research methodology.*

RESULTS

ANALYSIS FINDINGS IN THE SCOPUS DATABASE

In this section analyzes of publications on spatial legibility according to Scopus database data are explained with graphs and frequencies. First of all, the increase and change of publications by years (Figure 3), distribution of publications by country and region (Figure 4), publications by document type (Figure 5), subject area (Figure 6) and by affiliation (Figure 7) is seen.

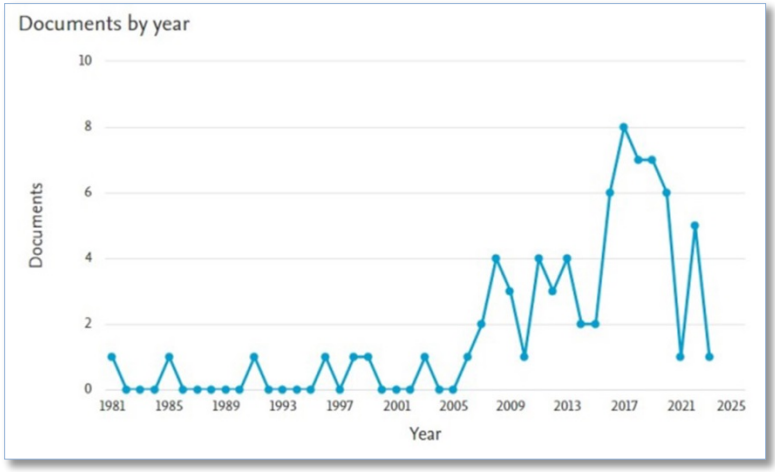

Figure 3. *Document by year (Copyright © 2023 Elsevier, Scopus® database).*

The increase and change of publications over the years can be seen in Figure 3. According to the graph, the highest number of publications is in 2017. Between the years 2015-2021, the number of publications increased compared to other years. Figure 4 shows document by country or territory. Accordingly, "United States of America (USA)" has the highest number of publications and second "United Kingdom" has highest number of publications. In addition, the country with the third highest number of publications is "Turkey" can be seen in Figure 4.

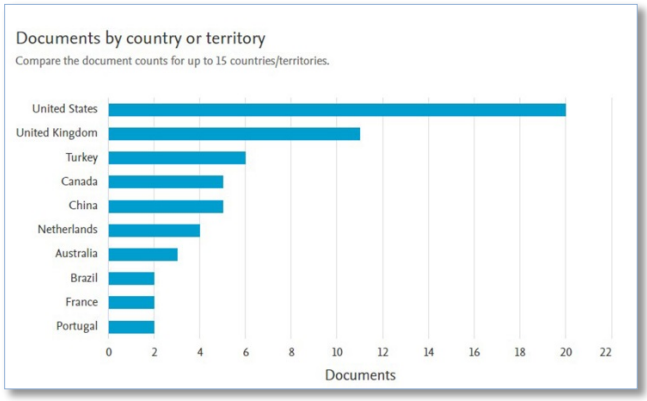

Figure 4. *Document by country or territory (Copyright © 2023 Elsevier, Scopus® database).*

Document by type is seen in Figure 5 "article" 41 (55, 4 %), "conference paper" 20 (27, 0%), "book chapter" 9 (12, 2 %), "review" 3(4, 1 %) and "note" 1 (1, 4%) in Scopus database. Also, document by subject area is seen in Figure 6; "Social Science" (31, 5%), "Engineering" (14, 6%), "Computer Science" (13, 1%) and "Art and Humanities" (12, 3%) in Scopus database (Figure 6).

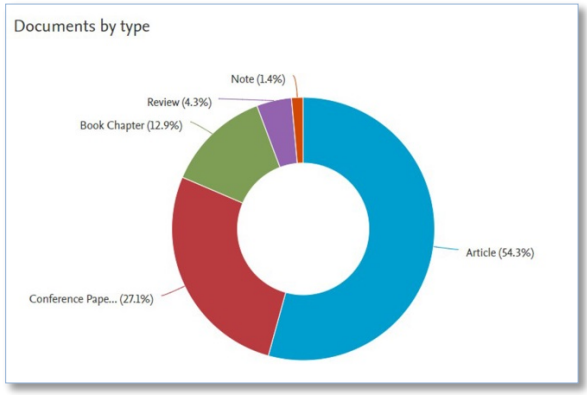

Figure 5. *Document by type (Copyright © 2023 Elsevier, Scopus® database).*

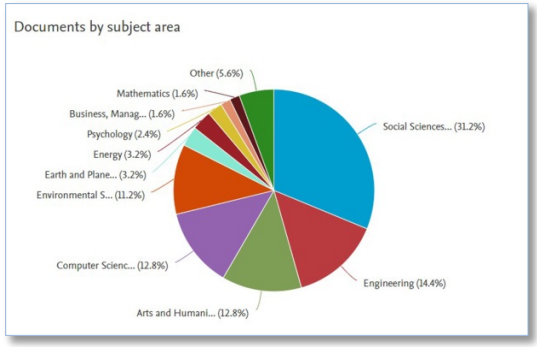

Figure 6. *Document by subject area (Copyright © 2023 Elsevier, Scopus® database).*

Document by affiliation can be seen in Figure 7. Accordingly, the affiliation of publications on spatial legibility "The University of North Carolina", "Delft University of Technology", "Beijing University", "State Key Laboratory of Remote Sensing Science", "University of Northumbria", "University of Waterloo", "Chinese Academy of Science", "Yıldız Technical University", "East China Normal University", "Massachusetts Institute of Technology" (Figure 7).

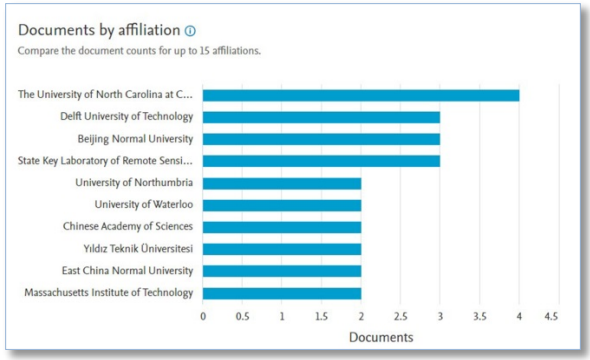

Figure 7. *Document by affiliation (Copyright © 2023 Elsevier, Scopus® database).*

ANALYSIS FINDINGS IN THE R STUDIO-BIBLIOSHINY SOFTWARE

Main information about data spatial legibility research with analysis of R Studio-Biblioshiny software is shown in Table 3. As seen in Table 3, the analysis of publications between 1981 and 2023.

Table 3. *Main information about data spatial legibility research with analysis of Biblioshiny Software.*

Descriptions	Results
Main Information of Data	
Timespan	1981:2023
Sources (Journal, Book, etc.)	62
Documents	70
Annual Growth rathe %	0
Document average age	9,11
Average citations per doc	23,73
References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	290
Author's Keywords (DE)	278
AUTHORS	
Authors	143
Authors of single-authored docs	30
AUTHOR COLLABORATION	
Single-authored docs	32
Co-authors per doc	2,46
International co-authorship %	12,86
DOCUMENT TYPES	
article	38
book chapter	9
conference paper	19
note	1
review	3

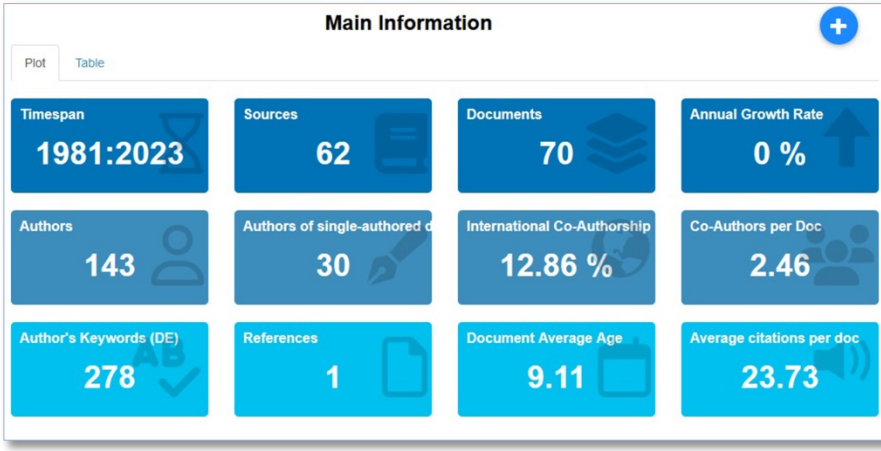

Figure 8. *Main Information and Interface of the Bibliometrix software.*

Figure 8 shows the interface and main information of the R Studio-Bibliometrix Biblioshiny software. This figure is the analysis of publications between 1981 and 2023. According to the main information, 70 documents, 62 sources, 143 authors, 278 author keywords, document average age 9.11 and average citations per doc 23,73 were accessed. It can be seen in most cited country Figure 9. The most cited countries, respectively "USA" (261 citations), "United Kingdom" (75 citations), "China" (49 citations), and "Turkey" (26 citations) (Figure 9).

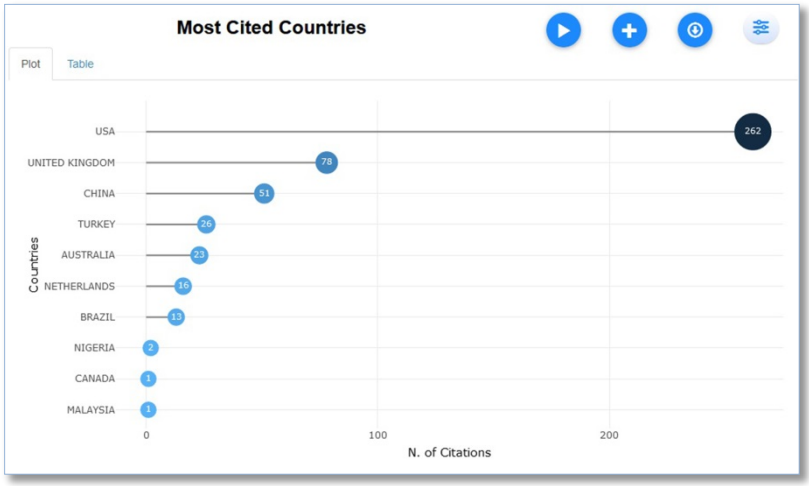

Figure 9. *Most cited countries.*

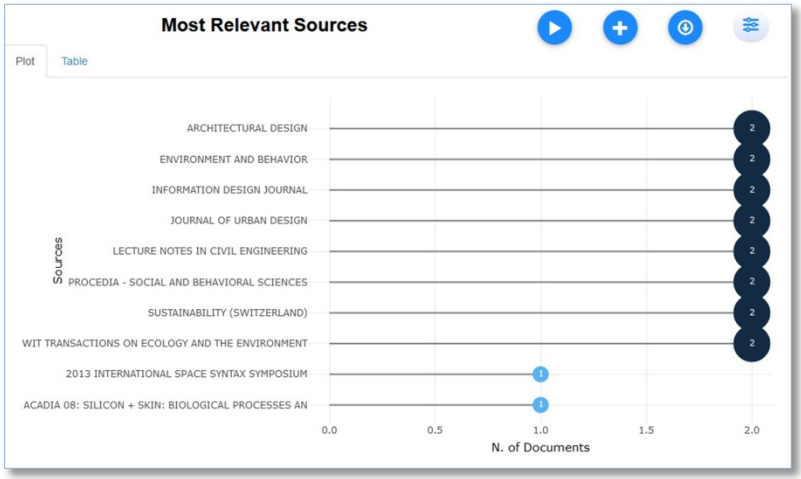

Figure 10. *Most relevant sources.*

It can be seen in most relevant sources Figure 10. The most relevant sources, respectively "Architectural Design", "Environment and Behavior", "Information Design Journal", "Journal of Environmental Psychology", "Journal of Urban Design", "Procedia-Social and Behavioral Sciences", "Sustainability", "Transactions on Ecology and the Environment", and "2013 International Space Syntax Symposium" (Figure 10). As can be seen in Figure 11, most relevant words in titles. These words "urban", "legibility", "city", "spatial", "design", "legible", "environment", "way finding", "built", "cognitive", "cities", "models", "visualization", "architectural", "assessment", "building", "buildings", "context" and "cultural" (Figure 11).

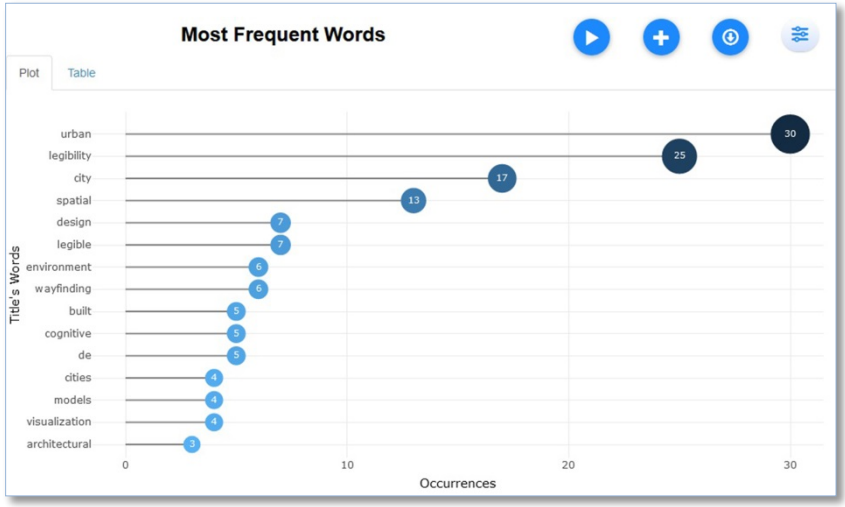

Figure 11. *Most frequent words in titles.*

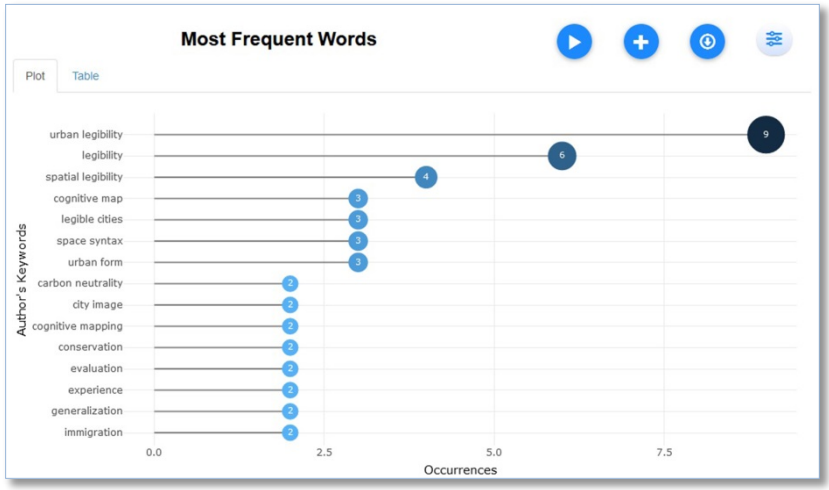

Figure 12. *Most frequent words in author keywords.*

As can be seen in most frequent words in titles (Figure 11) and most frequent words in author keywords (Figure 12). These words "urban legibility", "legibility", "spatial legibility", "cognitive map", "legible cities", "space syntax", "urban form", city image", "cognitive mapping", "conservation", "evaluation", "experience"

"way finding", "intelligibility", "urban design", "virtual environment", "Eskisehir", "image", "landmark", "navigation", "perception" and "Shanghai" Three-Field Plot in Biblioshiny software seen in Figure 13. Cited References (CR) -Authors University (AU) – Keywords (ID) (O'Neill, 1991; Weisman, 1981; Lynch, 1960; Garling, et al., 1983; Evans, 1980; Kitchin, 1994; Bafna, 2003; Appleyard, 1969; Siegel & White, 1975; Koseoglu, 2011) (Figure 13).

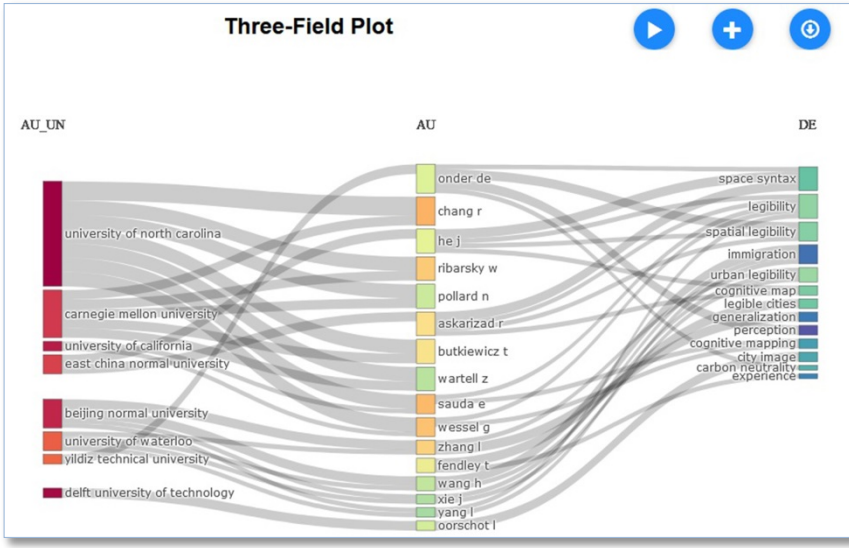

Figure 13. *Three-Field Plot in Biblioshiny software.*

Figure 14. *WordCloud created by R Studio- Bibliometrix Biblioshiny software.*

Word Cloud analysis using R Studio- Bibliometrix Biblioshiny software can be seen (Figure 14). Prominent words; “urban legibility”, “legibility”, “spatial legibility”, “space syntax”, “cognitive map”, “urban form”, “legible cities”, “perception”, “experience”, “way finding”, “city image”, “landmarks”, “image of city”, “urban design”, “cognitive mapping”, “urban models”, “user-centered design”, and “environment” in Word Cloud (Figure 14).

CONCLUSION

This article presents a comprehensive literature review and bibliomeric analysis of publications on spatial legibility.

In the article, the publications in the Scopus database were examined during the data collection process. Accessible publications were included in the research. Frequencies and visual maps of publications, authors, institutions, citations and keywords were analyzed in the Scopus database between 1981 and 2023. Accordingly, to summarize the results, the highest number of publications is from the “United States of America”. There are publications in the most article types. Most global cited document is by Weisman (1981).

The most relevant words in the titles of reviewed publications are “urban”, “legibility” and “city”. The most relevant words in the keywords of reviewed publications are “urban legibility”, “space syntax”, “spatial legibility”, and “way finding”. In the research, the spatial legibility research, which started with Kevin Lynch (1960), has been examined in the process until today and reveals their mapping with R Studio-Bibliosiny software.

As a suggestion, future research on spatial legibility could focus on specific years and periods. In addition, different databases or different bibliometric analysis software can be used for analysis.

As a suggestion, future research on spatial legibility could focus on specific years and periods. In addition, different databases (URL-4, URL-5) or different bibliometric analysis software (URL-6) can be used for analysis. Future research based on the recommendations will offer a different perspective. In summary, examining current sources and understanding spatial legibility are essential for academics and research students.

EDITORS' NOTE

The editorial board of JAH declares that it does not approve or cannot be held responsible for the contents of this paper. The article has passed a double-blind peer review process and multiple revisions.

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