A Bibliometric Analysis of Emotion at the Intersection of the Concepts of Biophilic and Design

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Abstract – Emotion is the research subject of many disciplines. Among these studies, emotion emerges as a concept related to biophilic design. The present investigation used bibliometric analysis, which included documents from the Scopus and Web of Science Core Collection stores of data to the science mapping approach in the VOSviewer. Considering the analysis’ findings, it can be said that the examination of emotion at the intersection of biophilic and design under the heading the concept of architecture is a field of study that is new, open to examination, and open to association with different concepts.

Keywords – emotion, biophilic, design, bibliometrics, VOSviewer.

1. Introduction

Throughout the history of architecture, natural objects, shapes, geometric natural patterns, and processes have inspired the field of architecture [1]. The most obvious example is the depictions that resemble or simulate the world of plants and animals in architecture [1]. Despite the fact that nature is one of the main sources of inspiration for architecture, the characteristic features of natural assets further develop the discipline. One of the primary sources of inspiration for architectural notions is nature; this field relates to the natural world, architecture, biophilic design, biophilia, perception of the environment, and emotional states. In this research, under the general title of the architecture concept, the emotion at the intersection of biophilic and design is the focus. As a subject, biophilic design and emotion showed a variety under the concept of architecture. Architecture has various effects on people. However, when examining in general terms, the architectural environment has effects on people at both cognitive (evaluation and processing of information) and emotional (adaptive response to perceived information) levels [2]. This is because individuals utilize their emotional experiences to comprehend the environment [3], therefore the design of architectural places and spaces should be connected to design and planning, as well as the mind of humans, emotions, and environmental effect experiences [4]. Architectural and scientific research studies have been conducted on the formation and change of different design styles and the emergence of differences in the relationships between environmental factors, human psychological, and physical behaviors, and experiences [4]. The first issue that these studies focused on was mostly the close relationship between human emotions and architecture. Some of these researchers even studied human emotion and perception on different subjects. Arnheim [5] concentrates on the dynamics and change of the visual aspect, while Holl, Pallasmaa and Pérez Gómez [6]; Pallasmaa [7], and Zumthor [8] concentrate on the significance of the human senses and perception. Malnar and Vodvarka [9] concentrate on architectural and landscape design with multi-sensory subjects. The second goal is to influence how various architectural shapes affect a person’s psychology.

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The connections between architectural components, interior spaces, and how people experience spaces psychologically are examined in this area. Weston [10] focused on substances, human psychology, architectural aspects, forms, and places whereas Lau [11] highlighted space and illumination. The last topic examined is the identification of what individuals require in the fields of environment and architecture, under the headings of architectural psychology and environmental psychology.

When people’s needs are evaluated since history, we come across people’s experiences of sustaining their lives as the main need. This demonstrates the concept of biophilia, as it enables the connection between settled life and the natural world, humans' survival, and development, and recreates an integral role in human-nature interactions. According to Kellert and Wilson [12] and Wilson [13], biophilia also highlights how people have a natural predisposition to bond with other living things. The biophilia hypothesis links contact, aesthetics, meaning, emotion, and empathy to the five biophilic values of naturalism, aesthetics, symbolism, humanism, and moralism, all of which point to the relation between nature and our physical surroundings and related positive health effects [14], [15]. In addition to the inherent emotional connection between people, this attribute is known as biophilia and is present in all living things [16]. A review can be found in Barbiero and Berto [17]. It includes a broad range of actions [12], feelings [18], and ideals [19] that come together to establish a human connection with nature. Wilson [16] asserts that “biophilia is a collection of principles that can be examined and studied separately, rather than being a single sense”. From attraction to aversion, the learning principles stimulate various emotions [16]. Biophilia refers to attraction, while biophobia refers to aversion [20]. In addition, emotional states can be thought of as people’s reactions to situations. For example, when evaluating and responding to natural landscapes, environment, water, natural life, and plants, people are influenced by their subjective experiences and become positive affect (biophilia) or negative affect (biophobia) [12], [20]. Ulrich further suggested that such emotional and aesthetic experiences, including likes and dislikes, had a direct impact on interactions with nature.

The relationship between the concepts of biophilia and biophilic design becomes evident when one examines humans and our experiences. Biophilic design is a field of study that aims to create artificial settings that represent biophilia, the intrinsic human need to connect with nature. Nature connectivity refers to how we interact with and perceive nature. A high level of nature connection implies a strong emotional connection to our environment.

The primary consequences of biophilic design are psychological and physiological well-being, which are related to cognitive gains [21]. Nature contact is crucial for human health and well-being. Based on this principle, an approach has been devised for connecting humans and nature within the built environment [22]. Biophilic design has numerous physiological, psychological, and emotional benefits [23]. Human emotions including happiness, joy, pleasant sentiments, aesthetic preference, and self-esteem can all be impacted by biophilic design. There is evidence of increased cognitive productivity, creativity, and efficiency in the cognitive category of study [24]. Furthermore, biophilic design is widely acknowledged for its capacity to reduce stress, stimulate inventiveness, and clear thinking, enhance physical and mental well-being, and accelerate the healing process [25]. Studies on biophilic design have demonstrated that it improves cognitive performance and stress recovery [26], [27], [28]. Some research has additionally examined the effect of biophilia on cognitive and interpersonal aspects, such as increased productivity [29]. There are different types of experience in biophilic design categories. There are three types of experiences: direct experiences (plants, animals, and water), indirect experiences (pictures, objects, and forms), and experiences of place (views, shelter). These categories establish relationships with different design disciplines. These disciplines are related to concepts such as senses, emotion, beauty, meaning, and care [25].

One of the key areas of environmental psychology, which is one of the fields of biophilic design, is emotion and how various settings can cause people to experience various emotional states (for instance, people’s liking or preferring reactions) [1]. As a word, different affect includes emotions and emotional states, and its meaning is the presence of strong feelings such as love, anger, and fear [30]. According to the preference matrix created by Kaplan and Kaplan [31] on this subject, the cognitive assessment of the presence of specific information attributes fundamental to these emotional states in an environment result in the generation of various emotions in various environments in people. Also, emotional reactions can be regulated in a variety of ways by both the self and the environment [32]. In studies on emotion and nature or territory, according to Kals et al. [33], an emotional affinity for nature is best described as a feeling that develops through childhood experiences with nature—according to Eagly and Chaiken [34], demonstrated that emotional affinity is more directly related to environmental engagement and behavior than just cognitive interest in nature.
According to these authors, their construct consists of four elements: a love for nature, a sense of being free in nature, a sense of safety in nature, and a sense of connection with nature. Kals et al. [33] summarize this subject as people’s emotional attachment to nature. However, nature and the environment can contain both positive and negative emotions in people. For instance, Capaldi et al. [35] examined the relationship between happiness (positive emotions) and a person’s connection to nature and found that persons who are more linked to nature tend to be happier. Research highlights the limitations of being task-specific when analyzing the level of impact on diverse cognitive tasks, even though biophilic design or environment offers multiple chances and positive psychological consequences [36]. There are more persistent psychological issues including biophobia, or fear of nature such as Taylor [37], Walimbe and Chitgopkar [38].

The data given in the article were collected by reviewing the information contained in the Scopus and Web of Science Core Collection databases. Through this research, it is possible to have a broad perspective on the current research gaps in the field, new research themes that can be studied on the subject, leading authors and theorists, the most used keywords, terms added to the field by accessing research conducted in the few divisions of science. Five research questions are as follows: Research question 1: How a co-authorship is constructed among the authors in the research literature in the intersection of biophilic, design, and emotion and what is the relationship among these authors?; Research question 2: Which keywords co-occur in the research literature in the intersection of biophilic, design, and emotion and what is the relationship among these co-occurred keywords?; Research question 3: What are the most cited documents in the research literature in the intersection of biophilic, design, and emotion and what is the relationship among these cited documents?; Research question 4: What are currently existing research gaps in the research literature in the intersection of biophilic, design, and emotion?; Research question 5: Who are the prominent authors in the research literature in the intersection of biophilic, design, and emotion?

In this approach, the primary aim of this research is to identify the body of knowledge on emotion that exists at the junction of biophilia and design, broadly referred to as the notion of architecture. When emotion is looked at the nexus of biophilic and design, this study implies how novel interactions can be created with the existing field of science. An introduction, methodology, findings, and conclusion make up the study’s road plan.

2. Methods

There are many types of methodologies for examining scientific studies [39]. The use of bibliometric methods has increased significantly in recent years [40]. The communication behaviors of academicians can be defined, explained, predicted, and evaluated using bibliometric methods [41]. Additionally, some links and citations join documents that are related, allowing the researcher to find their way through them [42], [43]. In addition, the keywords of the documents appear as an additional measure of similarity alongside the links based on the citations [44]. Mapping all these bibliometric links, social and knowledge structures [45], give researchers a broad perspective on the subject they are investigating.

The Scopus and Web of Science Core Collection sources were used in this paper to gather more systematic and scientific data for comparison and synthesis of the gathered findings, to reach a strong conclusion, and to make further relationships regarding emotion at the intersection of biophilic and design. Scopus and the Web of Science Core Collection have an extensive reach, they include significant, comprehensive, and competent indices since they cover journals with verified scientific quality requirements and standards [46]. Although the Scopus and Web of Science Core Collection databases differ in specific respects, they are both multidisciplinary, include peer-reviewed articles, and are supported by bibliometric programs [47]. Furthermore, data collected from Scopus and Web of Science Core Collection gives information for analysis, such as co-authors, cited references, citations, and co-citations by the documents [48]. Also, the Scopus and Web of Science Core Collection databases are bibliometric sources that have been selected since they allow for scientific mapping using a VOSviewer. Scopus includes open-access indicators for journals where all peer-reviewed scientific articles are freely available [49]. The largest citation database in the world, The Web of Science Core Collection, includes books, conference proceedings, and open-access journals [50].

The purpose of this study is to investigate the types of conclusions made in the literature regarding the biophilic design’s approach to emotion. The suggested bibliometric analysis technique is an efficient means to discover these methods in this context. It is possible to establish which domains are more current, which authors work on these subjects, which keywords are utilized, and which documents may be used when the content collected is provided to the bibliometric analysis technique.
As a result, the Scopus and Web of Scientific Core Collection databases were scanned utilizing scientific mapping methodologies for bibliometric analysis. The quantitative data for this study were gathered from the Scopus and Web of Science Core Collection databases. Bibliometric analysis is a research strategy that uses quantitative analysis to analyze and examine data from any field [51]. For this study, bibliometric analysis and scientific mapping methodologies were devised as part of a quantitative research strategy (Table 1). Furthermore, the bibliometric analysis approach is regarded as experimental or descriptive research [52].

**Table 1. The quantitative research design for this study.**

<table>
<thead>
<tr>
<th>Utilizing science mapping methods, bibliometric analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose:</strong> Investigating research on emotions in the context of biophilic design with the goals of identifying present-day knowledge gaps and outlining the main ideas of the contributing authors, together with the most important authors in the field and the most cited documents.</td>
</tr>
<tr>
<td><strong>Methods:</strong> Bibliometric analysis with science mapping techniques</td>
</tr>
<tr>
<td><strong>Data Sources:</strong> Scopus and Web of Science Core Collection</td>
</tr>
<tr>
<td><strong>Data Visualization and Analysis Tools:</strong> VOSviewer</td>
</tr>
<tr>
<td><strong>Selected Bibliometric Analysis Techniques:</strong> VOSviewer is a data visualization and evaluation tool.</td>
</tr>
<tr>
<td><strong>Techniques for Selected Bibliometric Analysis:</strong> Co-authorship data, co-occurrence data for author keywords, document citation data are all used in the mapping process.</td>
</tr>
<tr>
<td><strong>Findings According to Scientific Mapping Technique by VOSviewer:</strong> Scopus and Web of Science Core Collection</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
</tr>
</tbody>
</table>

Scopus and Web of Science Core Collection web pages and the bibliometric analysis approach were mostly used for scanning (Table 2). The Scopus and Web of Science Core Collection databases were searched using the terms biophilic, design, and emotion. The code for the advanced search field was used to search all the fields in the Scopus database’s publications section (“BIOPHILIC*”, “DESIGN*”, and “EMOTION*”). The databases are free of any time constraints. The full-time frame that the databases covered was scanned.

The number of papers collected is displayed in Table 2. 113 documents in total were stored, 64 of which were in Scopus and 49 of which were in the Web of Science Core Collection (Table 2). The data download and scanning date is May 17, 2023.

**Table 2. Findings of the scanning.**

<table>
<thead>
<tr>
<th>Scopus</th>
<th>Web of Science Core Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Code:</strong> ALL (“BIOPHILIC*”, “DESIGN*”, and “EMOTION*”)</td>
<td><strong>Code:</strong> ALL (“BIOPHILIC*”, “DESIGN*”, and “EMOTION*”)</td>
</tr>
<tr>
<td>Scan Results: 64 documents (2012-2023)</td>
<td>Scan Results: 49 documents (2017-2023)</td>
</tr>
</tbody>
</table>

On May 17, 2023, data files in .csv and .txt formats were downloaded after evaluating the bibliometric data of the Scopus and Web of Science Core Collection databases. The VOSviewer received the data files. A free software program called VOSviewer may provide important bibliometric maps, research relationships, graphical representations, and visualization [53].

3. **Findings**

The bibliographic maps in this part of the article were created by analyzing bibliometric data taken from the Web of Science and Scopus databases through the VOSviewer program. The visual maps were created by performing the following analyses: co-authorship/ the authors, co-occurrences/author keywords, and citation/documents analysis.

3.1. **Analysis of the Authors’ Co-Authorship Data**

Authors’ analyses of co-authorship are used as scientific collaborations analysis, which includes author co-attribute, co-authors, and co-word analysis to explore the collaborative roots of disciplines [54], [55]. In this research, the clusters and cluster sizes in the present research represent the authors. The connections between the clusters indicate the authors’ collaboration. The thickness of the network line lengthens in proportion to the total connection strength between the authors.
First, research data were obtained separately from Scopus and WoS. Data were obtained by searching “biophilic*” and “design*” and “emotion*” as words on Scopus and WoS. 64 different sources were accessed in Scopus and 49 in WoS. In Scopus, the required minimum for both the number of documents and the number of citations for an author was set to 2 and 0 accordingly. After establishing these parameters, the sum of 166 authors was reduced to 13 who satisfied the criteria. Each of the 13 authors’ overall co-authorship connections with other authors were estimated. The authors with the strongest overall link strength were chosen. The number of authors chosen was 13. The ranking by the most-cited author may be shown in the software’s user interface before proceeding to the author connections scientific interactions mapping, as shown in Figure 1. A minimum of 2 documents and 0 citations were specified as requirements for authors in the Web of Science Core Collection Data. After establishing these parameters, a total of 147 authors were reduced to 9 who satisfied the criteria. The overall strength of co-authorship relationships with other authors was estimated for each of the 9 authors. The authors with the strongest overall connection profiles were chosen. The authors to be chosen were 9. Before moving on to the author connections and scientific partnerships mapping, the software’s user interface may first offer the ranking by the author who has received the most citations, as seen in Figure 1.

The VOSviewer for Scopus forewarned us when we initially started mapping that part of our network’s 13 pieces was not connected and that the larger group of related content only had three elements. “Do you want to show this set of items instead of all items?” the software prompted. The mapping shown in Figure 2 was produced by choosing “No”. The co-authorship was divided into five groups, as shown by this mapping: Cluster 1 (Ahmed-Kristensen S., Sayuti N. A. A., Bonollo E.), Cluster 2 (Desha C., Reeve A.), Cluster 3 (Purani K., Kumar D. S.), Cluster 4 (Sal Moslehian A., Gaekwad J. S., Roös P. B.) and Cluster 5 (Liu H., Li Z.).

The VOSviewer forewarned us when we initially began mapping in the Web of Science Core Collection that some of our network’s nine pieces were not connected and that the larger group of related items only had three elements. “Do you want to show this set of items instead of all items?” the software questioned. The mapping shown in Figure 3 was produced by choosing “No”. Three co-authorship clusters were discovered in this mapping: Cluster 1 (Purani K., Kumar D. S.), Cluster 2 (Liu Hong, Liu Hui, Li Z.), and Cluster 3 (Roös, P. B., Gaekwad J. S.).
3.2. Analysis of Co-Occurrences Data by Author Keywords

Understanding how authors and research areas relate to each other is important to make comparisons among different study areas on the map. Cluster analysis can help to clarify the structures within the maps by increasing these map comparisons. This makes comparing the maps easier because the clusters highlight the important keywords and new concepts in the maps [56]. The clusters and cluster sizes in this study indicate the keywords. The connections between the clusters indicate the keywords’ collaboration. The general strength of the connection between the search terms increases the thickness of the scientific collaborations line. Scopus’s minimum keyword usage threshold of 2 was established as the standard. Following the restrictions, the total of 255 keywords was decreased to 27 that fulfilled the requirements. Each of the 27 keywords’ overall co-occurrence relates to other terms was assessed. The search terms with the strongest overall connections were eliminated. 27 keywords in total were chosen. The sequence of ranking determined by the biggest number of keyword occurrences may be sorted in the interface of the software before proceeding to the understanding of network mapping. This mapping shows that compared to the other terms, biophilic design, biophilia, and built environment are more commonly used in conjunction. The term “biophilic design” came out on top in this ranking, followed by “biophilia”, “built environment”, “nature”, “well-being”, “sustainability”, and “emotion”. Additionally, the mapping process was completed without giving any warnings as it proceeded.

The co-occurrences mapping revealed eight clusters, as illustrated in Figure 4. These clusters were symbolized by various-sized and colored circles. Table 3 shows that investigated other terms contained in clusters with the keywords biophilic design, emotions, biophilia, sustainable architecture, emotional design, and biophilic architecture.

VOSviewer may also display changes over time by overlaying the keyword network mapping developed in Figure 4. This figure shows that represent the connection between new keywords that have lately been utilized in publications. New research zones are color-coded in the temporal mapping with yellow and light, green-toned clusters of small sizes. Emotion and biophilic design were employed to contrast changes throughout time. The keyword biophilic design was highlighted in light green, while biophilia was marked in purple.
The words emotion, mental health, and well-being are light yellow and appear to be new research topics. According to Figure 5, yellow and light green tones signify new research concepts. Biophilic design and emotion are relatively recent subjects of research, according to Scopus statistics. Consequently, there is a continuing demand for research on subjects related to biophilic design. In this context, yellow and light green little clusters that are nearest to the group they correspond to were looked at to identify any new ideas that might be connected to the term “biophilic design.”

Table 4. Concepts related to biophilic, design and emotion clusters based on data downloaded from Scopus (Available at: https://www.scopus.com/). (Source: VOSviewer, 2023. Available at: https://www.vosviewer.com/).

<table>
<thead>
<tr>
<th>Web of Science Core Collection Data</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biophilic design</td>
<td>Biophilic architecture</td>
<td>Biophilic urban planning</td>
<td></td>
</tr>
<tr>
<td>Built environment</td>
<td>Biophobia</td>
<td>Emotions</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Connection to nature</td>
<td>Mental health</td>
<td></td>
</tr>
<tr>
<td>Well-being</td>
<td>Emotion</td>
<td>Wellbeing</td>
<td></td>
</tr>
<tr>
<td>Window</td>
<td>Nature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOSviewer may also display changes over time by overlaying the keyword network mapping developed in Figure 6. This figure shows that represents the connection between new keywords that have lately been utilized in publications. New study zones are color-coded in the temporal mapping with yellow and light, green-toned tiny groups. Emotion and biophilic design have been implemented to demonstrate changes throughout time. The keyword biophilic design was highlighted in light green, while biophilia was marked in purple. The words emotions, mental health, well-being, health, and connection to nature are light yellow and appear to be new research topics. According to Figure 7, yellow and light green tones signify new research concepts. According to statistics from the Web of Science Core Collection, research on biophilic design and emotion is comparatively recent. Consequently, there is a continual demand for research on subjects related to biophilic design.
In this context, yellow and light green little groups that are nearest to the group they correspond to were investigated to identify any new ideas that might be connected to the term “biophilic design”.

Figure 7. Analysis of co-occurrences data by author keywords developments over time in Web of Science Core Collection.
(Source: Created by VOSviewer, 2023, Available at: https://www.vosviewer.com/). Certain data included herein is derived from Elsevier Scopus (Available at: https://www.scopus.com/) and Clarivate Web of Science (Available at: https://www.webofscience.com/). © Copyright Elsevier 2023. © Copyright Clarivate 2023. All rights reserved.

3.3. Analysis of Citation Data by Documents

A citation describes the association between a mentioned document and the one that it is referencing [57]. In this part of the article, the clusters on the map consist of documents. The connections that exist between the clusters show that the files are connected [58]. As their connectivity increases, clusters are positioned closer together on the map [59]. The overall power of the connections amongst publications varies together with the network line’s thickness [60]. After the 64 documents taken from Scopus were exported to the VOSviewer, the citation was selected as the type of analysis, and documents were selected as the unit of analysis in the software. When a document’s minimum citation count was set at 3, 38 out of 64 documents fulfilled the requirement. For each of the 38 documents, an estimate of the number of citation links’ number was determined. It was decided to use the documents with the most links. For each of the 38 documents, an estimate of the number of citation links’ number was determined. It was decided to use the documents with the most links. There were 38 documents chosen in all. When beginning the mapping, it was possible to see the software’s interface’s sorting by the most often referenced texts (Figure 8).

The VOSviewer informed the following alert while integrating the Scopus data and presented the following query: 38 different things on your network, some of which did not join. The greatest group of linked things has 16 components. Do you want to show this set of items instead of all items? The map in Figure 9 was made after the “Yes” response to the question was given. This mapping indicates that “Yin (2018)” was the highest-ranked document, followed by “Ko (2020)” with 90 citations, “Beatley (2017)” with 72 citations, “Purani (2018)” with 38 citations, “Mangone (2017)” with 29 citations, and finally “Wijesooriya (2021)” with 25 citations.

Figure 8. Interface sorted by the most cited documents before mapping.
(Source: Created by VOSviewer, 2023, Available at: https://www.vosviewer.com/). Certain data included herein is derived from Elsevier Scopus (Available at: https://www.scopus.com/). © Copyright Elsevier 2023. All rights reserved.

Figure 9. Analysis of citation data by documents in Scopus.
(Source: Created by VOSviewer, 2023, Available at: https://www.vosviewer.com/). Certain data included herein is derived from Elsevier Scopus (Available at: https://www.scopus.com/). © Copyright Elsevier, 2023. All rights reserved.
A citation was chosen as the type of study and a document was chosen as the unit of analysis in the software after the 49 documents collected from the Web of Science Core Collection were exported to the VOSviewer. 30 out of 49 documents met the requirement when the minimum number of citations for a document was set at 3. With each of the 30 documents, an estimated number of citation connections was used. It was decided to use the files with the most links. There were 30 documents chosen in all. When beginning the mapping, it was possible to observe the software’s interface’s sorting based on the most often cited texts (Figure 10).

![Figure 10. Interface sorted by the most cited documents before mapping. (Source: Created by VOSviewer, 2023. Available at: https://www.vosviewer.com/). Certain data included herein is derived from Clarivate Web of Science (Available at: https://www.webofscience.com/). © Copyright Clarivate 2023. All rights reserved.]

4. Conclusion

In this research, bibliometric data from the Scopus and Web of Science Core Collection databases were used to investigate scientific articles regarding emotion at the point of biophilic design. The oldest document in Scopus dates to 2012, whereas the Web of Science Core Collection’s oldest document dates to 2017. These results are based on 113 articles worth of bibliometric data that have been gathered since 2012. The data downloaded by examining keywords as emotion, biophilic, and design in Scopus and Web of Science Core Collection was evaluated by bibliometric analysis applying science mapping methods. The ideas associated with the biophilic-design-emotion clusters, as well as their evolution through time (present trends), were established with co-occurrence mapping. Additionally, the cited authors and documents connected to the clusters of biophilic, design, and emotion have been identified. The connections between documents and authors in the biophilic, design and emotion research categories were identified with “citation of documents” mapping and co-authorship mapping. Based on the findings of the co-occurrence mapping, existing research requirements and concepts were identified (Table 5). The gaps indicated by the examined keywords in the databases identified for scanning include Biophilic Design, Emotional Design, Biophilic Architecture, Well-being, and Emotions (Table 5). These new concepts relating to design and architecture were highlighted when evaluating these gaps. The findings of citation mapping were used to identify authors and documents (Table 5). The databases selected for scanning contain information about the primary authors who can be called up as reference sources based on the keywords that were recognized. These principal authors are Gaekwad J.S., Kumar D. S., Li Z. M., Liu H., Hung S. H., Chang C. Y., Ahmed Kristensen S., Meenar M., Moslehian A. S., and Purani K.
When identifying those authors, mentioned references associated with design and architecture were highlighted.

Table 5. From the keywords to the new research gaps “concepts” and authors.

<table>
<thead>
<tr>
<th>Scanned Keywords</th>
<th>Scanned Databases</th>
<th>Determined Gaps</th>
<th>Determined Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotion</td>
<td>Scopus</td>
<td>Biophilic Design J.S.</td>
<td>*Gaekwad</td>
</tr>
<tr>
<td>Biophilic</td>
<td>Web Of Science</td>
<td>Emotional Design *Kumar D.S.</td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Core Collection</td>
<td>Biophilic Architecture *Li Z.M.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Well-being *Hun H.</td>
<td>*Chang C.Y.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Biophilic Architecture *Hung S.H.</td>
<td>*Ahmed Kristens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Emotions A.S.</td>
<td>*Moslehan</td>
</tr>
</tbody>
</table>

To finalize, it was noted that there is an increasing interest in concepts based on emotion at the connection of biophilic and design investigation fields. Furthermore, biophilic design has been argued to be a more recent distribution than biophilia in terms of how it connects space and emotion in architecture. Therefore, the ideas discovered in this study, particularly the distinctive combinations that could be created by applying the biophilic architecture method, allow the creation of new research areas.

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