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RESEARCH ARTICLE

# Mapping Design and Creative Thinking in Architecture and Design: A SciMAT-Based Conceptual and Thematic Analysis

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## Abstract

The aim of this research is to examine the conceptual and theoretical foundation of creative thinking and design thinking. In this study, a systematic literature review was conducted on the concepts of "design," "design thinking," "design-oriented thinking," "creativity," and "creative thinking." The steps followed in the research were in the first stage the publications within the scope of the architecture and design disciplines that were examined; in the second stage the articles were critically reviewed, and the articles that were not relevant were excluded; and finally, bibliometric and content analysis of the selected articles were carried out. In addition, the current publication trends, sub-themes, and conceptual variations were visualized using specialized software. The analyses of the research were performed using the SciMAT (Science Mapping Analysis Software Tool) software through strategic diagrams, network maps, and thematic maps. It is possible to develop various clustering methods and conduct analyses using different bibliometric networks with the SciMAT program. The study's conclusions provide recommendations that emphasize current trends in design education and design studio software-based, as well as suggestions for future research.

**Keywords:** Design thinking, design education, design studio, SciMAT software, creative thinking

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## 1. INTRODUCTION

Design thinking and creative thinking are recognized as important tools for solving complex problems. This study aims to examine the theoretical and conceptual foundations of design thinking and creative thinking, especially in the fields of architecture and design. While design thinking addresses user-oriented problem-solving processes with an innovative approach, creative thinking is a cognitive process that enhances individuals' ability to generate original solutions by adopting different perspectives. The combination of these two concepts allows not only academic research but also practical applications to be successfully implemented. Interdisciplinary approaches increase the applicability of design and creativity in many different fields (Cross, 2011; Brown, 2009). Design can be defined as a tangible output of the creative process aimed to finding solutions to human needs. Design thinking is a systematic approach to this creative process and enables the development of innovative and user-oriented solutions for problem-solving (Cross, 2011). Design thinking brings creative thinking skills into the design process and enables individuals or teams to generate new ideas, prototype, and implement them (Brown, 2009). While creativity is generally defined as the ability to generate new and valuable ideas as a broad concept, creative thinking, as a subset of creativity, is a mental process that develops solutions by looking at problems from different perspectives (Guilford, 1967; Runco, 2007). Creative thinking is considered a fundamental element of design processes because design thinking is based on the ability to generate creative solutions. Therefore, design and creative thinking are seen as complementary concepts; design emerges as the concrete and functional output of creative thinking (Cross, 2011; Brown, 2009).

### 1.1. Literature Review

The concepts of creative thinking and creativity have been the focus of attention within academic literature, particularly in recent years. Foundational research has extensively explored creativity and creative thinking within the context of architectural design and design studio pedagogy (Potur & Barkul, 2006; Cho, 2012; Nalkaya, 2012; Kowaltowski et al., 2010; Hamza & Hassan, 2016; Daemei & Safari, 2018; Park & Kim, 2021; Casakin & Wodehouse, 2021; Park et al., 2022; Kokorina, 2022; Park et al., 2023). Furthermore, contemporary investigations have increasingly applied bibliometric methodologies, employing tools such as VOSviewer software to analyze creative thinking trends in architectural design studios (Park & Lee, 2022).

The design thinking process is divided into five basic steps; empathize, define, ideate, prototype, and test. Since innovative and user-oriented solutions are developed through design thinking, they constitute the focus of the architectural design discipline. Basic research studies have focused on design thinking in architectural design and architectural design studios (Moore & Karvonen, 2008; Alagonya, 2015; Michalatos, 2016; Ghonim, 2016; Tepavcevic, 2017; Bhooshan, 2017; Simon & Hu, 2017; Duzgun & Bekdas, 2019; Holubchak, 2020; Özten Anay, 2020; Lüley, 2020; Avsec & Jagiełło-Kowalczyk, 2021).

Architecture and design disciplines are not limited to aesthetic concerns; they include creative processes that aim to produce solutions to social, environmental, technological and cultural problems. In this context, creativity is the capacity to develop original, valuable and innovative solutions to existing problems. Design thinking, on the other hand, is a user-oriented problem solving approach that enables this creative potential to be channeled systematically.

Creativity forms the basis for innovative design decisions in architectural education and practice. Students and professionals need creative thinking processes to transform abstract ideas into concrete spatial solutions. In this process, it is important to bring together different perspectives, structure imagination, and encourage interdisciplinary thinking.

Design thinking offers a structured methodology for this creative potential. This approach, which includes stages such as empathizing, defining the problem, generating ideas, prototyping and testing, facilitates effective solutions, especially in the face of complex and uncertain design problems. This approach, which is applied in design studios, enables the development of more functional, accessible and sustainable designs by centering user needs. The integration of these two concepts in the fields of architecture and design supports innovative thinking in both academic and professional contexts and enables more efficient use of new technologies and methods.

Moreover, not only technical knowledge but also competences based on creative thinking such as critical thinking, empathy and cultural awareness have become decisive in solving contemporary architectural problems. As a result, creativity is the source of original thinking in architecture, while design thinking provides a structural framework that governs this creative process. The combination of these two elements paves the way for qualified and innovative designs both in education and professional practice.

Additionally, the main aim of the study is to explore how the concepts of creative thinking and design thinking are shaped and how they interact with each other. In line with this aim, it is intended to systematically examine the studies conducted in the context of the architecture and design to evaluate the existing research on these concepts through bibliometric analyses. SciMAT software was used as an effective tool to visualize conceptual structures, trends, and sub-themes in the literature through bibliometric analysis (Cobo et al., 2011). At the end of the study, the thematic trends of the studies on the concepts of design thinking and creative thinking will be revealed, and the effects of these two concepts on architecture and design education will be evaluated.

To sum up, the main contribution of this study is to provide a roadmap for a better understanding of design education and creative thinking processes by identifying the place and development processes of the concepts of creative thinking and design thinking in the literature through bibliometric methods. The analysis through SciMAT software will reveal how these two important concepts are shaped by visualizing conceptual structures, trends, and sub-themes in the literature more clearly. The importance of this study is that it fills gaps in the literature and identifies new directions for future research.

It will also contribute to a better understanding of the role of design thinking and creative thinking in architecture and design education and provide strategic recommendations for the development of educational programs and design studios (Cross, 2011; Brown, 2009; Guilford, 1967; Runco, 2007). In this context, a deeper understanding of the conceptual and practical dimensions of creative thinking and design thinking will be an important resource for both academic research and practical applications. Addressing the concepts of creative thinking and design thinking with an integrated approach is of great importance for adapting to today's changing design dynamics.

## 2. RESEARCH METHODOLOGY

### 2.1. Research Data Collection

The data for this study were collected using the bibliometric analysis method, which is a quantitative research method (Park & Lee, 2022; Mutlu Avinç & Yıldız, 2024; Küçükyağcı, 2025; Çalışkan & Kayaakdağ, 2025; Benaicha et al., 2025; Khanzadeh, 2025). This method is commonly applied in current studies in the field of architecture and design. In the data collection process, the database used to collect the data was selected at the initial stage, as the choice of database has a direct impact on the quality of the results. There are many databases where scientific research can be examined (Web of Science, Scopus, PubMed, ProQuest, etc.). In this study, the Web of Science database, which is the most common multidisciplinary database used for literature review in scientific research, was selected. Data were collected by performing keyword-based searches.

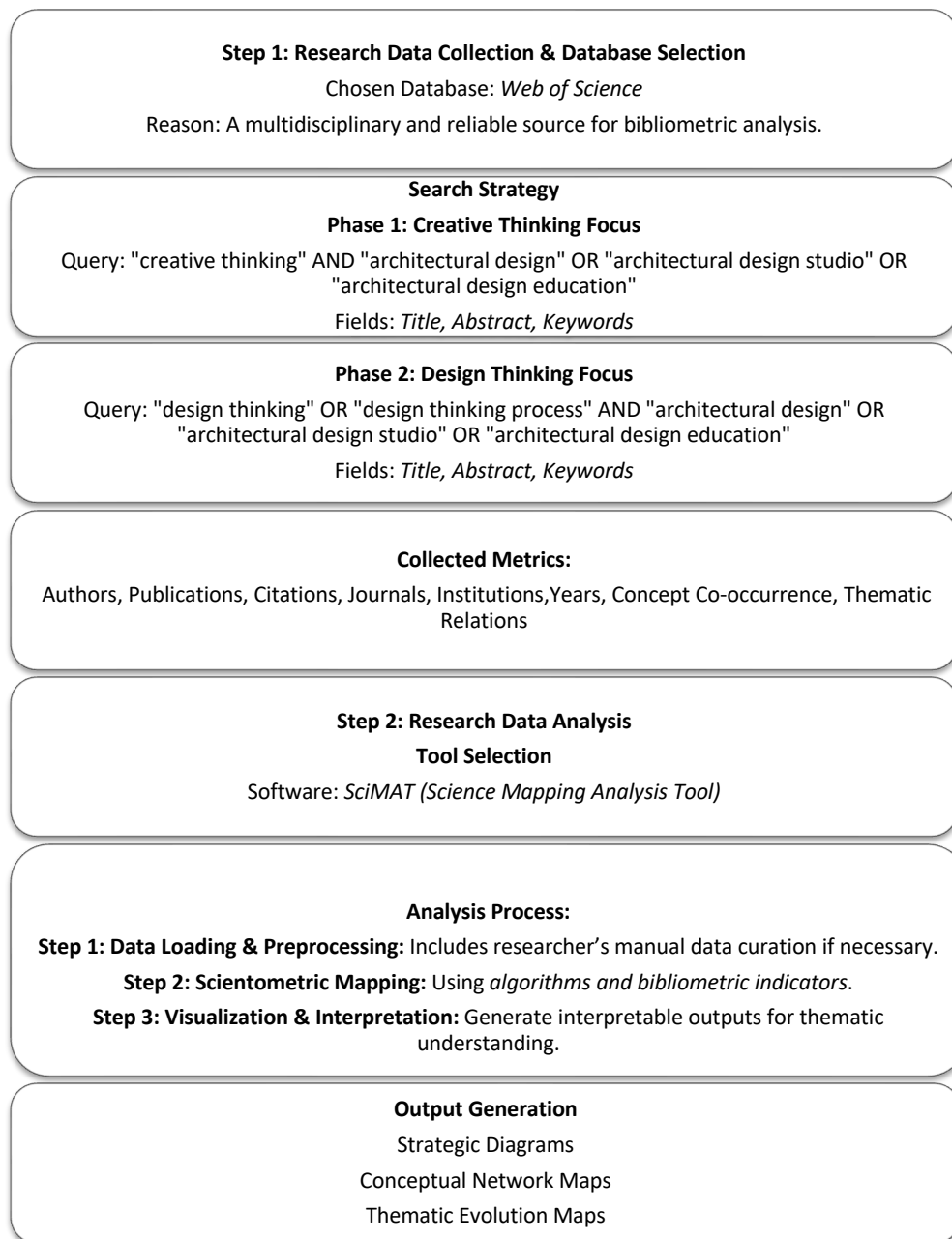


Figure 1. Research design and workflow (Created by authors, 2025)

Accordingly, in the first step of the study, various bibliometric indicators such as concepts, theories, and publications of authors, year of publication, journal, citation status, and co-authorship were accessed.

For this purpose, “creative thinking” OR “creativity” (Topic) AND “architectural design” OR “architectural design processes” OR “architectural design studio” OR “architectural design education” (Topic) is defined as title, abstract, and keywords. In the second step, many statistical data such as the place of design thinking in the field of architecture, the year of publications on this subject, citations, and journals published, the most influential institution, and trend words according to years were accessed. For this, search for “(creative thinking) creative thinking” OR “creativity” (Topic) AND “architectural design” OR “architectural design processes” OR “architectural design studio” OR “architectural design education” (Topic) defined as title, abstract, and keywords.

In the second step, additional indicators such as the place of design thinking in the field of architecture, the year of publications on this subject, citations, and journals published, the most influential institution, and trend words according to years were identified. For this purpose, “(design thinking) design thinking” OR “(design thinking approach) design thinking approach” OR “(design thinking processes) design thinking process” (Topic) AND “architectural design” OR “architectural design processes” OR “architectural design studio” OR “architectural design education” (Topic) were defined as title, summary, and keywords.

Figure 1 below illustrates all the steps of the research design and workflow. All steps are presented under the headings: Research Data Collection & Database Selection, Search Strategy, Creative Thinking Focus, Design Thinking Focus, Metrics Collected, Research Data Analysis, Analysis Process, and Output Generation (Figure 1).

## 2.2. Analysis of Research Data

SciMAT is open-source software developed by the University of Granada in Spain (Cobo et al., 2011). In this article, the SciMAT software is used for scientific mapping and identifying conceptual subfields. SciMAT is a scientific mapping software tool that has been used in many different fields of science in recent years. The SciMAT program applies algorithms and quantitative measures to create scientific maps. The explanation and interpretation of scientific maps, thematic analyses, and strategic diagrams through SciMAT software have been carried out by many researchers (Cobo et al., 2012; López-Robles et al., 2021; Gibbin et al., 2023; Morooka et al., 2024; Bagheri et al., 2024; Karakose et al., 2024). There are studies that obtained strategic diagrams, thematic networks and evolutionary maps with SciMAT (Özköse & Güney, 2023). Within this software, the researcher performing the analyses can monitor, intervene, and select at many stages of scientific map production, from the first step (data loading and raw data preprocessing) to the last step (visualization and interpretation of the results). This allows researchers to access multiple analytical perspectives in an objective, limited way to scientific maps created with existing data. First, factor and strategic diagram analyses were conducted on research addressing creativity and creative thinking. Second, the same analyses were performed for studies focusing on design thinking.

## 3. RESULTS

Different bibliometric visualization techniques can be applied using SciMAT software. These include strategic diagrams, cluster networks, evolution maps, and overlapping maps. The strategic

diagram shows measures of density and centrality. In addition, for each network, the associated network set is also shown (Cobo, 2012). SciMAT analyzes the data by importing the format of ISIWoS (ISI-CE), the formats used by RIS, Scopus, and other bibliographic resources, and the data in a specific CSV format.

### 3.1. Factor Analysis and Strategic Diagram Analysis of The Research in the Context of Creativity and Creative Thinking

Factor analysis and strategic diagram analysis were conducted in the context of creativity and creative thinking. SciMAT data analysis of publications focusing on creativity and creative thinking and research findings are presented below. Figure 1 displays data related to publications focusing on creativity and creative thinking on the interface of the SciMAT program, making it easier for the researcher to make decisions about the analysis. Figure 2 presents the strategic diagram of the keywords used by the authors in two different periods. In the second period, it is possible to say that concepts such as digital design and artificial intelligence were added to creativity and creative thinking.

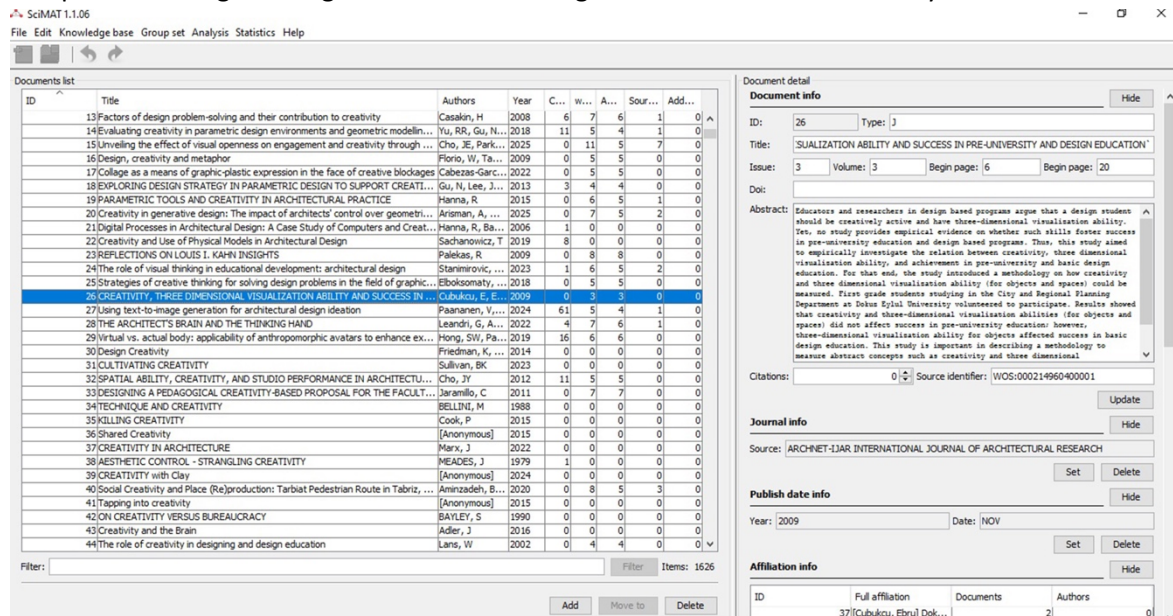


Figure 2. Uploading the pre-analysis data of publications focused on creativity and creative thinking to the system and the SciMAT software interface (Created by authors, 2025)

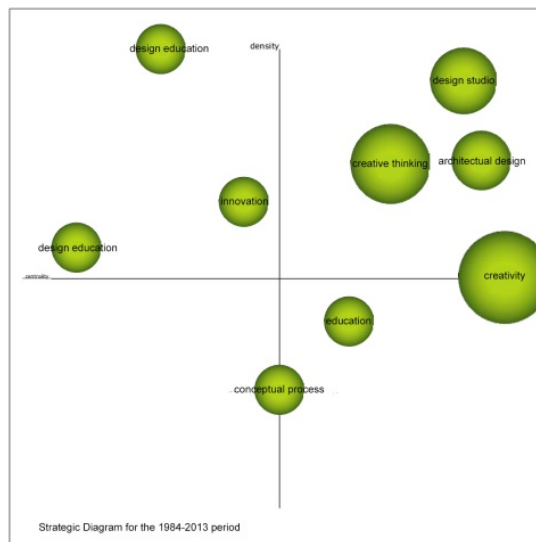


Figure 3. Strategic Diagram (Created by authors, 2025)

In addition, the factor analysis results of the authors' keywords and the numerical data of their clusters are shown in Table 1. In the factor analysis graph, it can be stated that concepts such as creativity, creative thinking, architectural education, architectural design studio, and design processes overlap and are located in the center of the graph, indicating that the keywords in the publications are closely related to one another (Figure 3).

Table 1. Factor analysis findings for authors' keywords (Created by authors, 2025)

WORD	DİM.1	DİM.2	CLUSTER
<b>creativity</b>	0	-0,19	1
architectural.design	-0,37	-0,5	1
architecture	0,2	0,52	1
design.education	-0,24	1,42	1
design	0,05	0,63	1
architectural.education	-0,12	0,02	1
design.process	-0,19	-0,26	1
architectural.design.education	0,04	-0,01	1
architectural.design.studio	-0,33	2,87	1
design.thinking	0,01	0,39	1
virtual.reality	-0,39	-0,36	1
design.studio	-0,24	-0,04	1
<b>creative.thinking</b>	-0,3	3,59	1
innovation	-0,21	-0,52	1
teaching	-0,08	-0,19	1
architectural.design.process	-0,17	0,33	1
conceptual.design	-1,31	-1,04	1
education	-0,01	0,43	1
architectural.design.firms	5,43	-0,55	1
artificial.intelligence	-0,07	-0,19	1
design.cognition	-0,96	-1,34	1
digital.design	-0,47	-0,79	1
protocol.analysis	-1,28	-1,73	1
architecture.education	-0,02	0,29	1
cad	-0,42	-0,76	1

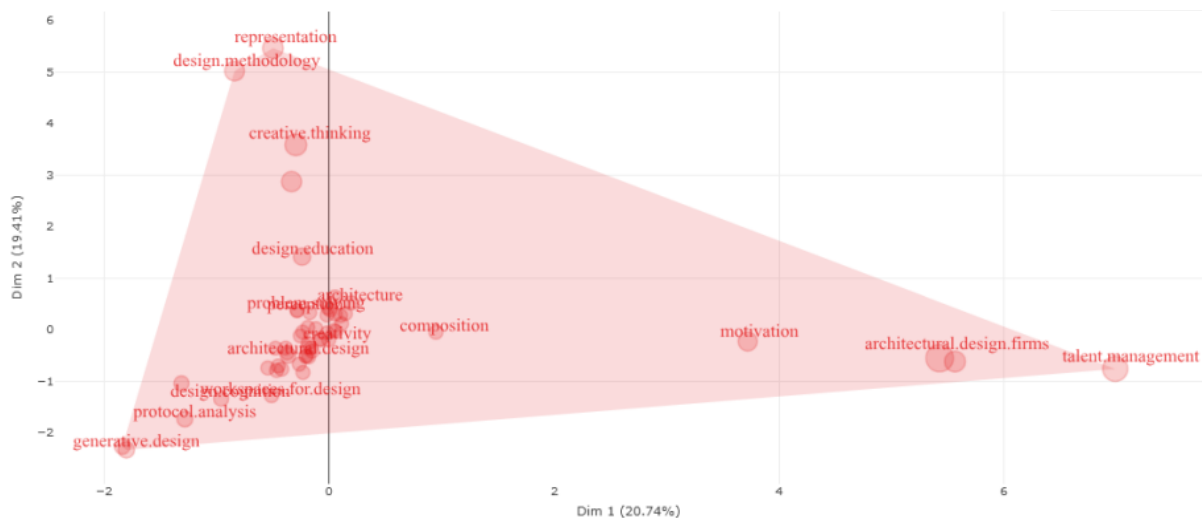


Figure 4. Factor analysis graph of authors' keywords in creativity-oriented publications (Created by authors, 2025)

### 3.2. Factor Analysis and Strategic Diagram Analysis of the Set of Research Themes in the Context of Design Thinking

Factor analysis and strategic diagram analysis were conducted in the context of design thinking, and design thinking processes. SciMAT data analysis and research findings of publications focusing on design thinking are presented below. Figure 4 displays the data of publications focusing on design thinking on the interface of the SciMAT program. In this interface, the researcher can make many selections and analyze the data based on the period, author, institution, or publisher. Figure 5 shows the strategic diagram of the keywords used by the authors in two different periods. In the second period, it is possible to say that concepts such as sustainability, innovation, empathy, interdisciplinary, and universal design belong to a close network relationship in design thinking.

The screenshot shows the SciMAT 1.1.06 interface. On the left, there is a 'Documents list' table with columns for ID, Title, Authors, Y., S., and A. The table lists various publications related to design thinking. On the right, the 'Document detail' panel is visible, showing information for document ID 61, including its title, issue, volume, and abstract. The abstract discusses the definition of design thinking and its application in interior design education.

Figure 5. Uploading pre-analysis data of design thinking-oriented publications to the system and the SciMAT software interface (Created by authors, 2025)

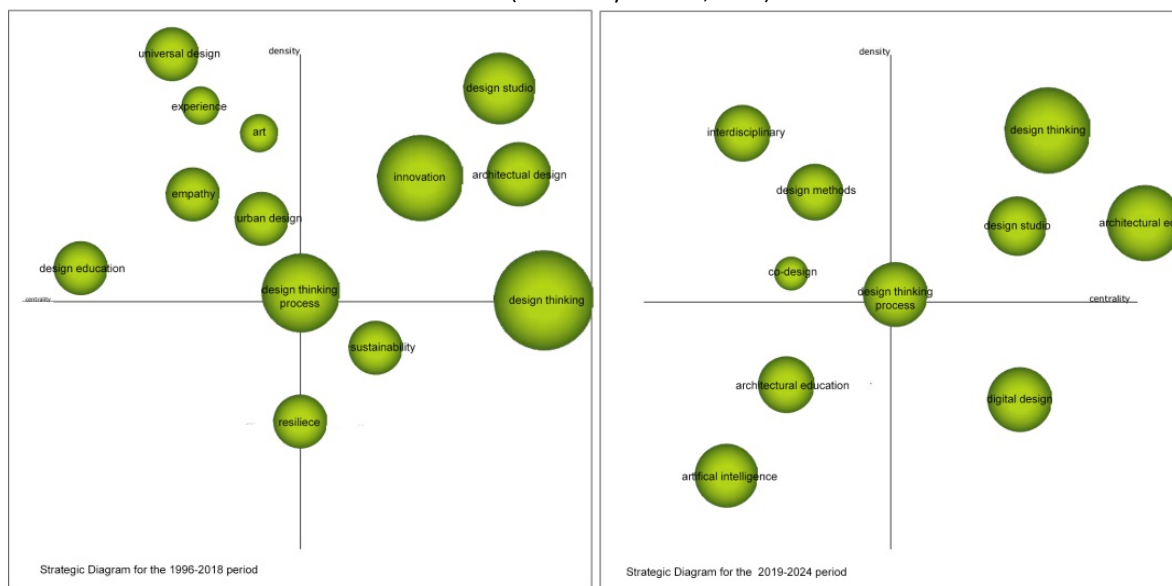


Figure 6. Strategic Diagram (Created by authors, 2025)

The factor analysis findings and numerical data of the clusters of the authors' keywords in design thinking-oriented publications are shown in Table 2. In the factor analysis graph, it can be stated that concepts such as design thinking, architectural education, architectural design studio, and design processes are located in the center of the graph by overlapping the density of red dots in the center (0,0) in Figure 7, which indicates that the keywords in the publications are closely interconnected (Figure 7).

Table 2. Factor analysis findings of authors' keywords in design thinking-oriented publications (Created by authors, 2025)

WORD	DİM.1	DİM.2	CLUSTER
<i>design.thinking</i>	0,3	-0,17	1
<i>architecture</i>	-0,17	-0,21	1
<i>design</i>	-0,19	-0,04	1
<i>design.education</i>	-0,12	-0,3	1
<i>thinking</i>	-0,06	0,02	1
<i>education</i>	-0,15	-0,39	1
<i>creativity</i>	0,08	-0,32	1
<i>architectural.education</i>	0	0,01	1
<i>pedagogy</i>	-0,18	-0,26	1
<i>innovation</i>	-0,04	-0,24	1
<i>design.process</i>	-0,17	-0,27	1
<i>sustainability</i>	-0,21	-0,19	1
<i>empathy</i>	1,62	-0,26	1
<i>architectural.design</i>	-0,15	0,48	1
<i>artificial.intelligence</i>	-0,3	5,21	1
<i>co.design</i>	-0,13	-0,3	1
<i>computational.design</i>	-0,15	-0,19	1
<i>design.methods</i>	-0,11	-0,32	1
<i>experience</i>	-0,04	-0,29	1
<i>interdisciplinary</i>	-0,22	-0,25	1
<i>universal.design</i>	-0,1	-0,29	1
<i>urban.design</i>	-0,09	-0,13	1
<i>art</i>	-0,24	-0,26	1
<i>built.environment</i>	-0,24	-0,21	1
<i>business</i>	-0,18	0,66	1

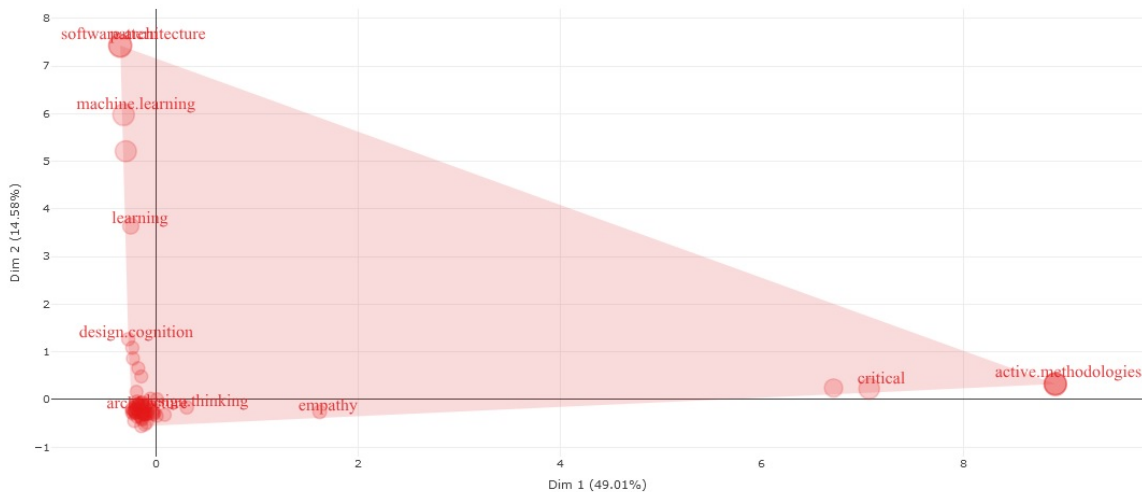


Figure 7. Factor analysis graph of authors' keywords in design thinking-oriented publications (Created by authors, 2025)

#### 4. DISCUSSION

In this section, the contribution of the findings of this research to the field of architecture and design is discussed. The literature on creative thinking and design thinking has several implications for architecture and design research. Firstly, by systematically analyzing and visualizing the development of keywords and conceptual clusters, this study provides a clearer understanding of how these key concepts are positioned and developed within academic discourse across the fields of architecture and design. Such mapping is particularly valuable for researchers and educators seeking to identify existing research gaps, dominant paradigms and emerging themes in design education, such as artificial intelligence, virtual reality and interdisciplinary approaches.

Secondly, identifying the central role of concepts such as “design thinking”, “architectural education” and “creative thinking” supports the ongoing pedagogical discourse on how to structure design studios and curricula. The findings highlight the link between creativity, innovation and pedagogical methods, enabling educators to reassess and enhance studio practice with a greater emphasis on user-centered design and cognitive processes. In this context, the study indirectly contributes to the development of more effective and reflective design education strategies.

Finally, this research serves as a methodological guide for architectural scholars interested in bibliometric analysis. While bibliometric mapping itself does not offer direct solutions to design problems, it serves as a diagnostic tool to assess the maturity, diffusion and focus of scholarly debates. By using SciMAT in the context of architecture and design, a field where its application is still relatively rare, this study encourages more evidence-based and data-driven approaches to conceptual development in design disciplines.

In sum, while this study does not directly propose new theories or design methods, it provides an important foundation for further empirical and theoretical research. The value of this study lies in clarifying the current state of the field and outlining how future work can develop this knowledge toward more critical, creative and applied outcomes in architectural and design practice (Table 3, Table 4).

Table 3. Creativity Orientated Keywords: Effects on Architecture and Design (Created by authors, 2025)

Keywords	Descriptive
<b>creativity / creative thinking</b>	It represents the capacity to produce original solutions in architectural education and to approach design problems from different angles. Develops the student's cognitive skills such as problem solving, flexibility and intuition.
<b>architectural education / architectural design education</b>	Creativity and design thinking are at the centre of this education. Pedagogical approaches should be structured to support creative thinking.
<b>design studio / architectural design studio</b>	They are practical spaces where architecture students develop ideas, experiment and transform creativity into space. These studios are the places where creative thinking turns into concrete outputs.
<b>digital design / virtual reality / CAD</b>	Digital tools are technologies that both support and transform the creative process. In architectural education, VR and CAD enable students to transform abstract ideas into experienceable spaces.
<b>innovation / design cognition / protocol analysis</b>	It is the analysis of mental maps of creative processes, intellectual strategies and intuitive decision mechanisms. Innovation symbolises the development of new solutions in design.

Table 4. Design Thinking Keywords: Effects on Architecture and Design (Created by authors, 2025)

Keywords	Descriptive
design thinking	It is a design methodology for solving complex problems in user-oriented, systematic and creative ways. It includes stages such as empathising, defining, generating ideas, prototyping and testing in architecture.
empathy / pedagogy / education	When design thinking is combined with the principles of sustainability and inclusiveness, more accessible, environmentally and socially sensitive projects emerge.
sustainability / universal design / urban design	When design thinking is combined with the principles of sustainability and inclusiveness, more accessible, environmentally and socially sensitive projects emerge.
co-design / interdisciplinary / business	Co-production and interdisciplinary collaborations increase innovation in architectural projects. It offers an approach that takes into account not only the physical but also the social and economic impacts of design.
artificial intelligence / computational design	Artificial intelligence and computational design processes support the architect's creative decision-making mechanisms. Architecture is now shaped not only by intuition but also by data.

## 5. CONCLUSION AND SUGGESTION

This research examines the theoretical and conceptual foundations and practical dimensions of design thinking and creative thinking in architecture and design disciplines. The study highlights that design thinking addresses user-oriented problem-solving processes with an innovative approach, while creative thinking is a cognitive process that develops individuals' ability to produce original solutions by developing different perspectives. The research further reveals how the concepts of creative thinking and design thinking are shaped and how they interact with each other. By systematically examining the studies conducted in the context of architecture and design disciplines, existing research on these concepts was evaluated and interpreted through bibliometric analysis. Accordingly, the graphic and strategic diagrams indicate that creative thinking and design thinking are in a close relationship in architectural design and design education. In addition, with recent technology and digitalization, it can be stated that the concepts of artificial intelligence, digital design, and virtual reality have formed strong network relationships in publications on this subject. Considering the findings and results of this study, some suggestions can be made for future research on the subject.

These suggestions are as follows:

- In this research, there are many analyses that can be obtained with the SciMAT software. A limited number of analysis findings and statistical data from these analyses were included. Therefore, in future research, more comprehensive comparative methodologies on the same concepts, authors, institutions, titles, or journals published can be presented.
- Another suggestion is to compare the findings of different databases (Scopus, etc.) or software used for bibliometric analysis (CiteSpace, VOSviewer, ScientoPy, etc.). For example, bibliometric analysis and scientific mapping visuals obtained from SciMAT analyses and VOSviewer software can be included.
- It should be stated that this study is handled from an interdisciplinary perspective. It should be stated how the distribution of many parameters, headings, and sub-concepts of the research topic and the percentage, frequency, graphics, and interpretations can be made to the development stages with different periodic themes.
- Finally, visualizing the sub-concepts and themes of creativity, creative thinking, and design thinking in the fields of architecture, design, and planning will make it more understandable for students, academics, and researchers.

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All authors contributed equally.

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