

A Bibliometric Analysis Of The Status And Trends Of AI Applications In Design Thinking Research Based On Scopus (2015–2025)

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Abstract— This study examines AI applications in design thinking through bibliometric and content analyses of 535 articles from the Scopus database (2015-2025). The number of publications increased from 2019, peaking in 2024, reflecting growing interest in AI's role in design thinking. Co-occurrence analysis indicates that AI is central to design research, particularly in AI-generated content (AIGC) and human-computer interaction, driving innovation in design education and practice. Design thinking, which emphasizes user needs and creative problem-solving, is key in integrating AI with design. AIGC tools, such as ChatGPT, enhance design processes and promote interdisciplinary collaboration. However, ethical considerations, including fairness, inclusivity, and sustainability, are becoming increasingly important. The findings suggest that AI in design thinking will continue to evolve, shaping both academic research and practical applications.

Index Terms— AI, design thinking, artificial intelligence, bibliometric analysis

I. INTRODUCTION

The Fourth Industrial Revolution is largely driven by Artificial Intelligence (AI), simulating human learning, reasoning, and decision-making. AI has endured ebbs and flows from its inception in 1956. The first known specification of AI was proposed during the 1956 Dartmouth Conference and framed as the problem of imitating human cognition through symbolic reasoning, rule-based representation, and logic-based methods [1]. The decades that followed saw fluctuating levels of optimism and skepticism surrounding AI. The last 80th and initial 90th were years of growth for expert systems concerned with knowledge representation and rule-based methods to facilitate the task of designing. Nevertheless, obstacles like computing power constraints and unrealistic relevance continue to pose daunting challenges (Buchanan, 2005). It has recently become a critical point for digital transformation in various sectors [2]. [3] found that AI officially created an interactive experience similar to face-to-face lessons with virtual teaching tools, making learning more direct and engaging. Generative AI technologies such as ChatGPT, DALL-E, and Midjourney have revolutionized design education regarding knowledge mobilization and personalized learning [4]. However, concerns about over-dependence on AI may inhibit students' design thinking, creativity, and critical thinking [5][6][7].

The integration of AI with design thinking is receiving increasing attention. Design thinking, a human-centered approach, consists of stages such as empathizing, defining, ideating, prototyping, and testing, helping students develop creative problem-solving skills [7]. When combined with AI, design thinking requires adjustments. In the empathize phase, AI aids in identifying core issues through data analysis. [8] suggest that AI can optimize each stage, assisting design students in understanding problems and generating solutions. Yet, [9] caution that while AI tools, such as ChatGPT, enhance creativity, they cannot replace insights derived from human experiences, including fieldwork and observation.

The integration of AI within design education is based on the harmony of human intuition and machine accuracy. It is not meant to be a substitute but a complement to human creativity. However, the possibility of students' disconnection from the learning process has limited educational and ethical concerns about learners' originality and critical thinking skills in the face of increased dependence on AI-mediated tools [10]. Consequently, it is important to be aware of AI's historical backdrop and development trajectory within the domain of design education to properly deal with the current and even emerging issues in this field. This article uses bibliometric analysis to explore the current situation and paths of AI in design education in order to provide a clear academic context and suggestions for future research.

II. RESEARCH METHODOLOGY

This study employed bibliometric and content analysis to investigate research on design education. Bibliometric

analysis was conducted over time to examine the distribution, co-occurrence, and trends of AI applications in design thinking research. The Scopus database was used to identify relevant design-related publications. The largest abstract and citation database in the world was introduced by Elsevier and is called Scopus. It features a significantly greater number of journals and publications compared to the Web of Science (WoS) database. Scopus encompasses a wide range of disciplines, including natural sciences, life sciences, medicine, and social sciences. In addition to indexing research abstracts and references, it includes patent information from five major patent offices: the United Kingdom, the United States, Japan, the European Patent Office, and the World Intellectual Property Organization (WIPO). Many global university ranking organizations, such as the THE and QS World University Rankings, utilize data from Scopus as a key source in their rankings. Scopus has been found to have the following advantages compared to other database options WoS (Web of Science) and Google Scholar: consistent citation analysis, sophisticated bibliometric tools, and robust standardization of metadata can ensure the precision and reproducibility of bibliometrics research [11]. Bibliometric studies typically rely on a single database (e.g., Scopus, WoS, or IEEE) due to challenges in integrating datasets with differing labeling conventions [12].

The search initially identified 14,564 articles containing "design" and "AI" in their titles, abstracts, or keywords. To refine the selection, the scope was narrowed to studies incorporating "design thinking" and "AI" or "artificial intelligence." The search was further restricted to English-language research articles published between 2015 and 2025, resulting in a final dataset of 535 articles for analysis.

III. RESULTS

Figure 1 presents publication data from the Scopus database, illustrating the evolution of design-related research between 2015 and 2025. From 2015 to 2018, publication volume remained stable, with only 35 papers indicating an early-stage field exploration. A surge in publications began in 2019, reflecting a growing interest in AI applications in design thinking, particularly in integrating design methodologies with technological innovations. The period from 2022 to 2024 witnessed rapid growth, with 2022 recognized as the "Year of AIGC," reflecting increased scholarly focus. In 2024, the number of publications peaked at 213, accounting for 40% of the total over the past 11 years. This increase is attributed to the integration of design with other fields and the adoption of emerging technologies [13]. Research topics have expanded beyond traditional design methods to encompass broader issues such as the creative industries and education. Although data for 2025 remains limited, current trends indicate that design thinking research is becoming a major academic focus.

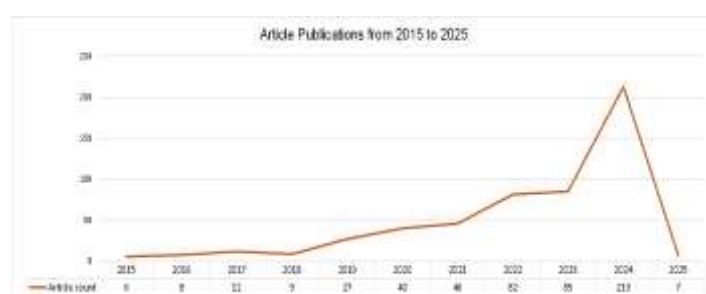


Fig. 1 Scopus Database Year Quantity Statistics

The co-occurrence analysis of Scopus literature using VOSviewer reveals the interactions among "Artificial Intelligence," "Design," and "Design Thinking," highlighting their interdisciplinary applications and development trends [14]. As shown in Figure 2, node size represents keyword frequency, while line thickness and color indicate co-occurrence strength. AI emerges as a central node, closely linked to "Design" and "Design Thinking," particularly in studies on AIGC and human-computer interaction, emphasizing AI's role in integrating technology and practice. This analysis underscores AI's growing importance in design research and its potential to drive innovation [15].

The connection between "Design" and AI reflects the integration of technology to address challenges related to innovation and efficiency in design. "Design Thinking" focuses on strategic frameworks, emphasizing its role in education and creative thinking. AIGC technologies, such as ChatGPT, form an independent research cluster associated with themes like "Effect" and "Future," highlighting their potential for future innovation. Research on education and skill development underscores design thinking's contribution to fostering creativity and technical abilities. The link between AIGC and future design innovation demonstrates its impact on the design industry [16]. Additionally, the combination of "Effect" and ChatGPT creates another research cluster, emphasizing AI's influence

on education, business design, and user experience while offering new research frameworks and development trends. AIGC-driven interdisciplinary collaboration and innovation are expected to be key drivers of future advancements [17].

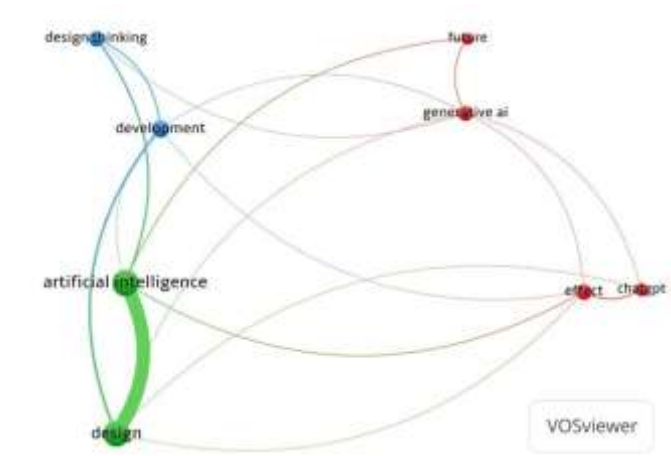


Fig. 2 Co-occurrence Analysis using VOSviewer

According to statistical data from the 535 articles, the keyword "artificial intelligence" appeared 304 times with a total link strength of 1,062, accounting for 57% of occurrences and consistently maintaining a central position in the research network (e.g., Figure 3). "Design thinking" appeared 43 times with a total link strength of 144, representing 8% of occurrences. It plays an important supportive role in frameworks centered around user needs, particularly contributing to applications in educational innovation and creative thinking development. Other AI-related keywords exhibit diverse technical and application focuses. For example, "artificial intelligence technologies" appeared 26 times (5%) with a total link strength of 95, while "artificial intelligence systems" appeared five times (1%) with a total link strength of 27, further highlighting the significant advancement of AI in systematic applications.

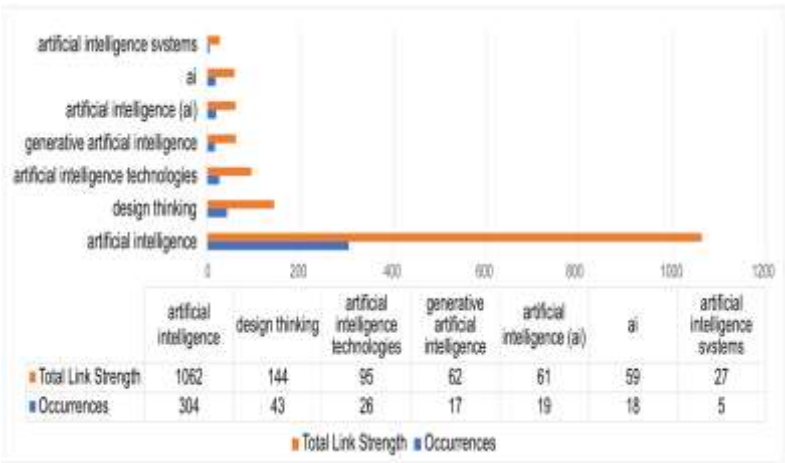


Fig. 3 Keyword Frequency Count

Additionally, the keyword "generative artificial intelligence" appeared 17 times (3%) with a total link strength of 62, underscoring its emerging potential in design assistance, creative generation, and data-driven design. This reflects its increasing prominence, particularly in the creative industries and design education.

IV. DISCUSSION AND CONCLUSION

AI in design education has evolved since then, enabling new methods and transforming pedagogical practices. AI has a history of being purely technical; however, as time passes, we see a shift in how AI acts with more collaboration in the creative process. Generative AI tools represent disruptive technology by providing improved interactions for education through personalized feedback and novel ideation-related support.

The interconnection between "Artificial Intelligence," "Design," and "Design Thinking" in academic research has expanded significantly over the past 11 years, peaking between 2022 and 2024, as reflected in the Scopus database. This trend highlights the rapid advancement of AI applications in design and Design Thinking, particularly under the influence of AIGC. Co-occurrence analysis using VOSviewer further highlights the interactions and interdisciplinary links between these fields. Design thinking plays a crucial role in this integration [18], fostering creativity and user experience while predicting trends. The synergy among design, AI, and design thinking continues to strengthen, with AIGC serving as a transformative tool for designers, reshaping creative processes and workflows [10] [19]. However, as AI technologies become more prevalent, considerations related to design ethics, such as fairness, inclusivity, and sustainability, will become increasingly important. Additionally, the role of AIGC in design education will remain a critical focus in both academic research and professional practice.

One of the main elements that bibliometric analysis brings to our attention is the need to make alliances that combine knowledge and results of different academic fields, thus creating collaborative and interdisciplinary spaces appropriate for AI applications. Future studies are needed to examine potential strategies for combining AI with conventional instructional practices and the enduring effects of AI-based teaching methods on student learning and professional practices. To sum up, AI has transformative potential on the one hand and a significant problem on the other hand for design education. With a well-rounded integration of technology developments balanced with humanistic education, stakeholders can leverage AI's full power in preparing future creative, ethical, and critical designers.

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