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Mapping the Research Landscape of Artificial Intelligence in Design Education: A Systematic Literature Review (2016–2025)

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ABSTRACT

This study reviews the research landscape of artificial intelligence (AI) in design education from 2016 to 2025. AI and generative AI tools have recently been taken up widely in design learning, design thinking, creativity training, and visual communication education. Research on AI in design education is still developing, however, and a clear overview of its main trends and research structure is still needed. To address this gap, the study combines a literature review with bibliometric analysis. Publications were retrieved from IEEE Xplore, Web of Science, and Scopus. Following keyword searching, database comparison, duplicate removal, and manual screening of titles, abstracts, and keywords, 137 journal articles were retained for analysis. Co-authorship and keyword co-occurrence analyses were carried out in VOSviewer. The results show that publications on AI in design education rose rapidly after 2022, with especially strong growth in 2024 and 2025. The co-authorship network is still fragmented: there are several small research groups but little collaboration between them. Keyword analysis points to "artificial intelligence," "design education," "generative artificial intelligence," "students," "teaching," "creativity," and "design process" as important themes. The findings suggest that AI in design education has become an emerging research area, although more studies are needed on how AI supports students' design thinking, creative processes, and visual communication practice in real learning contexts.

Keywords: Artificial Intelligence; Design Education; Systematic Review; VOSviewer

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Background

Artificial intelligence (AI) is advancing quickly in education, and this is particularly true of design education. AI tools have recently been used to support design learning, creative thinking, visual communication, and design practice. Earlier studies have shown that AI can help learners interact with digital learning environments and can improve their engagement and learning performance (Hwang *et al.*, 2022). Generative AI tools such as ChatGPT, DALL-E, and Midjourney have also proved useful in design education, where they can support knowledge learning, idea generation, visual exploration, and personalized learning support (Tsidylo & Sena, 2023; Yin *et al.*, 2023). Their use in design education, however, also raises important concerns. Some researchers warn that students may come to depend too heavily on AI tools. When students lean too much on AI-generated results, their design thinking, creativity, and critical thinking may suffer (Chen & Liu, 2023; Jin *et al.*, 2024; Zawacki-Richter *et al.*, 2019). Emerging empirical evidence suggests that these effects are not uniform. Hwang and Wu (2024), for example, found that generative AI can enhance design students' creative cognition through increased self-efficacy and reduced anxiety, which indicates that the relationship between AI use and creativity may depend on how students engage with the tools. Design students have to understand problems, develop ideas, make design decisions, and reflect on their own creative process. AI should therefore not be seen as a replacement for human creativity. It should be used instead as a supporting tool that helps students learn, think, and create.

AI has been applied in many areas of design education, including concept learning, design thinking training, creativity development, and collaborative creation. For example, AI-supported systems may help students improve their flow experience during collaborative creative work and support higher-level design thinking (Díaz-Rodríguez *et al.*, 2023). In addition, AI can process large amounts of information and help students explore design problems from different perspectives. This may provide new opportunities for design learning and creative problem solving. However, researchers have also warned that AI-driven design environments need careful instructional design. If teachers do not guide students properly, AI may reduce students' active participation and deep thinking in the design process (Verhulsdonck *et al.*, 2021). This is consistent with Li *et al.* (2025), who found that students learning with generative AI chatbots reported significantly higher emotional and agentic engagement when teachers were present to guide the interaction than when they were not. This concern is echoed by classroom-level studies; for example, Chans *et al.* (2025) integrated generative AI into a design thinking activity in a STEM course and found that careful activity design was needed to translate AI use into measurable gains in creativity and innovation.

Objectives

For this reason, a review of how AI has been studied and applied in design education is needed. Studies have multiplied in recent years, yet the research area is still developing, and its publication trends, major research themes, author collaboration patterns, and research gaps are not yet well understood. A clearer overview of the field would help design educators see how AI is being used in design learning and which issues still call for further study. This study therefore reviews the research landscape of AI in design education from 2016 to 2025. It draws on related journal articles from IEEE Xplore, Web of Science, and Scopus and applies bibliometric analysis to publication trends, co-authorship networks, and keyword co-occurrence patterns. The aim is to identify the main development trends, key themes, and future research directions of AI in design education. The findings can offer useful reference points for design educators, curriculum designers, and researchers interested in AI-supported design learning.

Literature Review

Research on AI in higher education has grown quickly, but its teaching side is still thin. Zawacki-Richter et al. (2019) found that educators were largely missing from this research, and Chen et al. (2020) pointed to a lasting gap between AI applications and educational theory. In design education, image generators such as Midjourney are now used in training and ideation (Tsidylo & Sena, 2023; Yin et al., 2023), helping with early concept generation and revision (Jin et al., 2024). Generative AI can lift design students' creative cognition through greater self-efficacy (Hwang & Wu, 2024), while graphic design students hold mixed views of these tools (Fleischmann, 2024). Teacher presence shapes engagement (Li et al., 2025), and design thinking pedagogy offers one way to use AI responsibly (Rana et al., 2025). Bibliometric mapping has covered AI in higher education broadly (Maphosa & Maphosa, 2023) but not design education specifically.

Methods

This study combined a literature review with bibliometric analysis to examine the research landscape of artificial intelligence in design education from 2016 to 2025. Bibliometric analysis is well suited to reviewing a large body of publications and tracing how a research field develops, including its publication trends, research themes, and collaboration patterns (Donthu *et al.*, 2021). Comparable bibliometric approaches have been used in related fields. Maphosa and Maphosa (2023), for example, paired bibliometric analysis with topic modeling to map the development of AI research in higher education, demonstrating the value of this approach for tracing the structure of an emerging field. The approach fitted the present study because AI in design education has grown quickly in recent years, yet its research structure still needs to be better understood. Data were drawn from three academic databases: IEEE Xplore, Web of Science, and Scopus. They were chosen because they cover different but related research areas. IEEE Xplore holds many studies in engineering, computing, and educational technology. Web of Science and Scopus are both widely used citation databases, but their journal coverage is not identical (Mongeon & Paul-Hus, 2016). Drawing on more than one database can therefore help reduce the limitations of relying on a single source, and it can also help the study gather a broader and more reliable set of publications. Previous research has also suggested that academic search systems differ in their retrieval functions and search quality, so researchers should choose suitable databases with care and use clear search strategies (Gusenbauer & Haddaway, 2020).

The search targeted studies on artificial intelligence and design education. The main search terms were "artificial intelligence," "generative AI," "LLM," "chatbot," "intelligent agent," "design education," "design pedagogy," "design studio," "design teaching," "design curriculum," "art," "creativity," "design thinking," and "learning outcomes." These keywords were combined through Boolean search strategies to locate relevant publications. The initial search returned 61 records from IEEE Xplore, 63 from Web of Science, and 453 from Scopus, giving 577 records in total at this first stage.

Rather than using every initial search result directly, the study applied a multi-stage screening process to improve the quality of the dataset. First, only English journal articles were included; conference papers and other document types were excluded. Second, duplicate records across the three databases were removed by checking DOI, title, author names, and publication year. Third, the titles, abstracts, and keywords of the remaining articles were read manually. Articles were excluded if they contained words such as AI, design, or education but were not actually related to design education. This manual check cut down the number of irrelevant records and kept the dataset more closely focused on the design education context.

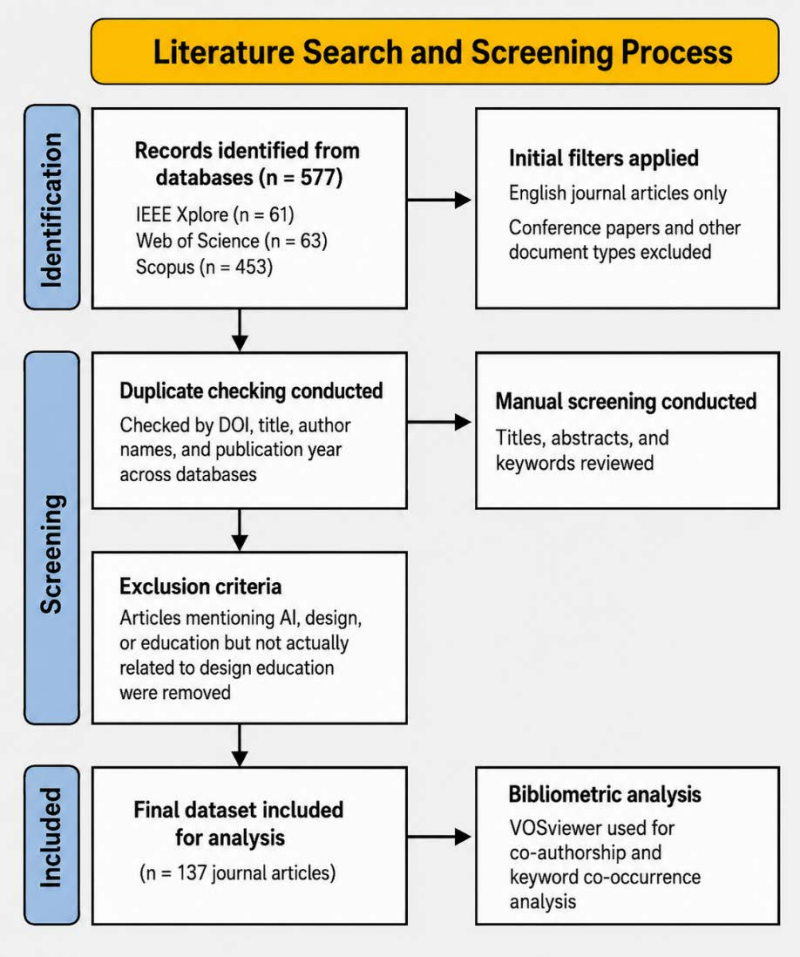


Figure 1: *Literature search and screening process*

Following these screening steps, the final dataset comprised 137 journal articles, which were then used for further bibliometric analysis. Co-authorship networks and keyword co-occurrence patterns were analyzed in VOSviewer. This tool is widely used to construct and visualize bibliometric maps and is particularly good at showing relationships among authors, keywords, and research topics (van Eck & Waltman, 2010). In this way, the study identified the main research structure and development direction of AI in design education.

Data collection, then, involved more than a single search. It covered keyword design, database searching, document type screening, duplicate removal, manual topic checking, and bibliometric mapping. Together, these steps helped to raise the quality of the final dataset and to keep the analysis focused on AI applications in design education.

Results and Discussion

Publication Trends from 2016 to 2025

The analysis begins with the annual publication trend of AI-related research in design education from 2016 to 2025. In the final dataset of 137 journal articles, publications were very scarce before 2022. Between 2016 and 2021, only one paper was identified, published in 2019; no relevant articles were found

for the other years. This shows that AI in design education had not yet become a major research topic in this early period.

From 2022 onward, the number of publications rises clearly. Eight papers appeared in 2022, which suggests that researchers had started to pay more attention to the role of AI in design education. The trend is also in line with the broader development of AI in education. Earlier studies have shown that research on AI-supported learning and online learning has grown in recent years, particularly around intelligent learning systems, personalized learning, and educational technology (Hwang *et al.*, 2022; Zawacki-Richter *et al.*, 2019).

In 2023, a key year for the rapid development of generative AI, publications rose to 15 papers. This growth may be linked to the wider use of large language models and generative AI tools in education. Kasneci *et al.* (2023) noted that large language models can support learning, teaching, feedback, and content generation, but that they also require careful educational design. The growth after 2023 may therefore reflect not only the popularity of AI tools but also a growing need to understand their educational value and possible risks.

Growth was even more pronounced in 2024, when 30 papers were published. This rise may be related to the wider use of AI tools in creative practice, design learning, and design curriculum development. In 2025 the count reached 83 articles, the largest share of the dataset. Although the 2025 figure should be interpreted with caution, the sharp increase still shows that AI in design education has become an important and fast-growing research topic. The publication trend suggests that AI research in design education has moved from an early stage into a period of rapid growth. It also reflects a wider shift in education. AI is no longer discussed only as a technical tool; it is increasingly tied to learning support, teaching design, creativity development, and curriculum innovation. Even so, as Chen *et al.* (2020) suggested, AI education research still needs stronger links between AI technologies and educational theories. The point matters for design education too, since design learning involves developing thinking, judgment, and creativity, not simply using tools.

Co-authorship Network Analysis

The second part of the analysis looks at the author collaboration network of AI research in design education. A co-authorship analysis was run in VOSviewer, with authors as the unit of analysis and full counting as the counting method. The 137 journal papers yielded 475 authors in total. To concentrate on more active contributors, the minimum number of publications per author was set at two, which left 38 authors in the final co-authorship network. Of these 38 authors, 47% were from China, 20% from Malaysia, and 11% each from the United States and Turkey.

As Figure 2 shows, the co-authorship network is fairly scattered and made up of several small clusters. Some authors have clear collaborative ties, yet many groups are only weakly connected with one another. VOSviewer also indicates that the largest connected group contains just 10 authors. This suggests that AI research in design education has not yet developed a highly centralized research community.

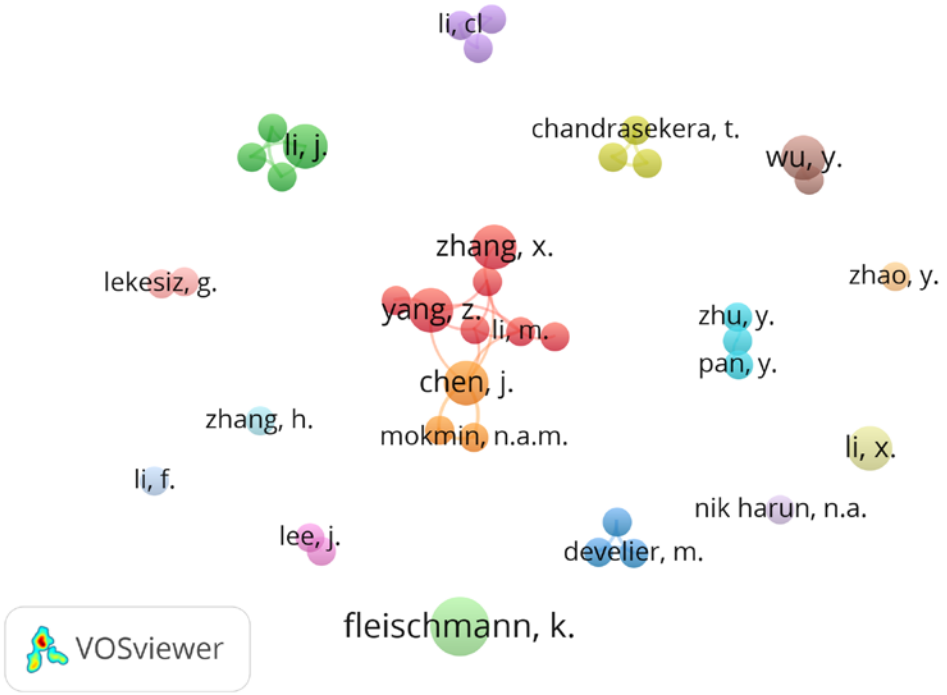


Figure 2: *Co-authorship network visualization generated by VOSviewer*

In the central part of the network, some authors, such as yang, z., zhang, x., li, m., chen, j., and mokmin, n. a. m., have more visible collaborative links. They may be regarded as part of a local collaboration core within the dataset. Most other authors, however, sit in smaller groups or in isolated positions. Current research on AI in design education, then, is still carried out mainly by individual research teams or small collaborative groups.

This scattered pattern also shows that AI in design education is still an emerging interdisciplinary field. Researchers may come to it from different backgrounds, including design education, educational technology, computer science, human-computer interaction, and creativity studies. This resembles the broader development of AI in education, where researchers have approached AI from a range of technical and pedagogical perspectives (Chen *et al.*, 2020; Hwang *et al.*, 2022). In design education, though, closer collaboration is still needed to build a more stable research community.

The co-authorship network indicates that future studies may benefit from stronger cross-disciplinary and cross-national cooperation. Design educators, for instance, can work with AI researchers to develop more suitable AI-supported design learning environments. Educational technology researchers can help evaluate learning processes and learning outcomes, while human-computer interaction researchers can help improve the usability and learning experience of AI tools. Collaboration of this kind could give the field a more integrated theoretical foundation and a clearer research direction.

Keyword Co-occurrence Analysis

The third part of the analysis deals with keyword co-occurrence. Co-occurrence was the type of analysis, keywords were the unit of analysis, and full counting was the counting method. The 137 journal articles contained 799 keywords in total. To concentrate on more important and recurring terms, the minimum number of occurrences per keyword was set at five. With this threshold, 29 keywords entered the final network, shown in Figure 3.

As Figure 3 shows, “artificial intelligence” and “design education” are the two most central keywords in the network, which indicates that AI and design education form the main research focus of the field. Both are closely linked with other terms, such as “students,” “teaching,” “learning,” “creativity,” “generative artificial intelligence,” “product design,” and “visual communication design.” Current studies, then, do not treat AI merely as a technology. They also examine how it is used in design courses, student learning, teaching practice, and creativity development.

The cluster structure in Figure 3 reveals several main research directions. First, “artificial intelligence” and “design education” sit at the center of the network; their larger nodes and stronger links mark them as the main knowledge focus of this body of studies. Second, “generative artificial intelligence” is linked with “design process,” “product design,” and “design education.” Generative AI has thus gradually become a more specific research topic. Rather than being discussed only as a general AI issue, it is increasingly tied to design processes and design teaching. Recent work on generative AI and design practice supports this result. Yin *et al.* (2023), for example, examined how Midjourney can be integrated into design systems and support future-oriented design innovation. Jin *et al.* (2024) likewise showed that generative AI tools can support early-stage design ideation and revision by supplying rapid visual stimuli. These studies suggest that generative AI may shape not only the final design outcome but also the way designers generate, compare, and refine ideas.

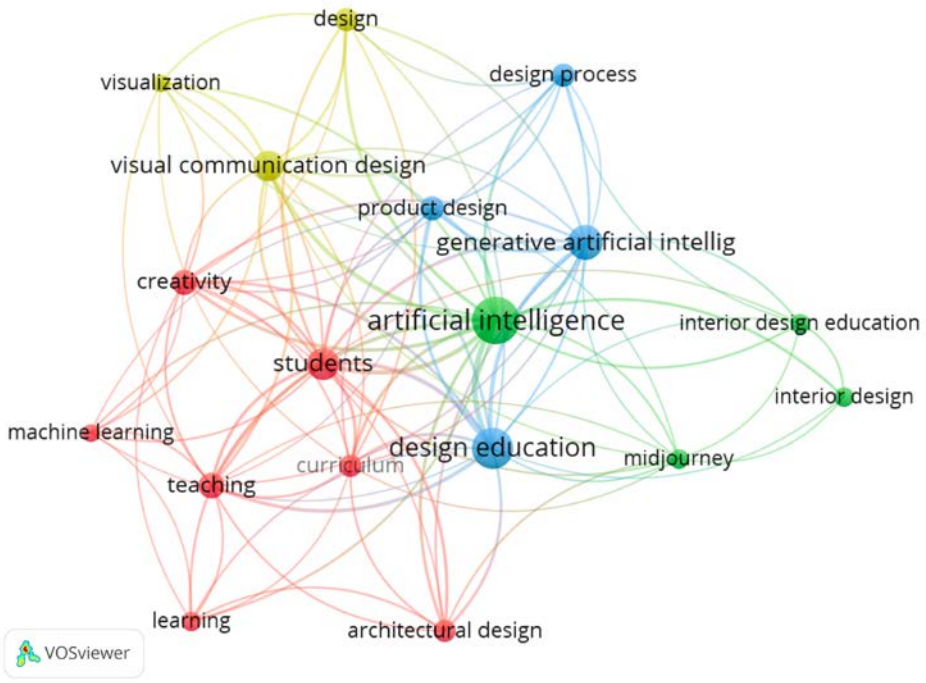


Figure 3: *Keyword co-occurrence network visualization generated by VOSviewer*

Third, the cluster on the lower-left side contains keywords such as “students,” “teaching,” “curriculum,” “learning,” and “creativity.” It shows that many studies are concerned with how AI affects student learning, instructional design, curriculum planning, and creativity development. This direction matters for design education, because AI may influence not only the final design outcome but also how students understand problems, develop ideas, and make design decisions. Fourth, the upper-left part of the network includes “visual communication design,” “design,” and “visualization.” Visual communication design and

visualization thus appear to have become important professional areas in AI-related design education research. Even so, compared with “artificial intelligence” and “design education,” “visual communication design” is still not a central keyword in the network as a whole. In other words, visual communication design has received attention but has not yet become a major research focus in the field. Fifth, the right side of the network contains keywords such as “Midjourney,” “interior design,” and “interior design education.” This indicates that generative image tools and their use in specific design fields are attracting more attention. These keywords also show AI research in design education moving from general discussion toward more concrete design domains and practical teaching contexts.

In sum, the keyword co-occurrence analysis shows that AI research in design education has gradually built a research network around artificial intelligence, generative AI, design education, design process, creativity, and visual communication design. The field has moved beyond simply introducing AI tools and has begun to explore how AI influences student learning, design thinking, curriculum design, and creative practice. This finding also connects with wider discussions of generative AI in education. Kasneci *et al.* (2023) stressed that AI tools can support learning and teaching, but that students and teachers need new literacies to understand the limits of these tools.

The results also show, however, that the field is still developing. The keyword network has a clearer research structure than the co-authorship network, yet several important design education issues still call for deeper investigation. For example, “creativity” appears in the network but is not the strongest central concept. This suggests that current studies have discussed creativity but may often treat it as a learning outcome rather than as a complex design process. Future research should examine how students form ideas, revise concepts, and make creative judgments with AI support.

Likewise, although “visual communication design” appears in the network, it is not yet a core theme. This suggests a need for more research on how AI affects concept development, visual expression, image translation, and communication in visual design education.

Read together, the publication trend, co-authorship, and keyword co-occurrence analyses give a coherent picture of a research field that is expanding quickly but has not yet consolidated. The sharp rise in publications after 2022, and above all after 2023, indicates that the spread of generative AI tools has been a major driver of scholarly attention to design education, rather than the gradual, steady growth typical of a mature research area. At the same time, the scattered co-authorship network and the still-peripheral position of keywords such as "creativity" and "visual communication design" suggest that the field's intellectual structure has not kept pace with its publication volume. Put differently, AI in design education is accumulating output faster than it is building a shared theoretical or methodological identity.

Two main implications follow from these results. First, for design education researchers, the fragmented collaboration network implies that cross-institutional and cross-disciplinary partnerships linking design education, educational technology, human-computer interaction, and learning sciences could speed up the field's theoretical maturation, in line with Chen *et al.*'s (2020) call for stronger links between AI technologies and educational theories. Second, for design educators and curriculum designers, the finding that "creativity" and "visual communication design" remain peripheral rather than central keywords suggests that current research has concentrated more on documenting AI adoption than on examining how AI reshapes the creative and visual reasoning processes at the heart of design education. This points to a practical need for curricula and assessment approaches that make students' AI-assisted design thinking visible and open to evaluation, instead of treating AI merely as a productivity tool. Recent pedagogical work offers concrete starting points for this shift. Rana *et al.* (2025) show how generative AI can be embedded in design thinking pedagogy to cultivate creativity, critical thinking, and ethical reasoning, and

Fleischmann (2024) gives a graphic-design-specific account of how students perceive and use these tools, which illustrates the kind of course-level evidence the field still needs.

This study has several limitations. First, the dataset covered only English-language journal articles indexed in IEEE Xplore, Web of Science, and Scopus. Relevant conference papers, book chapters, and non-English publications were left out, so some regional research communities may be underrepresented. Second, minimum-occurrence thresholds (two publications per author; five occurrences per keyword) were applied in the co-authorship and keyword co-occurrence analyses to keep the networks readable, and these may have excluded smaller but conceptually important contributions. Finally, bibliometric mapping reveals structural and thematic patterns across the literature but cannot capture the depth or quality of the pedagogical practice that individual studies describe. It should therefore be read as a complement to qualitative and empirical research on AI-supported design learning, not as a substitute for it.

Future research should build on this structural overview with study-level evidence. In particular, course observations, analysis of student design work, interviews with instructors and students, and process-level data on how AI is used during design ideation and revision would help clarify the mechanisms through which AI shapes design thinking, creativity, and visual communication in real learning contexts.

Conclusion

This study reviewed the research landscape of artificial intelligence in design education from 2016 to 2025, drawing on 137 journal articles collected from IEEE Xplore, Web of Science, and Scopus. The results show that AI in design education is not yet a fully mature research field, although it is becoming an important and fast-growing area of research. The publication trend shows that research on AI in design education increased rapidly after 2022, a rise that may be closely related to the wider use of generative AI tools in education and creative practice. AI is no longer discussed only as a technical tool. Instead, it has gradually become connected with design learning, teaching practice, creativity development, design process, and curriculum design.

The keyword co-occurrence analysis also shows that “artificial intelligence,” “design education,” “generative artificial intelligence,” “students,” “teaching,” “creativity,” and “design process” are important themes in the field. These keywords indicate that current research has started to shift from general discussion of AI tools toward deeper educational issues. Researchers are now giving more attention to how AI influences students’ learning, creative thinking, design decision-making, and teaching practice.

The contribution of this study, therefore, is not a claim that AI has completely changed design education. Rather, the study shows that the field has reached a stage where its main research themes are becoming clearer, while many detailed learning processes still need further study.

Declaration

Ethics Approval and Consent to Participate: This study relied solely on secondary data drawn from previously published academic sources; it did not recruit human participants or collect identifiable personal information. Ethics approval and informed consent were therefore not required. All sources were properly cited to ensure correct attribution and to maintain academic and research integrity. The study followed established ethical principles for systematic reviews, with particular attention to transparency, accuracy, and responsible reporting.

AI Assistance: The authors utilized a language enhancement tool to refine the manuscript's writing quality

and improve readability.

Conflict of interest: Not applicable.

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Authors' contributions: Yang was responsible for the research design, data analysis, and manuscript writing. Chou contributed to literature screening and manuscript revision. Both authors read and approved the final manuscript.

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