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Investigating the discourse on pedagogical effectiveness in the architectural design studio

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ABSTRACT

The purpose of this paper is to investigate the discourse on pedagogical effectiveness in architecture design studios to inform the future development of teaching and learning. Through a narrative literature review, the study explores articles published over a five-year period to investigate the shifts in design studio pedagogies and their effectiveness. After a subtle filtering process, we narrowed the analysis to thirty-eight articles by searching three keywords: pedagogy, evaluation, and effectiveness in the design studio. Twelve themes emerged from an iterative reviewing process and were discussed against the established theoretical origins of architectural studio pedagogies. The studies consolidated each other by mostly agreeing on the positive impact of implementing student-centered pedagogies. Robust evidence of effectiveness is captured from the literature on collaboration: interdisciplinary environment, teamwork, and group work (Theme 1). Furthermore, the findings reported in Theme 4, immersive technology, present a promising potential to incorporate technology with student-centered pedagogies. The study contributes to the discourse on design studio pedagogies and offers a platform to inform future teaching and learning strategies. It concludes with recommendations for researchers, studio instructors, and academic institutions to align emerging design studio pedagogies, their theoretical origins, and technology in agile organizational climates.

Highlights

- Recent studies mostly agree on the positive impact of student-centered pedagogies.
- Collaboration, teamwork, and group work are effective design studio pedagogies, especially in interdisciplinary environments.
- Incorporating technology with student-centered pedagogies holds promising potential.

Introduction

The approaches to teaching students in architectural design studio is a controversial topic worldwide (Salama, 2016). Architectural design studios are unique learning environments where students

employ mental and analytical skills to deal with complex social, functional, aesthetic, environmental, and technical issues in a creative manner. To solve a design problem successfully, self-reflection is crucial for students to review and reflect on design proposals (Schön, 1987). Through his reflection-in-action model of design instruction, Schön (1987) explains the 'reflective practitioner' studio pedagogy, which aligns with constructivism and student-oriented learning approaches (Dewey, 1961; Vygotsky, 1978; Wood, Bruner, & Ross, 1976). This approach places students at the center of the learning process as actively engaged and more autonomous learners. Salama (2016) calls for activating student-centered and evidence-based learning approaches in the studio. Hence, the field of architecture is interdisciplinary and needs innovative pedagogies.

Due to its pedagogical history of 'coaching' and 'learning-by-doing', Schön used the term 'practicum' to argue that the studio has much to teach other professional institutions (Schön, 1988, p. 4). 'Practicum' describes how the architectural studio, as a virtual world, resembles a lot of real-world working environments. According to Schön, practicum suggests a 'reflection-in-action' learning where students construct their knowledge from iterative testing and categorization of ideas (Schön, 1988, p. 5). Hence, how has the studio pedagogy evolved since Schön's argument? Between conserving the traditions of conventional studios and utilizing student-oriented pedagogies and information and communication technology, studio pedagogy seems to have more to offer to architecture students.

Pedagogy, derived from the Greek words *paid*, meaning 'child', and *agogus*, meaning 'leader of', is often seen as an ideology and set of beliefs about teaching and learning (Knowles, Holton, & Swanson, 2015). It was the only educational model in the US in the nineteenth Century and was extended into higher education. However, adopting the term pedagogy in higher education may suggest a teacher-centered approach, focusing merely on knowledge acquisition and limiting student autonomy. Blaschke argued that pedagogy could be seen as 'traditional (chalk-and-talk) classroom teaching' when compared to andragogy and heutagogy (Blaschke, 2019, p. 77). Andragogy calls for more autonomy for adult learners, while heutagogy suggests self-directed learning with more maturity and autonomy for learners (Blaschke, 2019). Pedagogy is commonly used in higher education literature on architecture design studios, where formal curriculum, course structure, academic accreditation requirements, and institutional expectations may constrain learner autonomy.

This paper explores the interplay between pedagogies, evaluation, and effectiveness in architecture design studios (Figure 1). Pedagogies involve experimenting with teaching and learning strategies and evaluating their effectiveness. Evaluation involves assessing students' performance and
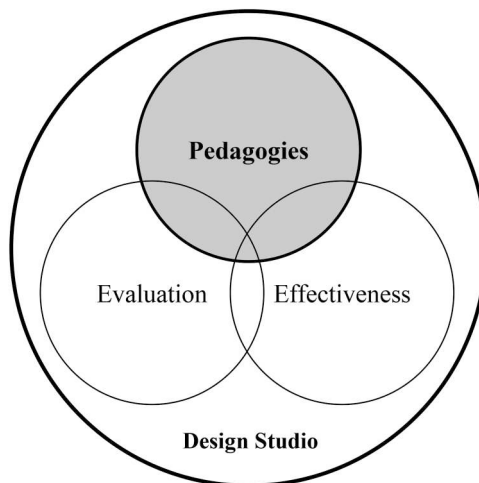
Figure 1. A research focus on pedagogies and their interplay with evaluation and effectiveness in the architectural design studio.

the quality of design projects (Casakin & Kreitler, 2008), while effectiveness refers to the studio's ability to achieve its educational goals (Oluwatayo et al., 2017). The three aspects are essential for ensuring the quality and success of the studio.

The evaluation process helps determine the studio's effectiveness in achieving its educational goals. By assessing students' performance and learning outcomes, instructors can discover areas for improvement and make required changes to improve the effectiveness of the studio (Cikis & Ek, 2010). Conversely, the effectiveness of the studio can influence the evaluation process by providing a basis for setting evaluation criteria and standards (Wang et al., 2019). When the design studio effectively promotes learning and achieves desired outcomes, the evaluation process can accurately assess students' progress and performance.

The faculty-to-student ratio is another factor that affects evaluating pedagogical effectiveness in the architectural studio. An Institutional Data Report by the Association of Collegiate Schools of Architecture (2021) shows that the faculty-to-student ratio in US architectural studios was 1:13 in the 2019–2020 academic year. On a global scale, the 2023 Annual Report on Architecture Education by the National Architectural Accrediting Board (2024) found the average faculty-to-student ratio in professional design studio courses was 1:12. Yet, more data is needed on the optimal faculty-to-student ratios based on the pedagogical approaches.

Aim and research questions

This paper aims to investigate the discourse on pedagogical effectiveness in architecture design studios to pave the way for future development of teaching and learning by answering the following research question: What can be learned from emerging effective pedagogical practices to inform the future pedagogies in architectural design studios?

The following sub-question is posed to answer the primary research question: What pedagogies have been implemented in architecture design studios? The paper proceeds from here by briefly building theoretical foundations based on learning theories and early pedagogical approaches in architecture studios. Then, the methodology of reviewing the literature is explained. Next, the literature is reviewed and discussed to synthesize the findings. The primary research question is answered in the conclusion.

Theoretical basis

Learning theories

Learning theories were compiled by Merriam, Baumgartner, and Caffarella (2007) under five orientations: behaviorism, cognitivism, social cognitivism, humanism, and constructivism. The behaviorist orientation (Skinner, 1971) enables educators to influence students' behavior to accomplish desired educational goals. In the behaviorist school of thought, theorists like Pavlov and Skinner concentrated on teacher-centered, didactic education restricted to conventional, self-contained classrooms. The cognitive approach, popularized by Piaget (1972, 1964) and Bruner (1966), aims to improve students' mental abilities through activities, interactions, and memorization. Different learning environments employ cognitivism to advance students from low-order basic abilities (remembering, understanding, and implementing) to high-order skills (analyzing, assessing, and creating). According to social cognitivism, primarily developed by Bandura (1972) and Rotter (1954), learning occurs in social contexts through observation of others and interaction with their behavior and environment. As a result, social cognitivism varies from cognitivism since it emphasizes the external environment more than the internal mental processes. The humanistic approach (Maslow, 1970; Rogers, 1983) is appropriate for adult education since it focuses on developing individual motivation and accountability for learning independently. The constructivist viewpoint first appeared in the 1970s; in this approach, teachers provide students with temporal virtual scaffolds to build knowledge and learn

independently (Wood et al., 1976). By advocating a constructivist (student-centered) approach and connecting learning abilities to the outside world, Vygotsky (1978) shares this viewpoint with Dewey's (1961). Following technological advancement and architectural innovation, this student-centered approach has experienced a resurgence in many established educational systems.

Learning theories as applied in the architectural studio

The adopted theories and pedagogies in the architectural studio stem from overlaps between the five learning orientations above. A common one is Kolb's experiential learning theory (Kolb, 2015, 1984), influenced by theorists such as Dewey, Lewin, and Piaget. Kolb (1984) suggests that learning is a process, not an outcome, that is not linear but occurs in a cycle, and each student can start learning from a different stage in the cycle based on their personal characteristics.

Learning also occurs through students' interactions with their peers and instructors. Critique sessions, dialogues, and juries frame these interactions. Utaberta, Hassanpour, and Usman (2010) suggest that the architectural studio relies fundamentally on critique, but they challenge how critique is implemented for assessment. For Utaberta et al. (2010), critique has been performed as a teacher-centered practice that lacked student collaboration and constrained creativity. The combination of individual and groupwork requires a variety of teaching styles and assessment methods, which impacts students' satisfaction with the learning experience (Tucker & Abbasi, 2015) as they go through interconnected activities that can support diverse patterns of knowledge (Rodriguez Bernal, 2017). More historical context is discussed below.

Early approaches in architecture design studio teaching and learning

In the past centuries, the Beaux-Arts and Bauhaus movements (19th and twentieth Century) influenced the pedagogies used in Architecture design studio teaching. The Beaux-Arts movement, which originated in France in the late nineteenth Century, focused on training architects through the École des Beaux-Arts in Paris (Zanten, 1987). Their approach was project-oriented, contextual problem-solving, and individual work (Schön, 1984). On the other hand, the Bauhaus movement emerged in Germany in the early twentieth Century. Walter Gropius founded the Bauhaus School, which operated at several stages between 1919 and 1932 (Frayling, 2007; Salama, 2021). It introduced new forms of architectural education that emphasized experimentation, interdisciplinary collaboration, and the integration of art and technology. However, between 1960 and 1995, the shift from conventional to new design pedagogy was apparent. Design teaching typologies such as participatory, energy conscious, analogical, pattern language, double layered, exploratory, case problem (experimental), concept-test, hidden curriculum, and interactional models were outlined by Salama (2021). This section will summarize each approach's primary definitions and principles to contextualize the narrative review.

The participatory model, explored by Sanoff (1981) in the late sixties, is a design methodology that involves the customer or user in design decision-making. It sees architecture as community architecture, aiming to influence settings by understanding the people living there. The model uses structured group decision-making and simulation exercises to facilitate participation. The design process includes awareness, perception, decision-making, and implementation stages. Students learn about community objectives, activities, and alternatives through workshops and simulation games. The model encourages early independence between the student and the client, allowing them to explore options jointly.

In the mid-1970s, Cole (1980) studied the effectiveness of incorporating energy principles in design, leading to the development of the energy-conscious model. The study focused on a design studio and a shift in theoretical course emphasis. Instructors determined the studio's focus, and students' designs were evaluated based on their interests, abilities, and ideals. A three-year BArch program offered an energy-conscious design studio, and students developed

effective plans that integrated energy principles. However, students without prior knowledge preferred the studio method. The study concluded that critical factors for strategy success include credibility, energy view, project relevance, role definition, and student/faculty conversation.

Simmons (1978) proposed an analogical model using deliberate exemplars for teaching and learning in second-year architectural design studios. He emphasizes the design process, building technology, and formal vocabularies as major influences. The design process models focus on the epistemological distinction between rational and empirical knowledge acquisition. The building technology model addresses students' lack of knowledge in technical aspects of construction. The formal vocabulary model examines examples from renowned designers.

In 1982, Davis (1983) introduced a studio course using pattern language methodology to teach students how common norms can create collective forms. This method helps students understand design elements, harmony between individual and group demands, beneficial and harmful rules, and the characteristics of cities or settlements. Students learn about buildings' multiple levels of significance and their connection to the physical and social fabric. Patterns are distinct physical arrangements that cater to specific human circumstances, encouraging debate and clarifying group goals. The course also emphasizes identifying global patterns and considering the order of patterns in design.

Goldschmidt's (1983) double-layered model for architectural design consists of three components: definition/design imperatives, interpretation/personalized program, and independent input/design modifier. Design imperatives include functional needs, cultural heritage, climate and site characteristics, and available resources. The definition involves analyzing facts, prioritizing, and personalizing the material. The interpretation is a customized program that organizes information according to the designer's priorities, gaining credibility by affecting the design imperatives. The final step is the architectural design, communicated through scale drawings and models.

The exploratory model, by Robinson and Weeks (1983) is a design methodology that combines programming and design phases, aiming to help students investigate physical forms and their implications. It emphasizes continuous investigation, documentation, and a transferrable technique. The model encourages ongoing inquiry, assessment, and result recording, focusing on design exploration in architecture. Activities tackle challenging problems, examining preconceptions, information gathering, past and future, analogies, and new design directions. It also emphasizes the importance of considering future technology and information access systems.

The experimental model, developed by Symes (1985) and Marmot in 1985, explored an educational innovation using design evaluation studios. The experiment focuses on fourth-year architecture students to establish links between design and theory. The studio consists of two phases: producing alternative design concepts using precedents and evaluating them through thorough analysis. Students' reactions to this model vary; some struggle with proposal creation, and others prefer detailed developer briefs.

The concept-test model, developed by Ledewitz (1985), emphasizes design as a developmental process involving conjecturing, testing, and presenting. It involves multiple iterations, working backward, incremental information, solution-type studies, form experiments, and self-evaluation. This approach helps students solve problems better by understanding their assumptions and the need for knowledge. It encourages self-evaluation and reflexivity and addresses project status and design aim through discussion and examples. Students and designers can use a concept-test approach for education that encourages reflection-in-action.

The hidden curriculum model, developed by Dutton (1987), used housing design and urban development to challenge students' value systems and dismantle hierarchical social structures. In the 'Housing/Mixed Use Development in Downtown Cincinnati' project, small teams collaborate to create an urban site while allocating a portion to residential use (p. 19). The pedagogy promotes equal deliberation, balancing student and teacher power, and encourages student-student relations.

Each student has veto power through consensus decision-making, ensuring equal authority. This approach has been effective in design studios, stimulating efficient learning and critical thinking among first-year and upper-year students (Dutton, 1987).

Gelernter's (1988) interactional model suggests that modern curricular structures often overlook design knowledge acquisition and application. He offers alternative learning models like Piaget and Hillier, emphasizing the importance of knowledge application and acquisition. The model encourages teachers to help students understand their cognitive schemata, work through issues, and apply these strategies in design development.

The explored ten pedagogies present an attempt to shift from the conventional studio by focusing on being process-oriented. Salama suggests that although these pedagogies pave the way for 'transformative pedagogy in architecture and urbanism', they do not replace the conventional studio teaching practices (Salama, 2021, p. 146).

Method of review

A narrative literature review is adopted to review the articles and explore the emerging pedagogical orientations in architecture design studios. A narrative review tends to focus on the critical reading of studies more than the search procedure's technicalities and inclusion and exclusion of papers as in the systematic review (Bryman, 2016). Hence, the researcher discovers a topic of interest with a mindset to adapt the research questions while comprehensively assessing, comparing, and interpreting other studies (Bryman, 2016). Considering the agility of a narrative review, this study applies rigorous search filters to narrow the results (see Table 1).

We started the keyword search with a tool offered by Elton B. Stephens Company (EBSCO) (EBSCO Industries, n.d.), which offers a search engine connected with institutional libraries to retrieve articles from different databases. After filtering the results from EBSCO, the same search process was applied in two databases, Scopus and Web of Science, until no additional articles were found. We used three combinations of keywords as follows:

- ('design studio') AND (evaluat*).
- ('design studio') AND (pedagog*).
- ('design studio') AND (effectiveness).

The phrase 'design studio' was written between quotation marks to seek an exact match. We did not add additional limiting words, such as 'architecture', to avoid missing relevant articles. However, we chose 'architecture' or 'architectural design' as the subject in the filtering process. The asterisk (*) symbol in the words 'evaluat*' and 'pedagog*' refers to looking up all stemming words from the original, such as 'evaluate' or 'evaluation' and 'pedagogies' or 'pedagogical'.

Table 1. Search filters.

1	Initial search filters	Range: 1/2019 to 08/2023. Type: Peer-reviewed journal articles. Subject: Architecture/ Architectural Design. Language: English		
2	Keywords/ sources	('design studio') AND (evaluat*)	('design studio') AND (pedagog*)	('design studio') AND (effectiveness)
	EBSCO **	257	475	52
	Scopus	114	86	31
	Web of Science	28	54	7
	Total	**399**	**615**	**90**
3	Additional filters	Removed duplicate, irrelevant, and unavailable full text, papers on post-pandemic online or blended studio environments, papers merely on the design process, and non-architecture studio environments (interior, graphic, and industrial design).		
4	Selected papers	**38**		

*Refers to potential stemming words.
**EBSCO results included major duplications of papers sourced from different databases.

We disqualified papers on post-pandemic online or blended studio environments. Despite the emerging publications on these topics, they are beyond the scope of this study, which focuses on physical studio pedagogies. It is worth conducting more research to synthesize the findings of these studies and offer lessons learned from the digital studio environment. Furthermore, to maintain accuracy and relevance in theoretical discussions, the articles on non-architecture studios were disqualified, as none of the theoretical bases investigated in this study (Salama, 2021, 2016; Schön, 1988, 1987, 1984) discussed interior, graphic, or industrial design as part of the architecture discipline.

This study investigates papers published between 01/2019 and 08/2023. The many papers found after the initial search (see Table 1) affirmed the sufficiency of five years for critical reading and analysis. Another reason for narrowing the time range is the impact of the COVID-19 pandemic, global lockdown, and public health emergency, mainly between January 2020 and May 2023 (World Health Organization, 2020, 2023), which encouraged studio instructors and researchers to question the taken-for-granted (conventional) studio practices. We suggest that the pandemic and post-pandemic return to the physical studio have come with different pedagogical potentials, new opportunities, and open-minded adaptation of unusual learning styles by instructors, students, and institutions. The last reason for the narrow time range is that this study builds on a previous narrative review paper by Hettithanthri and Hansen (2022) on architectural design studio contexts, practices, and technology implementation between 2010 and 2020. Based on a review of 60 articles to synthesize knowledge on the conventional architecture design studio, Hettithanthri and Hansen's (2022) qualitative thematic analysis showed that almost no research in 10 years was conducted about a non-conventional studio setting. Hettithanthri and Hansen (2022) called for a shift from conventional design practices into more context-oriented ones extending beyond institutional boundaries and learning set-ups. These topics share similarities with our research inquiry. Hence, this paper looks up articles from 2019 to minimize the overlap and avoid repetition.

Mapping the field

Here, we map the field based on our research inquiry on pedagogies, evaluation, and effectiveness in architecture design studios to highlight the generic trends and offer infographics. The thirty-eight selected papers were published in 25 different and interdisciplinary journals.

Figure 2 illustrates the numbers and places of case studies. Highlighting the places where design studio pedagogies were studied offers a background on the research interest based on pedagogical experiences in each part of the world. Most of the studies were authored by the studio instructor(s) who experimented with techniques for making students' learning experiences more positive. These studies were based on personal initiatives rather than institutional efforts. From Figure 2, it can be noted that most case studies were undertaken in Turkey (6), followed by the United Kingdom (5), and Australia, Egypt, and South Korea (3 for each).

Table S1, enclosed as a Supplementary material, summarizes key information in the papers and shows places of case studies and preliminary analysis based on a first attempt to define pedagogies. The articles are sorted chronologically from newest to oldest. The themes of exploration (pedagogy, evaluation, and effectiveness) overlapped in most papers, which supports our proposal that these elements collectively offer valid evidence to enhance teaching and learning. The variety in pedagogical strategies was observed from the initial analysis, which added difficulty in linking them with theoretical origins. Most pedagogies (in twenty-eight papers) were tested on the undergraduate level, whereas four studies focused on the postgraduate level, and three included both undergraduate and postgraduate. The student sample size ranged from 12 to 200 students (61.24 on average) for undergraduates, from 5 to 82 in postgraduate studies (33.66 on average), and from 10 to 12 in both levels (11 on average). Most studies, with 15 undertaken with 1st-year students, focused on the early levels of architecture programs.

Numbers and places of case studies
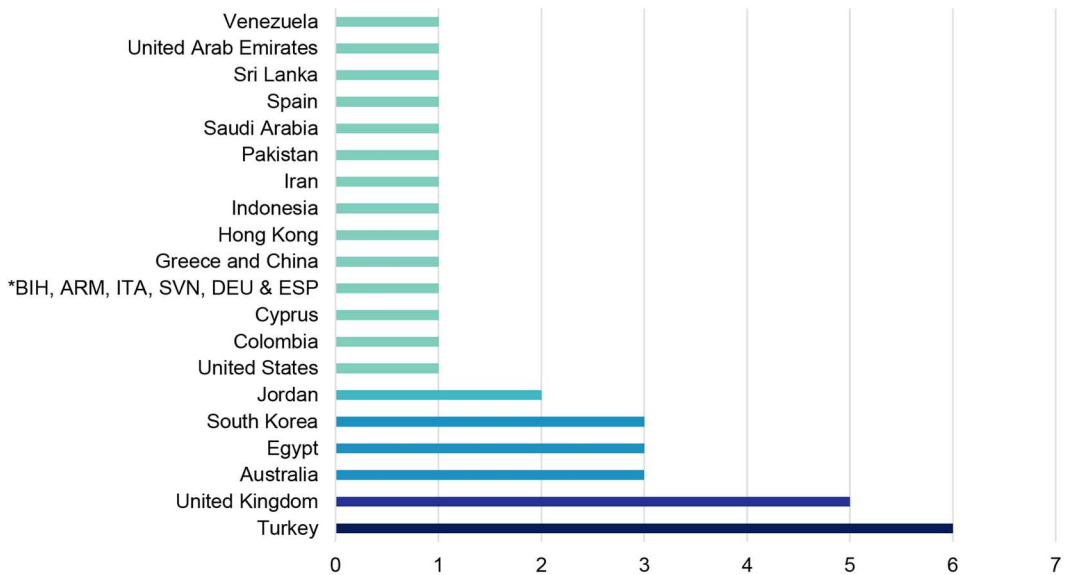
Figure 2. Numbers and places of case studies. * Refers to Bosnia and Herzegovina, Armenia, Italy, Slovenia, Germany, and Spain.

Results: emerging themes from the literature

This section presents findings from reviewing the thirty-eight articles. Each paper was classified under a theme representing its predominant pedagogical approach, and twelve themes emerged

Table 2. Final themes of selected articles.

	Themes	Articles	Citations	Average students/ studio
1	Collaboration: interdisciplinary environment, teamwork, and group work	8	Abusafieh (2022), Badawi and Abdullah (2021), Emam et al. (2019), Kostopoulos (2022), Munasinghe (2019), Qureshi (2020), Thompson et al. (2021), Zejnilovic et al. (2023)	70.8
2	Participatory stakeholder engagement	2	Dhadphale and Wicks (2022), Salazar Ferro et al. (2020)	14.5
3	Digital design	2	Agirbas (2019), Soulikias et al. (2021)	13
4	Immersive technology	6	Agirachman et al. (2022), Alp et al. (2023), Hajirasouli et al. (2023), Ibrahim and Shakhs (2023), Kharvari and Kaiser (2022), Lee et al. (2022)	27.7
5	Creativity stimulus	3	Lee et al. (2023), Lizondo-Sevilla et al. (2019), Park et al. (2022)	82.5
6	Physical model-making	1	Afify et al. (2021)	110
7	Experiential learning	3	Caner Yüksel and Dinç Uyaroğlu (2021), Djabarouti and O'Flaherty (2019), Hatıpoğlu et al. (2023)	44.7
8	Critique	3	Abd El-Latif et al. (2020), Crolla et al. (2019), Yorgancıoğlu and Tunalı (2020)	40.7
9	Dialogue	3	Smith et al. (2022), Catina (2020), Tahsiri (2020)	35
10	Student learning styles and autonomy	1	Al Maani (2022)	127
11	Problem-based Learning	1	Soonets et al. (2020)	37
12	Pedagogical strategies	5	Iftikhar et al. (2023), Lotfabadi and Iranmanesh (2023), McLaughlan and Chatterjee (2020), Saghafi (2021), Sönmez (2020)	53.3
	Total	**38**		**54.7**

from an iterative classification process (see Table 2). The themes are classified in terms of relevance to each other and ordered from the most specific to the most generic. The last theme on *Pedagogical Strategies* (Theme 12) presents combinations of more than one pedagogy. The last column in Table 2 shows the average number of participating students under each theme.

Theme 1: collaboration: interdisciplinary environment, teamwork, and group work

Research on collaborative studio pedagogy has received attention over the last five years, especially in Europe, the Middle East, South Asia, and East Asia. Eight studies evaluated several types of collaboration. The collaboration can be among a group of students and/or instructors within the same design studio (Emam, Taha, & ElSayad, 2019; Munasinghe, 2019; Thompson, Teba, & Braglia, 2021), expand to bring external participants such as architects and academics (Zejnilovic, Husukic, Pignatti, & Castellano, 2023), or create an interdisciplinary studio culture (Abusafieh, 2022) or includes bringing students from different design-related disciplines to work together on a project (Badawi & Abdullah, 2021). The collaboration can also be between multiple architecture departments from different institutions (Qureshi, 2020), countries (Zejnilovic et al., 2023), or cultures (Kostopoulos, 2022). Most of these studies adopted a qualitative or mixed approach. They reached a consensus that collaboration is an effective strategy to support students' learning and enable them to build diversified skills.

Theme 2: participatory stakeholder engagement

Two articles studied participatory design in the US and Colombia. The US study (Dhadphale & Wicks, 2022) suggested that participatory design activities helped students become more conscious about the sociocultural context of stakeholders and benefit from their feedback to balance innovation and feasibility in their projects. It also allowed them to integrate social and technical aspects. The Colombian article (Salazar Ferro, Artega Arredondo, Rodriguez Bernal, & Nadal, 2020) illustrated the alignment of a proposed 'Participatory Design Experience' model with aspects of active learning. The authors argued that combining traditional design studios with principles of participatory action research can enhance students' learning.

Theme 3: digital design

Although using digital design may not be called a pedagogy, it is linked with the pedagogical practices of almost every architecture design studio. Two studies discussed the effectiveness of digital design, i.e. utilizing computer software in the design studio. A pilot study conducted in Turkey argued that transitioning between multiple software is inevitable in the studio because of the variety of emerging programs and the differences in their capabilities (Agirbas, 2019). The paper noted various students' attitudes attributed to their prior knowledge, experience, and the way they approach design tasks. Hence, the study's results suggested that students' attitudes towards using multi-software impact how they use them. Another study critiqued the excessive use of computer technology, such as parametric design, to generate ideas and process design (Soulikias, Cucuzzella, Nizar, Hazbei, & Goubran, 2021). The authors called for a hybrid approach that combines digitization and analog to generate more creativity and accurate design solutions that meet human needs.

Theme 4: immersive technology

Six papers from five countries tested different approaches to integrating immersive technology in the design studio. A study conducted in Indonesia utilized affordance theory (from ecological psychology) to develop an affordance-based design review method using Immersive Virtual Reality

(IVR) (Agirachman, Shinozaki, Koerniawan, & Indraprastha, 2022). The study affirmed the method's effectiveness, as students and instructors perceived design issues differently. It also helped students self-assess the positives and negatives of their design ideas. Another study conducted in Australia aimed to develop a BIM-enabled IVR-based pedagogical framework to foster students' interdisciplinary engagement skills in architecture, construction, and engineering (Hajirasouli, Banihashemi, Sanders, & Rahimian, 2023). The study reported increased student and stakeholder engagement, which was considered evidence of the framework's effectiveness. Another study conducted in Turkey aimed to evaluate students' interactions with Augmented Reality technologies and reveal their experiences through design-and-build workshops (Alp, Yazici, & Oner, 2023). Although the study shared an experiment rather than conclusive results, it endorsed technology's effective implementation and integration. Another study conducted in South Korea observed students' behavior towards integrating a simulation tool that predicts users' behavior and movement to test their design concepts (Lee et al., 2022). Given the lack of flexibility in the simulation tool, the authors found that students lost motivation to use the simulation tool. Hence, they argued that simulation could be integrated into students' design process only if the user's creative ideas controlled it, not vice versa. Another study conducted in the United Arab Emirates explored the usability of VR in designing spaces that evoke particular feelings (Ibrahim & Shakhs, 2023). The study claimed that VR proved to be an effective tool to help students design based on feedback from the technology. Finally, in their systematic review of the literature, Kharvari and Kaiser (2022) analyzed 21 qualitative papers on the impact of Extended Reality technologies on learning outcomes and design processes. They found that Extended Reality effectively improved students' learning outcomes and helped them at various stages in the design process.

Overall, studies that utilized immersive technology such as simulation, Extended Reality, Augmented Reality, and IVR in the architecture design studio reported either a promising potential (Lee et al., 2022) or a positive impact on students' ability to self-critique and work in groups. This skill set aligns with student-centered pedagogical approaches.

Theme 5: creativity stimulus

Two studies undertaken in South Korea and one in Spain evaluated pedagogical prompts to enhance students' creativity in the design studio. The first study reported a positive effect of text stimulus as students developed diversified and innovative representations, which was evidence of enhanced creativity (Park, Kim, & Kim, 2022). The other study found that adopting storytelling as a pedagogical tool enhanced students' creativity, design skills, and comprehension of the design process (Lee, Kang, & Park, 2023). The Spanish study implemented Kolb's Experiential Learning Cycle (Kolb, 1984) to introduce various creative learning activities for first-year students, which led to improving students' ability to connect theoretical knowledge with practice (Lizondo-Sevilla, Bosch-Roig, Ferrer-Ribera, & Alapont-Ramón, 2019). Based on the conclusions of the three studies, there seems to be a need for more evidence of effective pedagogies that would help studio instructors purposefully adopt to foster students' creativity.

Theme 6: physical model-making

One article evaluated *Physical Model-Making as a Teaching Method* in Saudi Arabia (Afify, Alhefnawi, Istanbouli, Alsayed, & Elmoghazy, 2021). The study found that most students preferred the blended strategy and achieved better results when they combined sketches with physical model-making. Therefore, the results indicated that physical model-making remains an effective architecture teaching and learning strategy, especially for novice students who would not have mastered digital 3D modeling.

Theme 7: experiential learning

Three papers examined experiential learning in the design studio. The first paper noted that applying Kolb's Experiential Learning Theory (Kolb, 2015, 1984) positively impacted students' lived learning experiences and creative capabilities (Caner Yüksel & Dinç Uyaroğlu, 2021).

The other UK pilot study examined the impact of experiential, hands-on learning (Djabarouti & O'Flaherty, 2019). The study hypothesized that integrating experiential, hands-on learning in the design studio curricula can contribute to better design decisions by students working on built heritage projects. The findings suggest that experiential, hands-on pedagogy helped students better understand building materials and work better with heritage-context projects. Another study conducted in Turkey expanded the notion of experiential learning to include body and dance as an abstraction of students' embodied experience in space (Hatıpoğlu, Kamaoğlu, Şensoy, & İnceoğlu, 2023). The study statistically evaluated the relationship between body, movement, abstraction, and architectural design process and outcome through subtle quantitative and qualitative measures. The article found that a pedagogy focusing on body and movement improved students' awareness of space and subsequently their educational outcomes.

Despite the few recent studies on experiential learning, they agree that this pedagogy positively impacts students' ability to work with different types of projects with better awareness of spatial and contextual factors.

Theme 8: critique

Utaberta et al. (2010) propose that critique is the backbone of the architectural studio. One study reviewed the literature on the 'criticism' process in the design studio and proposed a framework to investigate it in a case study in Egypt (Abd El-Latif, Al-Hagla, & Hasan, 2020). The study highlighted seven types of critique sessions, including but not limited to individual, group, and peer critique. Abd El-Latif et al.'s (2020) model suggests that for a studio to be effective, it should cope with different types of critique based on design stages. The conclusion also highlighted that desk critiques were the most effective technique throughout all the design process stages.

Another two studies evaluated peer critique as a pedagogical tool in the architecture design studio. The study from Hong Kong explored the effectiveness of peer critique feedback (peer debate) and students' experiences and opinions about this method (Crolla, Hodgson, & Ho, 2019). Based on thematic analysis of interviews, a small sample of five master's degree students reported positive experiences of group peer critique (Crolla et al., 2019). Another Turkish study argued that 'pedagogic identities' can be formed from the interactions between students and tutors when they communicate and play pedagogical roles such as desk and peer critique (Yorgancıoğlu & Tunalı, 2020). The article found that the instructor's 'pedagogic identity' could construct a community of learners. It endorsed its potential as a participatory learning experience where tutors become facilitators and students critique their peers' projects actively (Yorgancıoğlu & Tunalı, 2020).

Both studies on peer critique found it helpful to facilitate the instructors' work when giving students feedback (Crolla et al., 2019; Yorgancıoğlu & Tunalı, 2020). They also agreed that students became more active learners as the activity triggered their critical thinking skills, consolidating the evidence of peer-learning effectiveness as a student-centered pedagogy.

Theme 9: dialogue

One study from the UK utilized learning theories about socio-constructivist pedagogy in the form of dialogic interactions (Smith, Burns, & Wilson, 2022). The author described this pedagogy as the co-construction of learning through social interactions and dialogue. The article discussed the impact of transitioning the dialogic interaction from face-to-face to online teaching and how this impact extends to returning to the physical studio environment. Smith et al. (2022) drew on extensive

literature and lessons from online experiments with students to conclude by suggesting qualities that enable students' social presence—glued by dialogue—in both face-to-face and virtual studio environments.

Another qualitative UK study explored the dialogic praxis in a design studio and factors that affect how students comprehended feedback (Tahsiri, 2020). The author emphasized the need to evaluate the infrastructure to support students and tutors to build and sustain an 'effective working relationship' (p. 162). Another UK study inquired how novice students from different cultural backgrounds could engage in dialogues (Catina, 2020). The paper concluded that a studio environment based around effective and multi-voiced dialogues in the early years could sustain students' engagement abilities at higher levels. Tahsiri's and Catina's studies evaluated a dialogic pedagogy between students and instructors and agreed on its effectiveness and importance in building and sustaining effective student engagement.

Theme 10: student learning styles and autonomy

A study in Jordan investigated the relationship between undergraduate architecture students' learning styles and autonomy based on gender and academic levels (Al Maani, 2022). The author adopted a quantitative approach through questionnaire and Likert scale filled out by students. The study noted differences in students' learning styles and increased autonomy as they progress in their academic studies. However, the author argued that although there is a gap in the literature, researching learning style differences is unnecessary as the learning style differences were related to each studio setting more than personal differences. Finally, the author recommended collaborative learning (see Theme 1) pedagogies to promote different learning styles and boost students' confidence.

Theme 11: problem-based learning

One study from Venezuela evaluated the effectiveness of problem-based learning in architecture design studios, concluding that it seemed to enhance students' performance (Soonets, Olaizola, Mena, Dorbessan, & Micucci, 2020). While the paper shows a comprehensive experiment, it could have benefited from a comprehensive review of the literature and theoretical accounts regarding the methodology and the components of problem-based learning.

Theme 12: pedagogical strategies

Five studies examined various teaching and learning strategies in architecture design studios without focusing on a specific pedagogy. A Cypriot study evaluated the effectiveness of four pedagogies: criticism, jury, peer learning, and self-learning (Lotfabadi & Iranmanesh, 2023). The study found that student's over-reliance on desk critique and non-preferring of peer learning were prevalent among fourth-year students and teachers. Teachers had similar preferences but less gap between each pedagogy and more willingness to transition from one pedagogy to another depending on the design stage. A Turkish study titled *Different Educational Approaches in Design Studio* aimed to evaluate two educational approaches by comparing students' outcomes (Sönmez, 2020). The study concluded that the 'controlled' studio was more 'successful' than the 'independent' one. However, theoretical evidence was not shown on the so-called 'independent' and 'controlled' pedagogies. An Australian university study offered five strategies to enhance student learning, including supporting students to play the role of architects, clarity of studio structure, clear expectations regarding performance, robust peer culture, and keeping expectations high (McLaughlan & Chatterjee, 2020). Another Australian study concluded that the contemporary studio environment should not be static regarding pedagogies and learning activities but support a seamless transition from one pedagogy to another (Iftikhar, Crowther, & Burton, 2023). Finally, an Iranian study explored strategies to link knowledge acquisition and application in the design studio (Saghafi, 2021). The

author called for a multi-scalar approach to realize these strategies, extending beyond the studio into administrative actions that support them.

These studies on pedagogical strategies stand at the intersection of pedagogies, evaluation, and effectiveness—the core of this research. They support other studies that reported positive pedagogical effectiveness when adopting student-centered methods such as peer critique, collaborative learning, participatory and stakeholder engagement, and problem-based learning.

Discoursing pedagogical effectiveness in the architectural design studio

This analysis aims to discuss the findings from the literature and relate them with the theoretical grounds. The twelve themes identified in the literature present a five-year research trend. Some of these themes had explicit pedagogical orientations that relate to the non-conventional approaches that were documented between 1960 and 1995, such as participatory stakeholder engagement (Theme 2), experiential learning (Theme 7), and dialogue (Theme 9). The participatory approach studies (Dhadphale & Wicks, 2022; Salazar Ferro et al., 2020) were influenced by Sanoff's late sixties model (Sanoff, 1981). Two studies on experimental learning (Caner Yüksel & Dinç Uyaroğlu, 2021; Djabarouti & O'Flaherty, 2019) did not refer to Symes and Marmot's 1985 experimental model in architecture studio but employed Kolb's experiential learning theory in education (Kolb, 1984). In Theme 9, Smith et al. (2022) combined Vygotsky's and dialogic pedagogy theories, while Tahsiri (2020, p. 151) associated the notion of 'dialectic' ('synthesis of voices involved in dialogue') to Vygotsky.

Most other studies focused on aspects of student-centered pedagogies such as collaboration: interdisciplinary environment, teamwork, and group work (Theme 1), creativity stimulus (Theme 5), critique (Theme 8), dialogue (Theme 9), student autonomy (Theme 10), and problem-based learning (Theme 11). The literature on collaboration (Abusafieh, 2022; Badawi & Abdullah, 2021; Emam et al., 2019; Kostopoulos, 2022; Munasinghe, 2019; Qureshi, 2020; Thompson et al., 2021; Zejnilovic et al., 2023) combined aspects of early non-conventional approaches such as pattern language (Davis, 1983), experimental (Symes, 1985), and partially energy-conscious model (Cole, 1980) that incorporates energy principles in design. The literature on creativity stimulus (Lee et al., 2023; Lizondo-Sevilla et al., 2019; Park et al., 2022) may relate to different pedagogies but more specifically to the double-layered model (Goldschmidt, 1983), where design evolves from the overlap of creativity and problem-solving. Studies on peer critique (Crolla et al., 2019; Yorgancıoğlu & Tunalı, 2020) relate to Dutton's (1987) hidden curriculum model, where student-student interactions are empowered. The study on problem-based learning (Soonets et al., 2020) may relate to all non-conventional early approaches, especially the double-layered (Goldschmidt, 1983) and the concept-test model (Ledewitz, 1985).

On the other hand, some themes did not deal with explicit pedagogies but focused on crucial aspects in the design studio that relate to pedagogical practices. These themes are digital design (Theme 3), immersive technology (Theme 4), physical model making (Theme 6), and critique (Theme 8). In particular, the eight studies (Agirachman et al., 2022; Agirbas, 2019; Alp et al., 2023; Hajirasouli et al., 2023; Ibrahim & Shakhs, 2023; Kharvari & Kaiser, 2022; Lee et al., 2022; Soulikias et al., 2021) on digital design and immersive technology represent seeds for future studio practices as they reported a positive impact on skillsets that align with student-centered pedagogies.

It is noted from the literature analysis that most studies were based on experiments done by studio instructors, which was the case with early approaches to design teaching and learning. Qualitative studies represented almost triple of quantitative studies. The sample size was primarily small, given the number of students in each studio or academic level. However, the studies consolidated each other by mostly agreeing on the positive impact of implementing student-centered pedagogies. Robust evidence of effectiveness is captured from the literature on collaboration: interdisciplinary environment, teamwork, and group work (Theme 1). These strategies seem to support students' learning and enable them to build diversified skills, although the term *collaboration* refers to different strategies in each study. Furthermore, the findings reported in Theme 4, immersive

technology, present a promising potential to incorporate digital advancements and artificial intelligence with student-centered pedagogies.

Conclusions and future directions

This study attempted to investigate the discourse on pedagogical effectiveness in architecture design studios through a narrative literature review. It contributes to the discourse on design studio pedagogies and offers a platform to inform future teaching and learning strategies. Twelve themes emerged from analyzing thirty-eight papers, which all investigated at least one of three keywords: pedagogies, evaluation, and effectiveness. These were discussed considering theoretical grounds and learning theories from the domains of architecture and education. The twelve themes do not necessarily represent pedagogical orientations but opportunities for researchers to consolidate the evidence reported in each topic. Future studies may benefit from linking the suggested themes (and new themes) with pedagogical origins to consolidate the evidence on the effectiveness of each approach. For instance, there seems to be a need for more evidence of effective pedagogies that would help studio instructors purposefully adopt to foster students' creativity.

While studies in the last five years may not reflect an accurate research trend, drawing a holistic picture of the field was possible. The recent research emphasizes collaboration, teamwork, group work in interdisciplinary environments, digital design, immersive technology, and creativity. What is explicit is that most recent studies are based on experiments for evaluating the effectiveness of student-centered pedagogies. This trend empowers student participation in the learning process by encouraging interactions, engagement, self-critique, and dialogue with peers and instructors. In this regard, it may be time to extend beyond the ideological boundaries of instructional teaching as assumed in the term *pedagogy* and consider *andragogy* or *heutagogy* as a more holistic notion of the adult student-centered approaches that suggest higher learner autonomy. A future study can better investigate this issue.

Academic institutions can be agile to support learning approaches where architectural teaching and learning are not confined by time, space, and studio individuals. For instance, the collaborative approaches reported positive experiences when students worked in interdisciplinary cultures and traveled away from the physical studio to collaborate with stakeholders on other campuses. Therefore, the physical studio can be a dynamic place that supports learning inside and outside the studio.

Research efforts can be made to evaluate the impact of embedding information and communication technology, immersive technology, and artificial intelligence in student-centered pedagogies. These advancements ontologically question conventional pedagogies. However, over-reliance on technology risks bringing off-the-shelf design solutions and replacing the analytical problem-solving process in design. Therefore, studio instructors may need to be familiar with technology to have a common language with students who already use advanced technology. Architecture schools may also develop strategies for benefiting from technology in the studio without compromising the learning value of brainstorming, desk crits, dialogue, peer learning, group discussions, participatory design, and problem-solving.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement and supplementary material

The data that support the findings of this study are openly available in: https://doi.org/10.5281/zenodo.13138596, Table S1: Preliminary comparison of selected articles on design studio pedagogies in the architectural studio.

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