Design Science

Evaluation of the relationship between studies of design research and design process in the field of architecture: a systematic review

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Abstract

Although design research is a relatively recent academic field, it has developed several influential typologies over the past decades. This study conducts a systematic review to evaluate how design research approaches relate to the design process, with a specific focus on two overlooked dimensions: the point of research integration in design and the research attitude guiding the inquiry. Drawing on foundational models by Frayling, Cross and Buchanan, the paper proposes a conceptual framework that cross-analyzes research typologies with these two dimensions. Seventy peer-reviewed studies in architecture and related disciplines were identified and analyzed through PRISMA guidelines and Critical Appraisal Skills Programme (CASP) checklist. The findings reveal four distinct clusters: (1) research about design – basic research – design epistemology, (2) research through design – applied research – design praxeology, (3) research for design – clinical research – design phenomenology and (4) a fourth category, research through design (II) – applied research – design epistemology. Moreover, five research attitudes were identified across the studies: practitioner, practitioner with user, practitioner with AI, researcher and user. These findings provide a more nuanced understanding of how design knowledge is produced in architectural research.

Keywords: Design Process(es), Design Research, Research through Design, Architectural Design, Systematic Review

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1. Introduction

In recent decades, design research has grown in popularity throughout design disciplines, notably in architecture, where the convergence of research and practice is evolving. The need to reconcile theoretical frameworks with the real-world difficulties of architectural design has heightened interest in how research is performed, understood, and used. Foundational models by Frayling (1993), Cross (2006) and Buchanan (2001) have shaped the academic discourse, offering useful typologies for understanding design research. However, in architecture – where design practice is inherently iterative and context-dependent – such models may fall short in capturing the dynamics that shape knowledge production (Downton 2003; Groat & Wang 2013).

A key gap in the current literature lies in the limited attention paid to two critical but underexplored dimensions: the point of research integration in design (i.e., whether research occurs before, during or after the design process) and the research attitude (the orientation of the researcher, whether academic, practitioner, hybrid or AI-assisted). Most typologies implicitly assume that these variables are fixed or irrelevant, leaving unexamined how they influence methodological choices and the framing of design knowledge. In architectural research, where context and authorship deeply shape the inquiry, this omission limits both theoretical clarity and methodological adaptability (Jonas 2007; Creswell 2014).

To address this, the present study poses the following research question: How do (1) the point of research integration in design and (2) the research attitude influence the selection and application of design research approaches in architecture? Through a systematic review of 70 architectural design research studies, this paper analyzes how existing frameworks – such as Frayling's triad, Cross' model and Buchanan's research categories – interact with these two dimensions. By introducing a conceptual model that incorporates time-based and attitude-based classifications, this study aims to advance both theoretical understanding and practical utility in the categorization and application of design research in architecture.

2. Theoretical background

Design research is an emerging field in the academic disciplines of design. The Title, which is formed from the combination of two words "Design" and "Research," refers to all scientific or non-scientific research and explorations which are carried out with the aim of innovative understanding of artificial objects and creation of knowledge. It involves investigation strategies, procedures, methods, routes, tactics, schemes and modes through which people work creatively (Roggema 2017). The roots of this concept go back to the Design Methods conference in 1962 and the attempt to reveal the different aspects of the design process, which includes a wide range of disciplines and trends. The evolution of design methods has been categorized into various generations. Throughout these generations, there is an observable shift of focus from the methods themselves toward the contexts and conditions that influence design development (Bayazit 2004). A similar shift can be felt in the evolving attitudes that influence research methods.

Although the term is broad and encompasses various activities and methodologies, it signifies a burgeoning effort to formalize design's contribution to scholarly inquiry. Key frameworks have been developed to classify types of design research, most notably those by Frayling (1993), Cross (2006) and Buchanan (2001). Each of these offers a particular lens: Frayling organizes research into categories of "into," "through," and "for" design; Cross explores the sources of design knowledge in people, processes and products; and Buchanan introduces a distinction between basic, applied and clinical research.

Despite being often referenced, these frameworks are not without limitations, especially when used in architectural research. One major problem is that they frequently fail to consider when the design research takes place throughout the design process and under what attitude it is conducted (Findeli 1999; Groat & Wang 2013). As Groat & Wang (2013) also show in Architectural Research

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Methods, these frameworks attain their complete significance and practical utility when their link to the particular research environment is clarified. They emphasize that choosing a research method in architecture is not solely a function of the research goals, but is also influenced by the design context, the kind of inquiry being posed, and the chronological place of incorporation within the design process. This idea directly corresponds with the dual dimensions of "time" and "attitude" examined in this investigation, illustrating why generic models must be merged with these dimensions to produce more accurate, practice-related outcomes (Groat & Wang 2013). For example, the aims and methods of research can be greatly changed depending on whether it takes place during early ideation, mid-process development, or post-design evaluation. Similarly, the attitude of the researcher influences the questions posed and the knowledge generated, regardless of whether they are practitioner, academic researcher or hybrid actors (Jonas 2007). These dimensions are rarely addressed explicitly in existing models, resulting in a disconnect between typological classifications and research practices in architecture.

This study looks at how the point of research integration in design and the attitude affect architectural research in an effort to close this gap. These two elements may be added to current frameworks to provide a more comprehensive understanding of architectural design research that captures its multidisciplinary nature and methodological intricacy.

2.1. Overview of key design research frameworks

Archer has identified academic research in three main fields: science, the humanities and design (Archer 1981). The claim that design is an independent discipline (Cross 1982) marked a distinct point in the history of design research. In the 1970s, many prominent academic architects promoted this view in the design community.

Theoretical attempts to categorize design research have traditionally aimed at defining its boundaries, articulating its aims and legitimizing it as a scholarly endeavor. Three of the most widely referenced models – Frayling's (1993) triad of research into, through and for design; Cross' (2006) domains of designerly ways of knowing; and Buchanan's (2001) typology of basic, applied and clinical research – have significantly shaped how design research is taught and discussed in academic settings (Table 1).

Three modalities of design research are presented by Frayling's model: research through design, which incorporates practice-led inquiry; research into design, which concentrates on historical, theoretical or cultural knowledge; and research for design, which aims to improve tools or techniques. However, Cross groups research into three categories based on their sources: people (design epistemology), processes (design praxeology) and products (design phenomenology). By separating basic research for fundamental knowledge, applied research for focused problem-solving and clinical research based on actual professional contexts, Buchanan's method presents a pragmatic typology.

These frameworks have been instrumental in shaping how design research is discussed and taught, particularly in architecture schools. However, they rarely engage with questions of when in the design process research is conducted or under what research attitude it is carried out. The temporal placement of research,

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Table 1. Key frameworks in design research

Type	Classification	Studies
A	1. Research into (about) design 2. Research through design 3. Research for design	(Frayling 1993; Findeli *et al.* 2008)
B	1. Basic research 2. Applied research 3. Clinical research	(Buchanan 2001; Friedman 2003)
C	1. Design epistemology 2. Design praxeology 3. Design phenomenology	(Cross 2006)

whether in early conceptual stages, during or after design, is often a tacit element of the research process and is not explicitly articulated or discussed. Similarly, the attitude guiding the research, be it that of a practitioner, academic researcher or hybrid, remains implicit in most models. This leaves a conceptual gap in understanding how time approach and attitude shape the kinds of knowledge design research produced.

2.2. Gaps and conceptual tensions

While the frameworks listed in Table 1 are important and widely referenced, they initially operated in isolation and were rarely seen to be synthesized or critically compared. Each offered a particular lens on how knowledge in design is structured or generated, but they lacked integration when applied to architectural contexts. Within architectural education, they often remain abstract and somewhat disconnected from the realities of design practice (Findeli *et al.* 2008). They rarely specify when in the design process research takes place or whose perspective shapes the inquiry. For instance, a research project conducted by a practitioner during conceptual development might follow entirely different assumptions and methods compared to one led by an academic in a retrospective study (Groat & Wang 2013). These distinctions – though subtle – have significant implications for how design knowledge is generated and applied (Jonas 2007).

Attempts have been made to bridge these silos. Frankel & Racine (2010), for example, mapped Frayling's triad (Frayling 1993; Archer 1995; Friedman 2008) onto Buchanan's structure (Frayling 1993; Archer 1995; Findeli 1999; Downton 2003; Friedman 2003; Cross 2007), establishing correspondences between research about design (basic), research through design (applied) and research for design (clinical). Clemente, Tschimmel & Pombo (2017) proposed a fourth category – research from design – derived from doctoral case studies, extending the typology to reflect emerging practices better. They also integrate authors' contributions among them Frayling (1993), Cross (2007), Friedman (2008) and Findeli *et al.* (2008). In the current study, there are instances which have not been widely interpreted due to the manuscript's coherency. For example, Wang's arguments in book Architectural Research Methods (Groat & Wang 2013) provide a

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Table 2. Other frameworks in design research and their similarities or differences with key frameworks

Type	Classification	Studies
A + B	1. Research about design: Basic 2. Research through design: Applied 3. Research for design: Clinical	(Frankel & Racine 2010)
A + C	1. Research about design 2. Research through design 3. Research for design 4. Research from design	(Clemente *et al.* 2017)
B + A	1. Basic/ Applied/ Clinical research into design 2. Basic/ Applied/ Clinical research through design 3. Basic/ Applied/ Clinical research for design	(Lee & Lee 2019)

comprehensive overview of discussion around research by design alongside presenting several paradigms in design research. As it has been claimed that research by design grew out of the tradition of design research, Wang's results are worthwhile. Other research on this topic is Lee & Lee (2019), which is in accordance with Frankel & Racine (2010), but variations can be observed.

These efforts are outlined in Table 2. Still, most of these efforts overlook the role of (1) Timing (the point of research integration in design) and (2) Attitude.

Gap No. 1: Schön's theory of reflective practice (Schön 1983, 1992; Reich 2017; Busciantella-Ricci & Scataglini 2024) introduces time as a central variable, distinguishing between reflection-in-action (unconsciously – through experience – during design) and reflection-on-action (self-consciously – retrospective – after design). According to Schön (1983, 1992), the timing of research integration not only affects the nature of the data collected but also influences the type of knowledge produced. Findings from this study revealed that some research categorized at first glance as "through design" in fact aligned more closely with reflection-on-action, since their documentation was compiled after the completion of the design process. This theoretical and empirical overlap underscores the value of integrating Schön's temporal framework with existing design research classifications to capture such variations better. His work demonstrates that while research and reflection are conceptually distinct, an awareness of the integration point of research into the design can influence the structure and organization of various forms of design research (Figure 1).

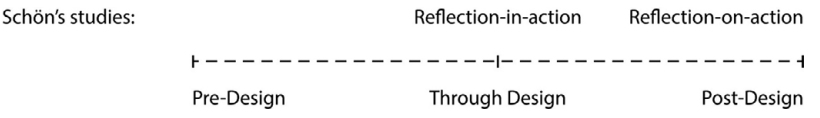

Figure 1. The role of timing in design research (Gap No. 1).

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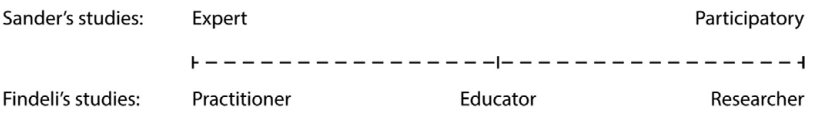

Figure 2. The role of attitude in design research (Gap No. 2).

Gap No. 2: Sanders, meanwhile, adds the dimension of attitude by contrasting expert-driven approaches with participatory, user-centered ones (Sanders 2006). Also, Findeli and colleagues consider three end users of design research are interested in its outputs: the design research community (researchers), the design practice community (practitioners) and the design education community (educators) (Findeli *et al.* 2008). These insights point toward the need for a more flexible and responsive model. Beyond design methods, a research attitude is crucial (Figure 2). Rowe was one of the first pioneers in the study of design thinking in architecture, a concept central to the design research community since the 1980s (Rowe 1994). The Delft Protocols Workshop (Cross *et al.* 1996) further explored design thinking and cognitive psychology through protocol analysis of individual and team processes. Both Rowe's approach to "design thinking" and the Delft Protocols' cognitive analysis provide evidence of how research attitudes and within-process interactions shape the generation of ideas and design decisions. In the dataset analyzed for this study, patterns emerged that resonate with those identified by Rowe and the Delft team – particularly in studies adopting a "practitioner + user" attitude, where joint sessions and direct feedback formed integral parts of the design process. The consistency between our observational findings and previous studies bolsters the soundness of the suggested attitude-based structure and shows its usability in different design contexts.

In response to this appeal, the current study suggests a conceptual framework that superimposes two important elements on top of the current classifications: (1) when research is conducted during the design process and (2) who performs it. This framework provides a matrix that aids in putting studies within the broader field of architectural design research, rather than taking the place of previous models. By doing this, it seeks to offer more conceptual clarity as well as useful advice for negotiating the challenges of doing research in design-driven domains.

2.3. Conceptual framework

To address the conceptual gaps identified in previous models, this study introduces an integrative framework that incorporates two underexplored but highly influential dimensions in design research: time-based approach and research attitude. Rather than proposing a new classification system, the proposed approach first seeks to enrich existing frameworks – particularly those of A, B and C as outlined in Table 1 – by adopting a time-based perspective that allows for more nuanced interpretation and application. The time-based approach refers to the point of research integration in design. Drawing from literature in architectural design pedagogy and practice, it seems possible to differentiate between three temporal phases: reflections on pre-design, design or post-design. This dimension recognizes that the relevance, purpose and methodology of research may shift depending on when it is situated within the design process.

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The research attitude, in parallel and in the subsequent stages of this study, reflects the dominant orientation and guiding role of the research process. Also, as mentioned earlier, this study has attempted to focus specifically on architecture from the broad disciplines of design to conduct a more detailed investigation. The precedent for this can be found in the studies of Till and Lawson. Where Till thought of a model that goes beyond both the science/art and quantitative/qualitative divisions (Till 2008), to enable thematic and interdisciplinary research across the three stages and to allow contributions from very different kinds of expertise – scientists, historians and practitioners – to contribute to the research.

This study does not claim these to be exhaustive or mutually exclusive, but they serve as useful heuristics to understand better how attitudes and research goals vary across contexts. By crossing these two dimensions, the conceptual framework facilitates a transparent analysis of how different studies locate themselves within the design research landscape – not only in terms of what kind of research is conducted but also when it happens and under what research attitude. This enables both more precise categorization and a deeper appreciation of the dynamics shaping knowledge production in architectural design.

Beyond the two primary dimensions discussed, namely the timing of research and the research attitude, this study also takes into account the kinds of knowledge that design research tends to produce. Building on the work of Cross and Schön, three modes of knowing can be distinguished that often operate in parallel. First, epistemological knowledge emerges from analytical or theoretical inquiry, often conducted by researchers working outside the act of designing itself. Then there is praxeological knowledge, grounded in the hands-on process of designing – what Schön famously called "reflection-in-action." Finally, phenomenological knowledge arises from how design is experienced, whether by designers, users or communities. These modes of knowing are not always categorized in taxonomies, but they shape how design research in architecture is understood. Figure 3 offers a way to map this understanding, showing how timing and attitude intersect across different approaches drawn from the literature.

Figure 3 presents the conceptual framework guiding this study, combining two key dimensions identified from the literature: the point of research integration in design (before, during or after) and the attitude of the research (for example, practitioner, researcher or user). Each intersection in the framework is informed by established theoretical typologies. For instance, research about design led by researchers before or after the design process corresponds to Frayling's classification and Buchanan's research categories. Practitioner-driven inquiries during design align with Schön's reflective practice and Cross' praxeological approach. User-centered approaches during or after design relate to participatory design or post-occupancy evaluations, as discussed by Groat & Wang. By integrating these models, the framework not only maps existing design research typologies but also surfaces conceptual blind spots, particularly where time and research attitude have not been jointly considered. This framework sets the stage for the analytical categorization of architectural design research studies in the following sections.

3. Research methodology

The PRISMA approach was used as the transparent protocol for this systematic review (Moher *et al.* 2009). The current research focuses on the existing literature

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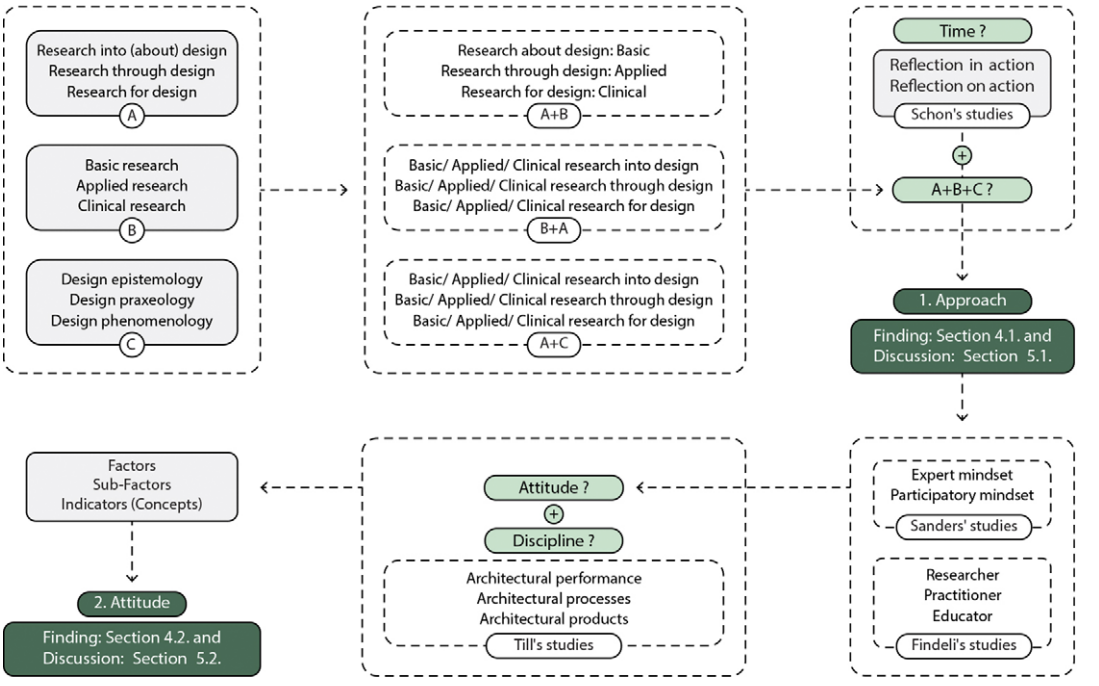

Figure 3. Conceptual framework.

related to several fields of design research which are related to the design process category, specifically in the discipline of architecture or fields close to it. Accordingly, the study deals with this main question: How do the point of research integration in design and the research attitude influence the selection and application of design research approaches in architecture?

This study extracted and updated the primary data in the period from 15 April to 15 September 2023. It has searched six unique databases: Scopus, Web of Science, Google Scholar, Science Direct, Taylor and Francis and Saga for this purpose. Also note that the time stated above does not relate to the studies reviewed and analyzed for this paper. The time span, however, is 1982–2023 for the first group of studies identified before the application of screening procedures, while it is the period from 1993 to 2023 associated with the relevant time pertaining to the final selection of 70 studies after the screening procedures. According to the questions and the structure formulated based on the background of the subject, the main keywords extracted for searching the texts include "design process" and "design research." For this literature search, some constraints were put in place with regard to the various studies that would be included at the beginning. The search returned 1021 sources, whose details by database in the searched areas are shown in Table 3 (The Google Scholar database was checked and revised to be consistent with others based on the same limitations as other databases; for this reason, the number obtained, 107, was far less than the number that existed at the beginning of the search in this database).

To ensure transparency, Figure 4 presents the PRISMA 2020 flow diagram of study selection, showing the three-step screening procedure:

- Title screening (removing duplicates and irrelevant records);

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Table 3. Search strategies in each of the databases

Databases	Search strategy	Results
1. Scopus	TITLE-ABS-KEY ("Design Process" AND "Design Research") AND (LIMIT-TO (DOCTYPE, "Article") OR (LIMIT-TO (DOCTYPE, "Book Chapter") OR (LIMIT-TO (DOCTYPE, "Review") OR (LIMIT-TO (DOCTYPE, "Book") AND (LIMIT-TO (LANGUAGE, "English") AND (LIMIT-TO (SRCTYPE, "Journal") OR (LIMIT-TO (SRCTYPE, "Book Series") OR (LIMIT-TO (SRCTYPE, "Book")	484
2. Web of Science	TOPIC: ("Design Process" AND "Design Research") Refined by: LANGUAGES: (ENGLISH) AND DOCUMENT TYPES: (Article OR Review Article OR Book Chapters)	260
3. Google Scholar	allintitle: ("Design Process" AND "Design Research") Refined by: LANGUAGES: (ENGLISH) AND DOCUMENT TYPES: (Article OR Review Article OR Book OR Book Chapters)	107
4. Science Direct	Title, abstract, keywords: "Design Process" AND "Design Research" AND Article Type (Research Articles OR Review Articles OR Book Chapters)	83
5. Taylor and Francis	([Publication Title: "design research"] AND [Publication Title: "design process"]) OR ([Keywords: "design research"] AND [Keywords: "design process"]) OR ([Abstract: "design research"] AND [Abstract: "design process"]) AND Article Type (Article OR Review Article)	57
6. Sage	([Title: "design research"] AND [Title: "design process"]) OR ([Keywords: "design research"] AND [Keywords: "design process"]) OR ([Abstract: "design research"] AND [Abstract: "design process"]) AND Article Type (Research Article OR Review Article)	30
Sum		1021

- Abstract screening for alignment with architectural design research;
- Full-text review to confirm eligibility.

3.1. Inclusion and exclusion criteria

Also, Table 4 presents a list of the inclusion and exclusion criteria used in the process of study selection. As it has already been noted, for the purpose of screening and collecting studies, the updated guidelines of PRISMA 2020 were followed by this paper (Page *et al.* 2021). Figure 4 includes the details of screening studies. The collection of selected studies has been screened in three separate stages – title, abstract and full text.

3.2. Quality appraisal (CASP)

All 94 identified studies underwent full-text screening and critical appraisal using the Critical Appraisal Skills Programme (CASP) qualitative checklist by independent reviewers (P.A. & N.S.) (CASP Qualitative Checklist 2018). Studies were categorized as high (9–10), moderate (7.5–9) or low (≤7.5) based on quality scores (0–10) assigned using a predefined checklist. The CASP criteria included

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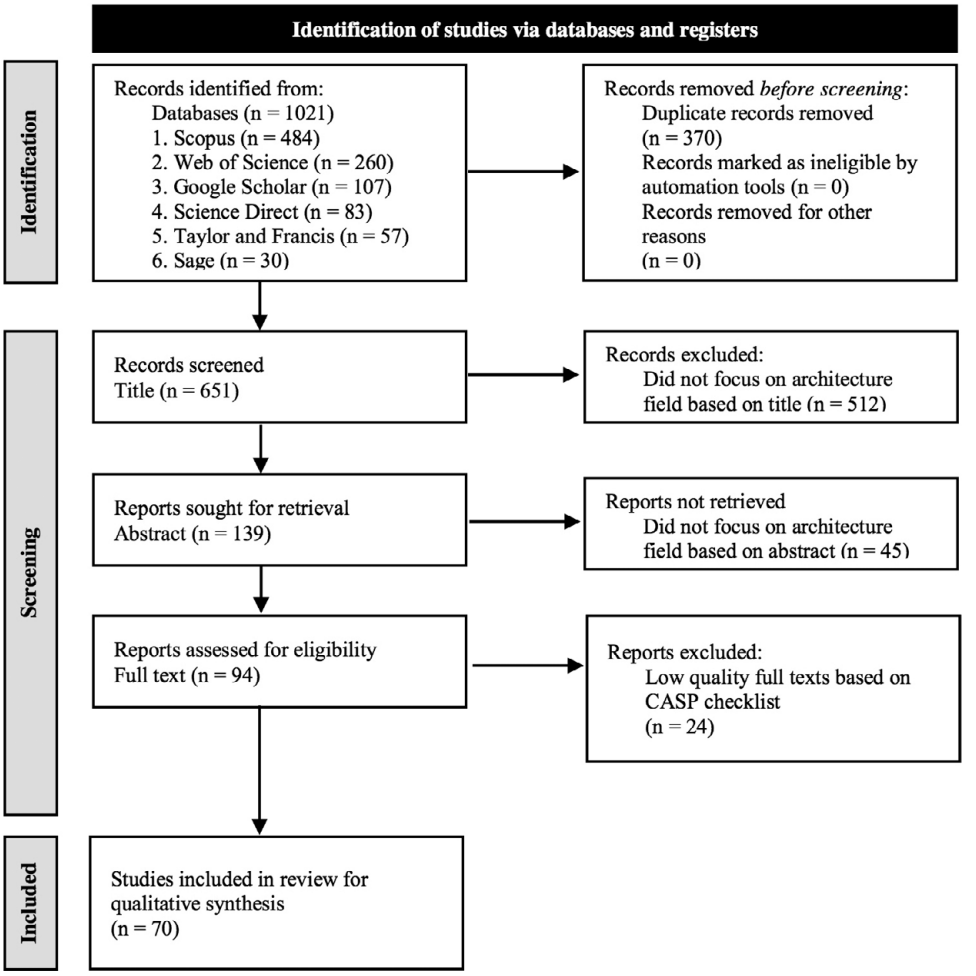

Figure 4. PRISMA 2020 flow diagram of screening and study selection.

evaluation of research aims, methodological clarity, ethical considerations, rigor of data collection, transparency of analysis and the validity of findings. In this context, several systematic reviews can be referenced. For instance, DeSa *et al.* have applied the same ranges for the three intervals (high, moderate and low) for overall quality (DeSa *et al.* 2022). Additionally, some studies, such as Tao *et al.* (2012), have adopted a more flexible approach by considering scores of 75% or higher (7.5–10) as indicative of high quality. Therefore, it can be concluded from these similar studies that scores of 7.5 and below may be excluded from further analysis.

Following resolution of any disagreements regarding study quality (When one reviewer had given a study an 8 and another a 5, the average being 6.5, the study would be excluded from the review since the score was less than 7.5. When this happened, a third reviewer (M.Z.) would be invited for a meeting to ascertain whether he or she felt that the study was worth a higher quality rating than 7.5. The objective was to agree on the two existing scores to provide the study with an

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Table 4. Inclusion and exclusion criteria of selected studies

	Inclusion criteria	Exclusion reasons
Document type	Research article Review article Book Book chapter	Editorial texts Brief reports Short survey Conference paper Conference review Book review Thesis or dissertation
Language	Full text English documents	Abstract in English, but full text in a different languageOnly the title in English but the rest is in a different language
Publication date	All articles and publications in the databases, from 1982 to 2023	Published online after review period (Sep 2023 onwards)
Accessibility	Articles and publications whose abstracts and full texts are accessible	Articles unavailable electronically or by other means
Peer-review	Articles and publications underwent a peer-review process	No peer-review, no information on publication criteria
Subject area	Documents from all disciplines potentially relevant to the topic (e.g., architecture, built environment, urban design, landscape design, interior design, product design and interaction design)	Different meanings of certain search terms in other disciplines (e.g., information architecture, hardware architecture, political science, law and chemistry)

opportunity to not exclude from further review), only studies categorized as high ($n = 24$) or moderate ($n = 46$) quality (scores 7.5–10) were included for analysis of the connection between design research and design process in the context of architecture, and the theoretical synthesis of the research was done based on them. This procedure ensured that decisions regarding inclusion or exclusion were not based on single-reviewer judgments, but were collaboratively discussed to enhance fairness and minimize bias.

The results that come from the scores taken from evaluators are used in determining whether the evaluated resources can conclude by the percentage of agreement between evaluators, and Cohen's kappa coefficients (Warrens 2011). Evaluator scores, P.A. & N.S., have been adopted for computing quality ratings, low, medium and high, for every study on its own in the research. Inter-rater agreement assessments were performed using percent agreement and Cohen's kappa coefficient. Kappa interpretation followed established guidelines slight, fair, moderate, substantial and perfect (Landis & Koch 1977; Conger 2016). As can be seen in Table 5, in the current study, the inter-rater agreement was 89.36%, while the kappa coefficient was 0.835, indicating almost perfect agreement between the evaluators. Disagreements were resolved through discussion, and when necessary, with the involvement of a third reviewer. This process contributed to the reliability and transparency of the quality appraisal.

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Table 5. Details of kappa coefficient and percentage of agreement between evaluators

		Reviewer 02			
		High	Low	Moderate	Total
Reviewer 01	High	22	0	6	28
	Low	0	24	0	24
	Moderate	4	0	38	42
	Total	26	24	44	94
Measure of agreement	Percentage (%)			89.36	
	Kappa coefficient			0.835	

3.3. Coding and categorization

Following the checklist application, a comprehensive list of records was reviewed. Title and abstract screening identified some preliminary thematic areas. The coding process followed a structured consensus approach: each author independently coded the studies for two analytical dimensions, (1) time of research integration (pre-, during or post-design) and (2) research attitude (practitioner, practitioner + user, practitioner + AI, researcher or user), before meeting in structured consensus sessions to resolve disagreements. A structured procedure was used to determine author agreement, starting with the categorization of each paper across three research timings and research attitudes. The timing dimension showed scant inter-author discord. An attitude was accepted if it was endorsed by most of the authors. In instances of disagreement, a structured group meeting was held with the three reviewers involved in the checklist procedure (P.A., N.S. and M.Z.). The goal of these sessions was to either gain a majority consensus on an existing attitude or to suggest and name a novel attitude founded on theoretical structures. It is vital to mention that the practitioner attitude with AI, and the user attitude were derived from these meetings. Following the conclusion of each study's attitude, the next phase involved the raw coding of ideas. This stage followed the same method of naming and improvement, enabling the adjustment of existing names or the formation of new ones, as shown in Figure 8.

The thematic analysis followed that of Braun and Clarke. The steps involved in conducting a thematic analysis are identified as (Braun & Clarke 2006; Jones, Coviello & Tang 2011): familiarization with data; generating initial codes; searching for themes; reviewing themes; defining and naming themes; and producing the report. Thematic areas are the key concepts that represent the holistic view of the selected studies. During the second phase of the analysis, themes provided relevant information on search terms and recommendations of subthemes. Accordingly, the authors comprehensively labeled the thematic areas, while sub-themes were derived from the analyzed literature. The results are presented in the ensuing sections.

The coding of the studies subsequently began with the initial coding of each study against the listed attitudes in reading the literature. The authors thereafter independently open-coded the studies according to each attitude, and the results are presented as raw concepts in Section 4.2 and Figure 8. This was followed by

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discussion of how to render these concepts into indicators. Inter-rater reliability was assessed using Cohen's kappa coefficient at two key stages: the determination of attitudes and the conceptual coding phase. At the attitude-determination stage, the level of agreement was found to be in the "almost perfect" range. In the subsequent conceptual coding stage, the agreement was in the "significant" range. Both results were deemed sufficient to proceed with the research.

Through extensive authors' discussion, and consideration of the included studies, the findings were first categorized into sub-factors. During the next phase, collated sub-factors were consolidated into more general factors. The iterative nature of coding and discussion allowed refinement of categories through readings of selected studies introduced earlier. Further details about this process can be obtained in Section 5.2 and Figure 11. Also, this section achieves validity and reliability through triangulation, peer debriefing and an audit trail.

4. Findings

As explained in the previous section, the last step of the screening process led to 70 studies included in the selected research. After a full-text review and labeling of the studies by authors, there was a need for systematization of the findings according to different views, as shown in Figure 3. Two axes, time-based approach and research attitude, seemed to have the potential to provide enough analytical power to drive this discussion forward. Consequently, the data in Sections 4.1 and 4.2 are analyzed through a framework that makes distinctions for both time-based approach and research attitude. This dual-axis model enables a layered reading of the selected studies and helps uncover underlying patterns that may remain hidden in more conventional classifications.

4.1. Based on time approach

In the literature, one of the main classifications is related to Christopher Frayling's study in 1993 (Frayling 1993), which has been partially followed by other researchers in the naming of various types (Friedman 2008; Forlizzi, Zimmerman & Stolterman 2009; Frankel & Racine 2010). Research into/about/on design, research through/by design and research for design are the three categories into which design research is separated. Based on this classification, 70 selected studies were initially labeled after reading the full text and then analyzed more clearly. Several selected studies aligned with this highly cited framework. However, in other cases a conflict was recorded between the intent of the research and the attempt to apply this model. Some studies, while aligned with the spirit of research through design, did not incorporate research integration during the design process. Conversely, other studies were conducted after the design phase, but they lacked any connection to research about design. These mismatches were observed in relation to Frayling's typology, which despite its influence did not fully accommodate the temporal diversity found in contemporary architectural research. As a result, a group of studies has been identified and is temporarily referred to in this section as a fourth type of research X design. Consequently, the first potential gap in research emerged, referring to the point of research integration in design (time-based approach). Further discussion of this section can be found in Section 5.1.

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After the classification of the 70 selected studies based on design research approaches, reading and labeling them were conducted based on different subjects. The following chart shows the timeline of the studies within these four categories (Figure 5).

Also, referring to the book *Research Methods in Architecture* authored by Linda Groat and David Wang (Groat & Wang 2013), it was determined which strategy or strategies were used in each study (Figure 6). This classification for studies made it possible to identify the variety of methodological approaches used in architecture – from interpretive-historical to experimental-applied – and to examine how these strategies intersected with the time-based and attitude-based dimensions analyzed in this research. This methodological linkage revealed that certain temporal categories (such as post-design) showed a stronger association with particular strategies and tactics, a relationship explored in more depth in the Discussion (Section 5). As shown in the figure, 18 studies in research about design were identified as utilizing the interpretive-historical research strategy. On the other hand, research through design combines various qualitative research strategies such as case study, ethnography or simulation research. The other two types of design research (For and X types), as per their labels, were recorded as relatively more recent, with an increase observed since the 2010s. In the following, the tactics used and the duration of the research were analyzed and categorized (Figure 6).

Analysis and reading of studies conducted as research about design shows that this type is about the cognition of design. Also, they generally do not use qualitative strategies, and only four studies had case studies in their research. They have often used historical-interpretive research with archival documents tactics from the researcher's point of view. Some of these researches are about reflective knowledge (Jacques 1993; Koskinen *et al.* 2011; Robertson & Simonsen 2012; Robertson & Wagner 2012; Luck 2018; Herr 2019). Others have dealt with design creativity (Purcell & Gero 1998; Biskjaer & Christensen 2021), and more specifically, they have examined topics such as the role of drawings and the primary generator. In this cluster of studies, an analytical distance between researcher and process was observed, with retrospective insights reported more frequently than real-time ones. Another part of the studies in this field briefly focuses on evidence-based design (Lawson 2010; Pati & Barach 2010; Shepley & Song 2014; Halawa *et al.* 2020), and the relationship between computers and design (Rosenman, Gero & Maher 1994; Hight 2013; Joachim & Aiolova 2015; Kızılcan 2021) and universal design (Heylighen 2014).

Also, in research X design, it has been tried to find out how design works in a scientific and research-oriented way through archival documents, content analysis, interviews, questionnaires, audio and video recording, etc., by mentioning two points: 1. These activities often not focus on the outcome and the final product and are more concerned with design cognition (different from research for design) and 2. The recording of documents was not done at the moment of the process, but after its completion, in such a way that in some cases it seems to be a narrative of design in the past (different from research through design). While both through-design and X-design emphasize the inner workings of design cognition, their temporal stance differs significantly; one engages in-process observation, while the other constructs narratives retrospectively. This distinction was identified as aligning with the time-based lens, which provided a framework for nuanced classification.

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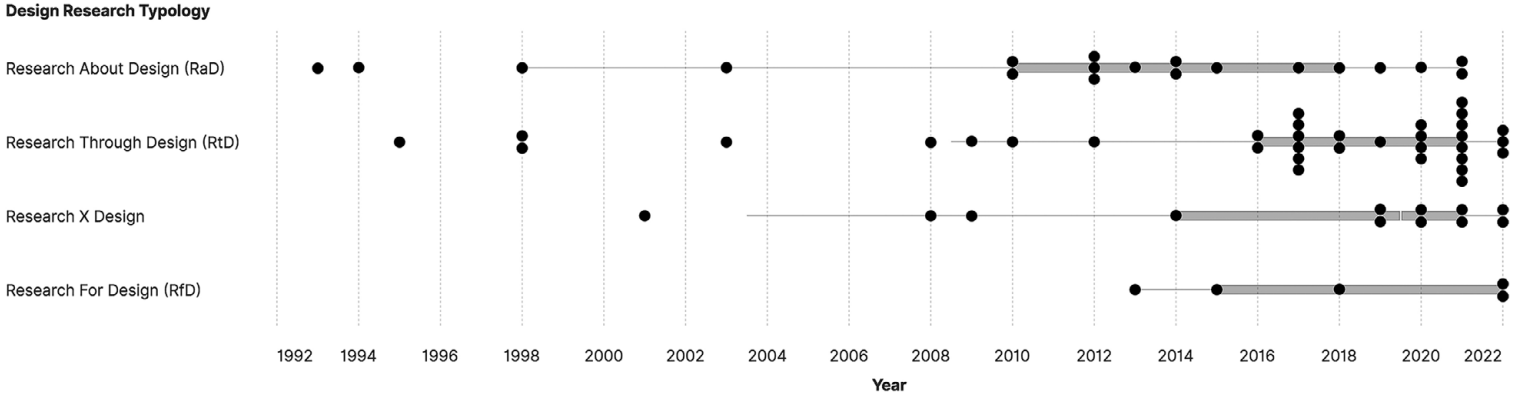

Figure 5. Labeling of studies based on design research approaches by year.

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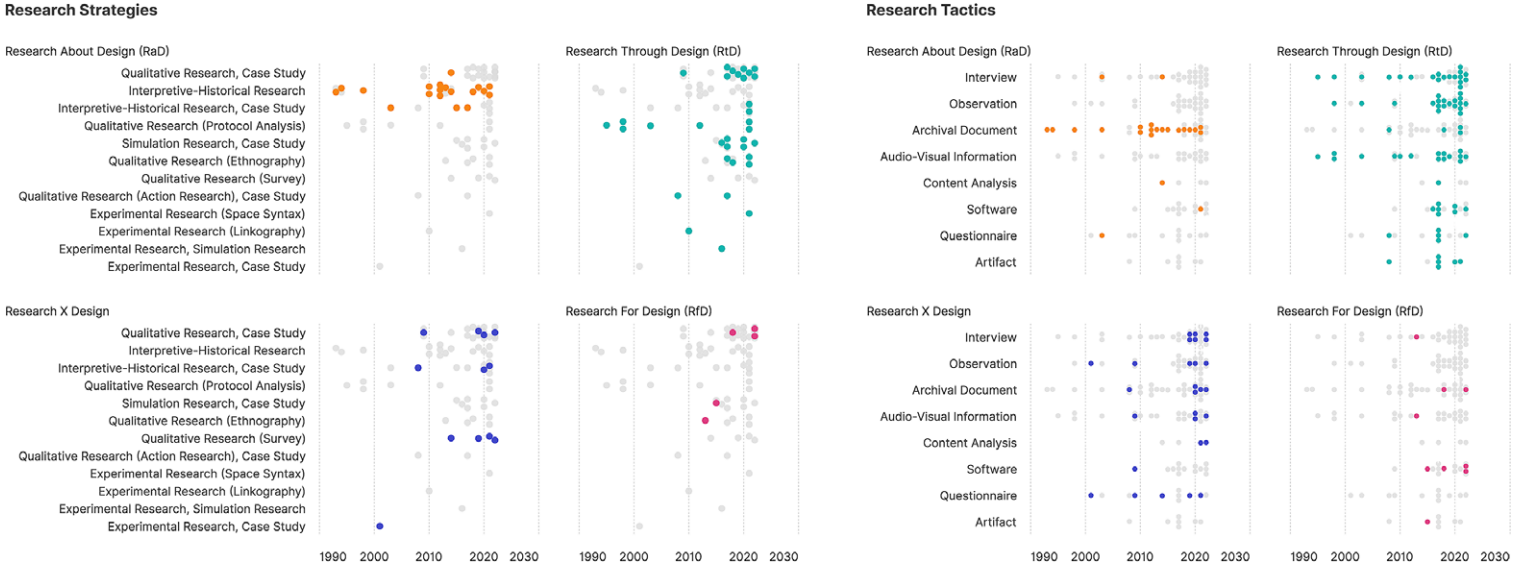

Figure 6. Strategies and tactics employed in the studies by year and design research approaches.

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4.2. Based on research attitude

Literature review shows that, next to the time-based approach, another relevant concept in design studies is the necessity of heeding the effective attitude in every study. In most of the reviewed literature, knowledge production was reported as being positioned in close proximity to the practitioner's attitude. This knowledge relates to Sanders' expert mindset and Findeli's practitioner and educator attitude constructs. In this research study, the people engaged in the practice of architecture, ranging from students to experts, were positioned as practitioners. A second subset of the analyzed studies was marked as practitioner + user, indicating a participatory dynamic similar to Sanders' work. In addition, a researcher's attitude, in line with Findeli's approach, marked another group of the selected studies. Aside from the three aforementioned groups, some studies developed knowledge almost exclusively based on user attitude, with minor indirect input by practitioners. Such studies commonly utilized post-occupancy evaluation methods, usually including user interviews. Concurrently, the increasing use of artificial intelligence (AI) has led to the emergence of a practitioner + AI attitude in some of the studies examined.

Therefore, after a thorough review of each study and brainstorming, the studies were categorized according to the attitude that guided the research direction. These research attitudes were identified in five modes: (1) practitioner; (2) practitioner with user; (3) practitioner with AI; (4) researcher; and (5) user. This classification was observed to show diversity in design research not only in terms of roles, but also in the nature of decision-making and motivation. Therefore, coding was followed to identify indicators, sub-factors and factors in each study in five main groups (as mentioned at the end of the research methodology section). Proper identification of factors and sub-factors may help to get a network with related concepts (Figure 7).

The authors further read each study and compiled concepts that seemed relevant, and then grouped these concepts into the attitudes as depicted in Figure 8. For example, the concept of "drawing" was found mainly in the attitude of practitioner but also occurred in practitioner working with user. This overlap was recorded as showing that, while research attitudes provide a useful framework, many concepts in design research appeared across multiple orientations, reflecting the hybrid nature of real-world design practice.

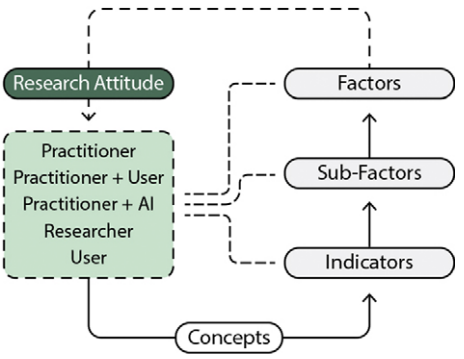

Figure 7. Relationship between attitude, factor, sub-factor and indicators in the research.

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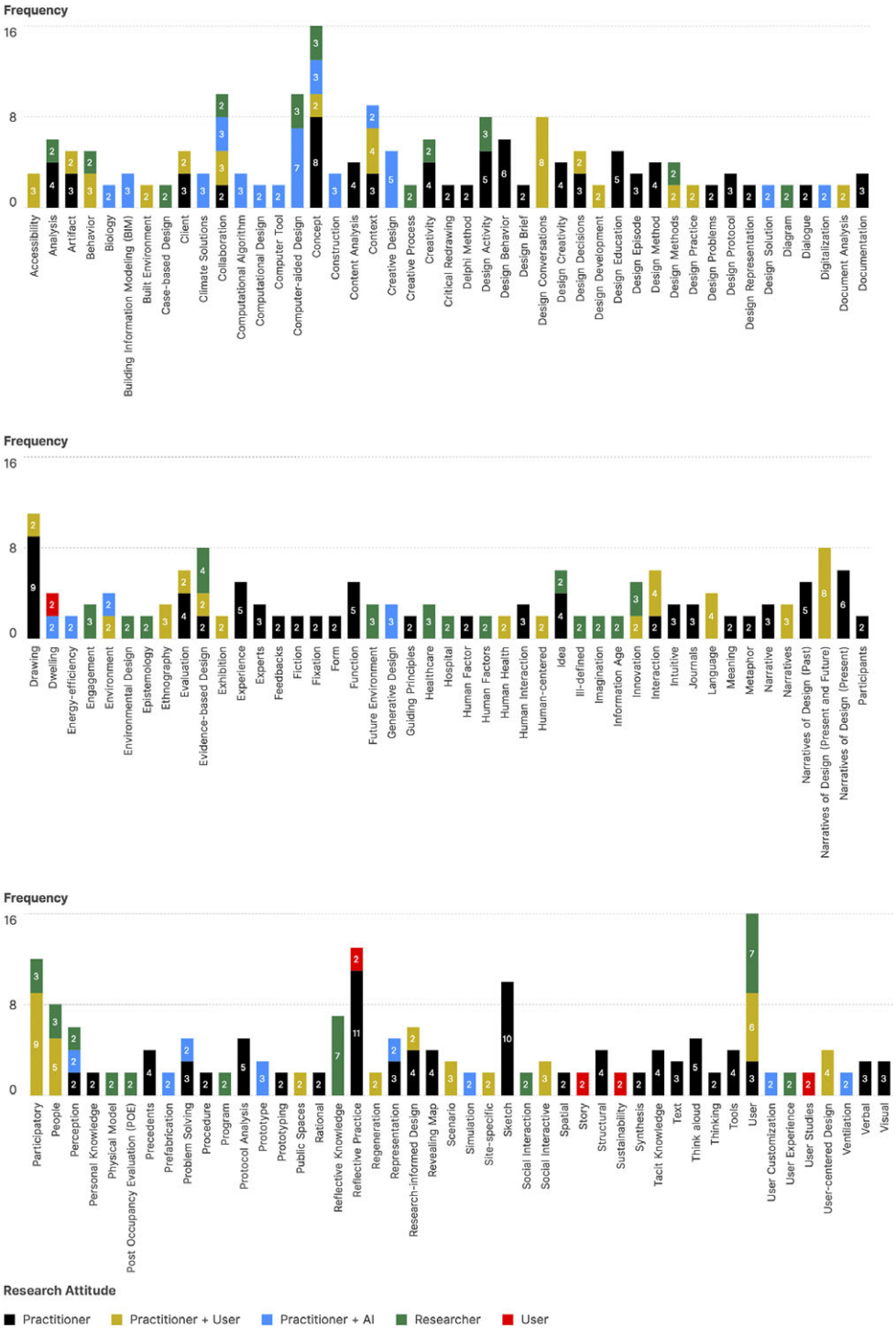

Figure 8. Concepts coded in the research.

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5. Discussion

5.1. Based on time approach

From the literature review on design research typologies, at least three overarching categories were extracted, each reflecting a different perspective on the field's evolution (as summarized in Table 1).

The first is Frayling's well-known model (1993), which classifies research into three types: (1) research about design; (2) research through design; and (3) research for design. The second comes from Buchanan (2001), who categorized research based on the type of problem as: (1) basic research; (2) applied research; and (3) clinical research. The third framework, proposed by Cross (2006), approaches design knowledge in terms of: (1) design epistemology; (2) design praxeology; and (3) design phenomenology. This study initially integrated the first two frameworks (Frayling + Buchanan) to form a base for typological analysis (see Table 2), following precedents like Frankel & Racine (2010). In the next step, it incorporated Cross' conceptual lens to enrich the framework. While scholars such as Clemente *et al.* (2017) have acknowledged the value of such integration, their efforts have remained conceptually fragmented and not systematically unified. This study aligned these three typologies (A + B + C) into a coherent structure. Cross associates theoretical and conceptual knowledge with design epistemology, which overlaps with what other scholars identify as basic research: research about design (Pedgley & Wormald 2007; Findeli *et al.* 2008; Forlizzi *et al.* 2009; Lee & Lee 2019; Félix 2020; Galdon & Hall 2022). Process-oriented knowledge in Cross' view corresponds to design praxeology, which resonates with applied research: research through design (Findeli *et al.* 2008; Forlizzi *et al.* 2009; Lee & Lee 2019; Félix 2020; Galdon & Hall 2022). Lastly, Cross' notion of design phenomenology, focused on knowledge embedded in final products, is aligned with clinical research: research for design in professional practice or studio settings (Findeli *et al.* 2008; Forlizzi *et al.* 2009; Félix 2020; Galdon & Hall 2022). Accordingly, the selected studies were initially categorized into three triplets (The first three rows of Figure 9):

(1) Research about design – basic research – design epistemology
(2) Research through design – applied research – design praxeology
(3) Research for design – clinical research – design phenomenology

To account for the outliers and better accommodate them within the framework, a time-based analytical lens was introduced. Drawing inspiration from Schön's theory of reflection (1983), the design process was split into three temporal phases: pre-design (before), design (during) and post-design (after). This provided deeper insight and captured cases that were missed in the tripartite typology. Nevertheless, a subset of studies did not fully conform to these three-fold combinations during the categorization process (see Section 4.1).

In this time-based framework, the first group (design as subject) consists primarily of post-design studies or studies that are not directly related to a particular design; these studies are typically interpretive, theoretical and centered on examining design phenomena after the fact, which is consistent with fundamental research and epistemology.

Research is done throughout the design process, and the act of designing itself is employed as a technique of inquiry in the second group (design as a tool).

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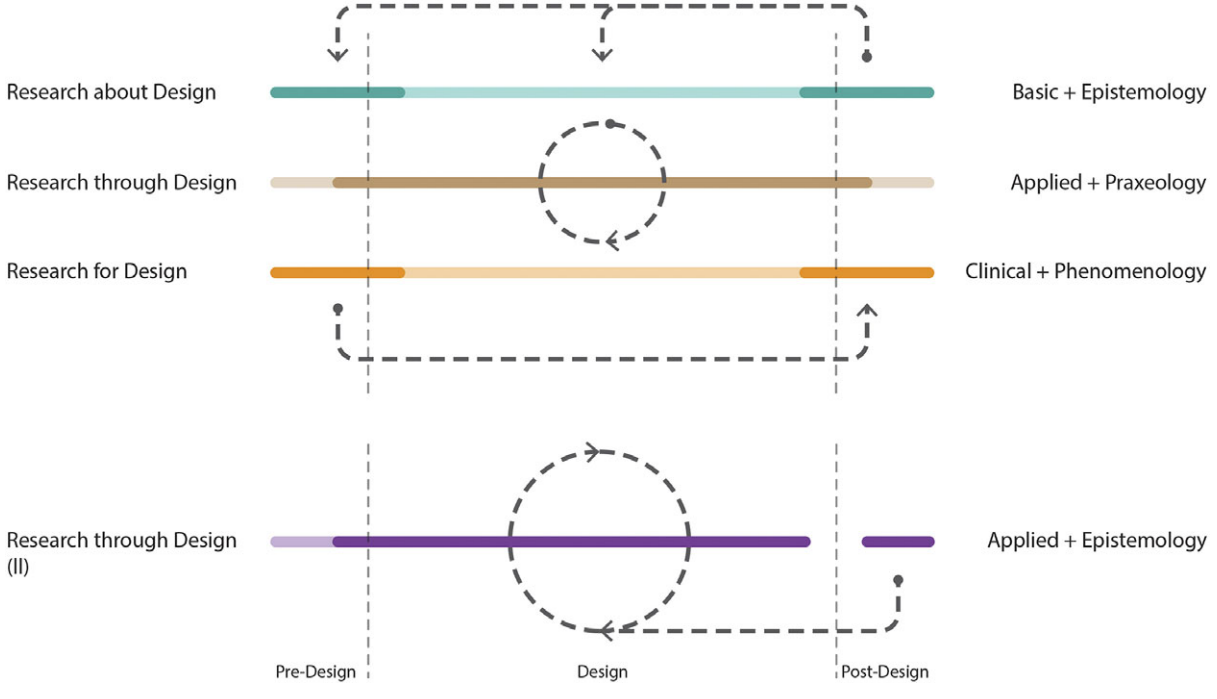

Figure 9. Conceptual diagram of the relationship between the time of occurrence of design research and the time of design (in three general types of design research and the fourth type of it).

In keeping with Schön's reflection-in-action, this exemplifies applied research and praxeology, where knowledge is generated by interaction with the design process.

Although they are less commonly published in scientific literature, investigations that focus on design outcomes and are typically carried out in studios or practice-based settings fall under the third category (design as an object). Their phenomenological nature places them within the context of clinical research.

Yet, a fourth pattern was recognized. Some studies – although classified as research through design – lacked real-time process documentation or alignment with praxeological methods. Instead, they adopted a retrospective lens, analyzing completed designs to understand decision-making. These studies align more with Schön's "reflection-on-action" and demonstrate a hybrid: research through design in form, but closer to epistemology in substance. Thus, a fourth row was added to the framework (Figure 9):

(1) Research About Design (RaD) – basic research – design epistemology
(4) Research Through Design (RtD) – applied research – design praxeology
(5) Research for Design (RfD) – clinical research – design phenomenology
(6) Research Through Design (II) – applied research – design epistemology

This categorization provided the foundation for identifying how attitudes shape design research. Now, with the inclusion of the attitude axis, all selected studies can be categorized (Table 6), and their relevance toward the time-based approach can be extended to provide observations on how such attitudes influence design research.

In the first design-research group, that is research about design, which is basic research along with design epistemology, the attitudes of the study were researcher, practitioner and practitioner with AI, respectively. Based on the frequency of

Table 6. The frequency of selected studies based on the identified types of design research and attitudes

Design research typology A	Design research typology B	Design research typology C	Attitude	Attitude num.	DR num.
Research about design (RaD)	Basic research	Design epistemology	Researcher	17	19
			Practitioner	1	
			Practitioner + AI	1	
Research through design (RtD)	Applied research	Design praxeology	Practitioner + User	14	34
			Practitioner	12	
			Practitioner + AI	8	
Research for design (RfD)	Clinical research	Design phenomenology	Practitioner	2	5
			Practitioner + AI	2	
			User	1	
Research through design (II)	Applied research	Design epistemology	Practitioner	11	12
			User	1	

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studies in this field, it seems that the attitude of researcher has been more influential than others by a significant difference (researcher is marked in green in Figure 10). In the second group, that is research through design which is an applied research and is related to design praxeology, the attitude was, in the order of frequency, practitioner with user, practitioner and practitioner with AI. In research through design, both participatory approaches (practitioner with user) and practitioner independently produce knowledge almost equally (practitioner is in black, and practitioner with user is marked in yellow in Figure 10). In the third group, that is research for design which is clinical research along with design phenomenology, the attitudes were practitioner independently, practitioner with AI and user, respectively. In the fourth group, that is research through design (II), which is applied research and is related to design epistemology, the attitudes were practitioner or user independently, with the explanation that the majority of the studies were dedicated to the practitioner attitude independently and a very limited part regarding the user attitude independently (practitioner is in black and user is in red in Figure 10). This point shows that in the research through design (II), the produced knowledge is predominantly formed based on the attitude of the practitioner.

On the other hand, each of the four kinds of research identified – research about design, research through design, research through design (II) and research for design – seems that it can be guided by a practitioner attitude. This observation indicated that practitioner attitudes are widespread in design research. The practitioner attitude through an AI lens, speaks to three distinct categories of design research: research about design, research through design and research for design. In this way, so far, there has been no impact on studies through design (II). If the practitioner is considered along with the user, it is limited to research through design and has not yet affected any of the other species. A similar pattern emerges with the researcher attitude, where its sole observed influence is within research about design. The attitude of the user was also seen in two types of Research through Design (II) and Research for Design. It seems that the users cannot play a sole role in the design or while doing it (research through design), and only after going through the process, knowledge can be produced based on their attitude (Figure 10).

5.2. Based on research attitude

Based on the process described at the end of Section 3 and in Section 4.2, raw concepts were open-coded within each of the five discovered attitudes. They were then synthesized into the form of indicators, first in some of sub-factors, then more broadly in a number of main factors (Figure 11). As inferred from data represented in Figure 11, researcher and practitioner attitudes indicate a strong contribution to knowledge production in this area. Furthermore, combinations of practitioner with user and with AI also indicate impressive contributions with future potential to increase. Meanwhile, the correspondence between coding factors and these attitudes might allow for multiple interpretations.

The reflective practice aspect was observed in the knowledge production associated with the practitioner, practitioner + AI and user attitudes. It broadly relates to sub-factors such as design narratives, which extend across both past and present. This process of reflection gives rise to reflective knowledge when seen from the vantage point of the researcher attitude, which encompasses a larger number of

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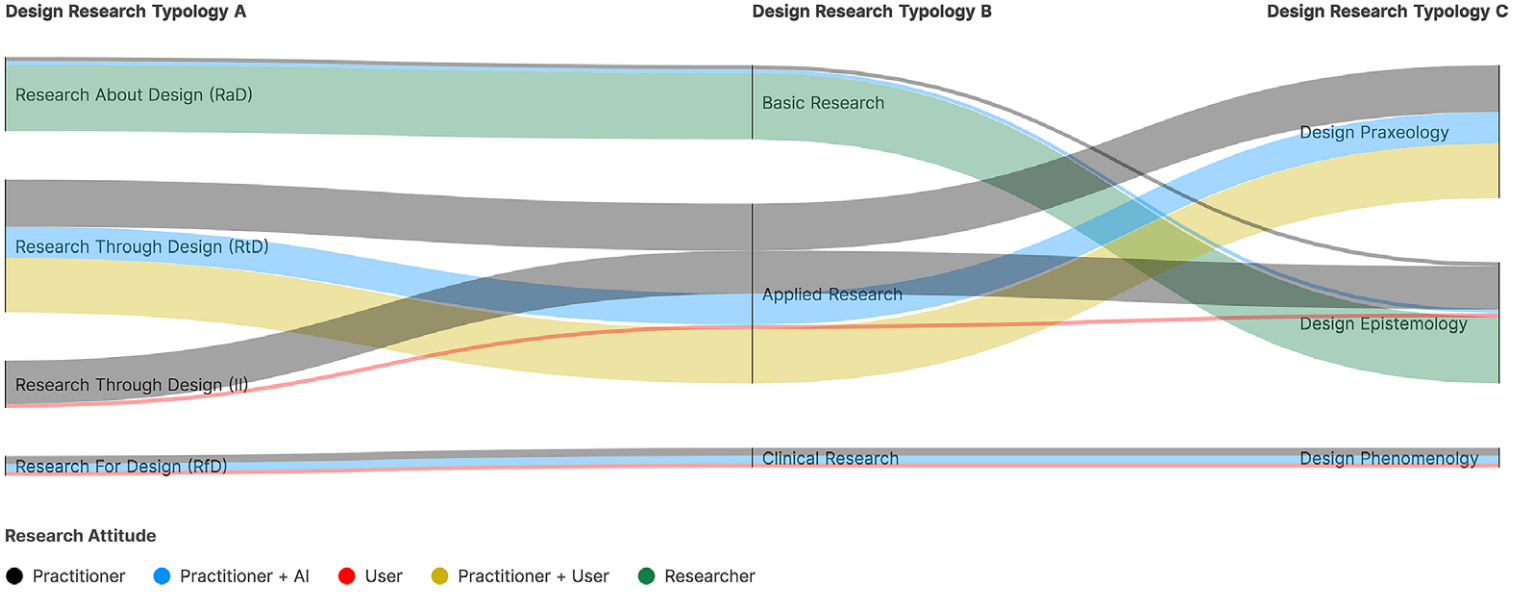

Figure 10. Conceptual diagram of the existing situation regarding the relationship between the types of design research to reveal the design process in the discipline of architecture by separating the attitudes of the studies and their strength (the size of the colors indicates the greater frequency in each section).

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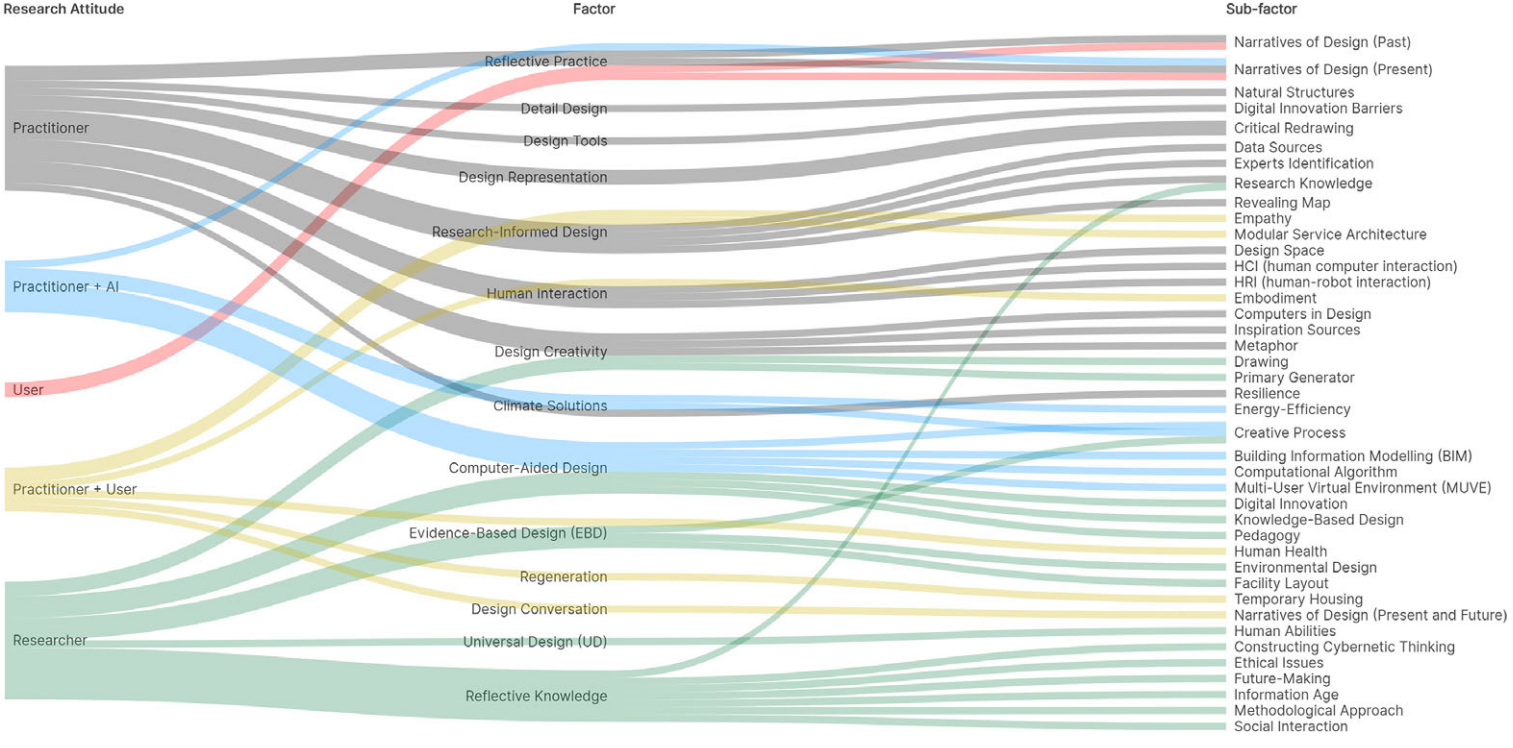

Figure 11. The relationship between sub-factors and factors in studies based on the types of attitudes guiding the research flow.

sub-factors like constructing cybernetic thinking, ethical issues, future-making, methodological approach and other related sub-factors.

The design creativity factor was also identified as a central concern. It presents an ongoing challenge within the practitioner attitude and has significant implications for the researcher attitude as well. Its sub-factors include the use of computers in design, sources of inspiration, metaphor, drawing and the primary generator.

In some coded factors, the overlap between practitioner and practitioner + user attitudes is evident. Research-informed design and human interaction are two examples, both of which have a variety of sub-factors. Besides the above-mentioned reflective practice, climate solutions become another overlapping factor between the practitioner and practitioner + AI attitudes.

The computer-aided design factor was found to enable knowledge production in both the practitioner + AI and researcher attitudes with numerous sub-factors such as building information modeling (BIM), computational algorithm, creative process, digital innovation, knowledge-based design and pedagogy. Similarly, evidence-based design allows for knowledge production in both the practitioner + user and researcher attitudes.

Some factors appear to be more directly associated with specific attitudes. Design tools, detail design and design representation are, for instance, important problems in practitioner knowledge production. Likewise, design conversation and regeneration are especially concerns of the practitioner + user attitude. Finally, the issue of universal design (UD) primarily emerges from the researcher's attitude in the context of knowledge production processes such as those examined here.

5.3. Interaction of time approach and research attitude

This section addresses a current research gap by exploring the interaction between time-based phases and research attitudes. As evident from the analysis of Figure 12, the practitioner attitude is infused in knowledge production across all the phases, from pre-design to post-design, with its most significant contribution occurring during the design phase. Conversely, the researcher's attitude in the studies examined is primarily situated in the post-design phase, where theoretical reflections are more dominant. It needs to be clarified that this focus on the post-design phase should not be taken to imply a complete absence of researcher action at other stages. In this particular conceptualization, the researcher is depicted as an independent agent, who might be external to the design process and even a non-designer, and who conducts design research primarily using theoretical inquiry. In contrast, other attitudes, e.g., practitioner, practitioner + user or practitioner + AI,

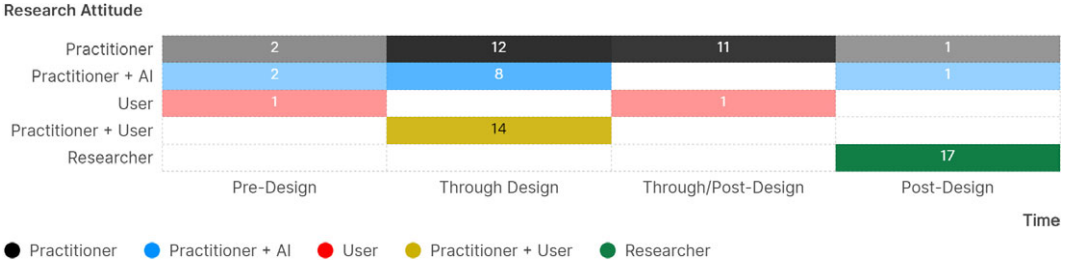

Figure 12. Interaction of time approach and research attitude in the included studies.

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integrate research activities as part of the designer's job. In those attitudes, the designer is an internal researcher during the design process, with ongoing data collection and analysis.

Interactions between practitioner and user attitudes are most visible in the design stage. However, user involvement in knowledge production also occurs independently in both pre-design and post-design stages. Furthermore, practitioners' increasing use of AI is most apparent at the design stage. Expansion of AI usage in the pre-design phase and the immediate post-design phase, particularly in the retrospective analysis setting, was anticipated. Notably, absent from the selected studies was the synergistic coupling of the researcher and AI attitudes, which was suggested as a potential new attitude in the near future with potential influence on knowledge production at various stages of the design process.

Altogether, this integrated perspective – linking time and attitude – offers a more comprehensive understanding of how, when and by whom knowledge is produced within design research.

6. Conclusion

This study examined how the point of research integration in design and the research attitude influence the orientation of architectural design research. By systematically reviewing 70 studies, it identified two often-overlooked dimensions – the point of research integration in design (before, during or after design) and the research attitude (researcher, practitioner, user, AI-assisted or hybrid) – as critical to understanding how design knowledge is generated, framed and applied.

The proposed conceptual framework, based on the intersection of these two dimensions, was found to provide a clearer mapping of the research landscape. Main clusters of design research practices were identified, each shaped by different combinations of methodological orientation. Borrowing from existing studies, this research generated a further typology, known as research through design (II) (characterized by its retrospective nature and primarily grounded on practitioner attitude), expanding upon the three historical classifications. These clusters were observed to explain the diversity of approaches in architectural research and suggest that existing classifications, while valuable, are incomplete without accounting for when and by whom the research is conducted.

Crucially, this framework was found to provide educators and researchers with a useful tool to place their work within the broader field. It promotes increased reflexivity in technique selection, alignment with research objectives and understanding of the presumptions underlying various attitudes and investigative moments.

While this research was concerned with broad patterns, it also paves the way for more focused investigations. Subsequent studies might explore whether there are dynamic relationships between individual sub-factors of each attitude, or how emerging conditions – like AI-influenced design or participatory paradigms – continue to redefine the field of design research.

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