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A Systematic Review of Design Research Approaches in Architectural Design Processes

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ABSTRACT: This paper reviews 70 scholarly studies to explore and organize key methodologies in architectural design research through a systematic lens. It is grounded on three widely used frameworks: Frayling's research into, through, and for design; Cross's typology of design knowledge as epistemological, praxeological, and phenomenological; and Buchanan's basic, applied, and clinical research model. The study employed a structured review procedure, following PRISMA guidelines, to evaluate articles from 1982 to 2023 in major scholarly databases. A shared set of strategies and methods was also developed for each type of design research. The proposed conceptual framework—derived from the timing of the research intervention (pre-, through-, or post-design)—provided a more distinct charting of the research landscape. It revealed prevalent clusters of design research practice, each shaped by unique pairs of epistemological emphasis and methodological stance. Based on past studies, this research developed a further typology known as research through design (II), an expansion of the three earlier categories. By offering a distinct and understandable classification, the article aims to assist architecture students, instructors, and novice researchers in selecting the most suitable research approaches. The conclusions enhance the clarity of architectural education and help position design research as a central component of both academic study and professional practice.

Keywords: *Design Research, Architectural Education, Research about Design, Research through Design, Research for Design, Systematic Review.*

INTRODUCTION

Design research has gained increased importance in the international research environment, emerging as an independent method of inquiry situated between the scientific and creative realms. Research practice, design process, and design problems have led to the development of various research approaches, connecting knowledge production to design and architecture. Design ideas and knowledge production intersect through numerous productive encounters and analogies. Academic research and design research exist as separate entities, yet each maintains its unique set of epistemic, aesthetic, and social considerations. (Hensel & Nilsson, 2019).

Design research is not only a theoretical construct; it is also a form of knowledge creation rooted in the practice of designing itself (Cross, 1999; Findeli, 1999). Despite its relatively short history, the foundation for thinking about contemporary design issues has been developed and promoted by many committed academics and practitioners, not all of whom offer the same taxonomy (Frankel & Racine, 2010). In the conference "Design: Science: Method" held by the Design Research Society in 1980, Archer defined it first, and then in 1981, with the publication of a book titled "Systematic Methods for Designers," he considered design research as systematic inquiry performed to generate knowledge of the form/embodiment of – or in – design, composition, structure, purpose, value, and meaning of human-made things and systems (Archer, 1981). Archer's definition is as follows: "Design research is a systematic search for and acquisition of knowledge related to design and design activity" (Bonsiepe, 2007). This interpretation positions design research as a field dedicated to generating and articulating design knowledge through various expressive and presentational methods.

Bruce Archer examined his peers' study titles to propose ten design research and knowledge areas, which he then condensed into three primary categories (Archer, 1981): The practice (including praxeology,

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modeling, technology, and metrics), The understanding (covering taxonomy, history, axiology, philosophy, and epistemology), and teaching. Nigel Cross states that design research focuses primarily on exploring the various locations and manifestations of "design knowledge." This knowledge, according to him, is derived from three key sources: People, Processes, and Products (Cross, 2006, 2007). Similarly, Dorst argues that design research should prioritize several interconnected areas. These include: 1. The content of design, particularly the characteristics of design problems and their corresponding solutions; 2. The role and perspective of the individual designer or design team; 3. The organizational or broader social context in which design activities occur; and 4. The design process itself (Dorst, 2008). Also, the preface to a recent publication titled "Design as Research" has discussed the considerable shift in the mutual interaction between design practice and the production of knowledge in design research that has taken place over the last few years (Joost et al., 2016).

As a starting point, different types of design research are presented, which will provide a basis for a comprehensive review of the selected studies. In the following, the theoretical framework is formed based on the fundamental theories of Frayling [A], Buchanan [B], and Cross [C], and this framework is then used to analyze the structure of the selected research. One of the most significant gaps identified in the literature is the limited attention given to a key factor: the timing of research interventions in the design process, whether they occur before, during, or after the design activities. Finally, in the data analysis section, in addition to covering general types, in line with the view of Frankel and Racine (2010), it has tried to establish correspondences between categories. This present research will be the first to open a fourth category, which extends Frayling's triad, with different kinds of conceptual details than previous research findings, for example, Clemente et al. (2017) (whereby its structure also uses insights from the studies of Cross and Schön). The research outcome analysis is multidimensional, examining both the interaction of the methodologies used and the point of entry for research into the design.

Conceptual Framework

The present study poses the following research question: How does the timing of research intervention in design influence the implementation of design research approaches in architecture? The following text attempts to first answer three of the most common types of these studies (Figure 1).

[A]: Frayling, drawing on Herbert Read's ideas, was among the first to propose practical classifications for research applicable to art and design discipline (Frayling, 1993):" 1. Research on (into) art and design, 2. Research through (through) art and design, 3. Research for (for) art and design." Subsequent scholars expanded upon this typology, offering both aligned and divergent perspectives on design research methodologies.

[B]: Richard Buchanan, from the perspective of problem typology, proposes a third category of research—clinical research—positioning it alongside the more established forms of basic and applied research (Buchanan, 2001). His triadic model offers a richer and more practice-oriented lens, providing a closer alignment with the realities of professional work than the traditional binary distinction between basic and applied research (Buchanan, 2001). While the binary model may serve the natural sciences adequately, it often proves insufficient when applied to the complexities of the technical and social sciences or the professions they support (Friedman, 2003). Clinical research, in particular, is characterized by direct professional involvement, responding to the uncertain and dynamic conditions of real-world practice. In this light, much of what constitutes design activity can be understood as a form of clinical research (Friedman, 2003).

[C]: Also, Cross classifies design research grounded in the sources of design knowledge, framed through the triadic lens of people, processes: 1. Design epistemology, concerned with understanding the unique cognitive approaches and ways of knowing inherent to design; 2. Design praxeology, which focuses on the study of design practices and the operational aspects of the design process; and 3. Design phenomenology addresses the analysis of the physical form and structural characteristics of design artifacts (Cross, 2006, 2007). Findeli and his colleagues propose three areas similar to Frayling's classification, but their definition of "research through design" is more methodologically grounded, focusing on the critique of common methods in this field, which they counter with research for design and research about design (Findeli et al., 2008). They categorize their argument as follows (Findeli et al., 2008): research for design, research about design, and research through design. Whereas Frayling's classification of design research is rooted in discourse, Forlizzi and her colleagues propose an alternative framework derived from twelve semi-structured interviews with recognized design researchers, as perceived by their peers in the field. Their model identifies three distinct forms of design research: research on or about design, research through design, and research for design (Forlizzi et al., 2009).

Although the structures in the green rows of Figure 1 are prominent and widely used, they have rarely been synthesized or critically compared. Each provided particular insight into how knowledge in design is structured or generated, but it was not synthesized when applied to architectural settings. In education within architecture—they are abstract and partly disconnected from the realities of practice in design. They seldom clarify when research takes place during the design process. These differences have significant impacts on how knowledge is generated and applied in design. In Dorst's perspective, the design research revolution rests upon the foundations of earlier understandings of professional practice. Contemporary demands necessitate a more critical analysis of existing approaches, along with the formulation of newer methodologies and the generation of inquiry methods to address outstanding issues (Muratovski et al., 2022). In addition to the cases mentioned, there are also studies that, while sharing similarities and differences with the aforementioned cases, attempt to suggest alternative cases and viewpoints to clarify the types of design research.

[A+B]: One of the main studies about types of design research is Frankel and Racine's research relating Frayling's terms - research about, through, and for design (Archer, 1995; Frayling, 1993; Friedman, 2008) - and the terms of contemporary funding bodies - basic, applied,

and clinical (Archer, 1995; Cross, 2007; Downton, 2003; Findeli, 1999; Frayling, 1993; Friedman, 2003) - through the practice of design, seeks to establish a sense of continuity while clarifying the differing perspectives within the field. In this way, they established correspondences between these three categories and arrived at three parts: 1. Basic: research about design, 2. Applied: research through design, and 3. Clinical: research for design (Frankel & Racine, 2010). Recent efforts in this field are also evident, as shown in Figure 1 (Lee & Lee, 2019).

[A+C]: Having focused more on design research theory, Clemente and colleagues (Clemente et al., 2017) contributed to the conceptualization of doctoral research by taking boundaries between design research and design practice. They integrate the contributions of authors such as Frayling (1993), Cross (2007), Friedman (2008), and Findeli et al. (2008). The original classification of design research comprised three categories. However, following an empirical investigation, a fourth category was identified, leading to the development of an expanded four-tier model. This revised framework includes research about design, through design, from design, and for design.

[Architectural C]: Design research became holistic, crossing domains and investigating the design process—not just prioritizing but also emphasizing inclusivity. If its applicability is broad, architecture is one of the best cases to show its utility. In an attempt to explain the scope of architectural research, Till, drawing on Lawson, proposes a three-stage model of interaction between architecture and research: (1) Architectural processes, and (2) Architectural products, 3. Architectural performance. This kind of model transcends both the science/art and quantitative/qualitative divides, as it enables thematic and interdisciplinary research across the three stages and allows contributions from diverse kinds of expertise—scientists, historians, and practitioners—to contribute to the research (Till, 2008).

Architecture has experienced notable changes in recent years. In the preface to the second edition of "Architectural Research Methods," Linda Groat and David Wang reflect on how architectural research—both within universities and professional settings—has undergone a gradual transformation since the book's first edition was published

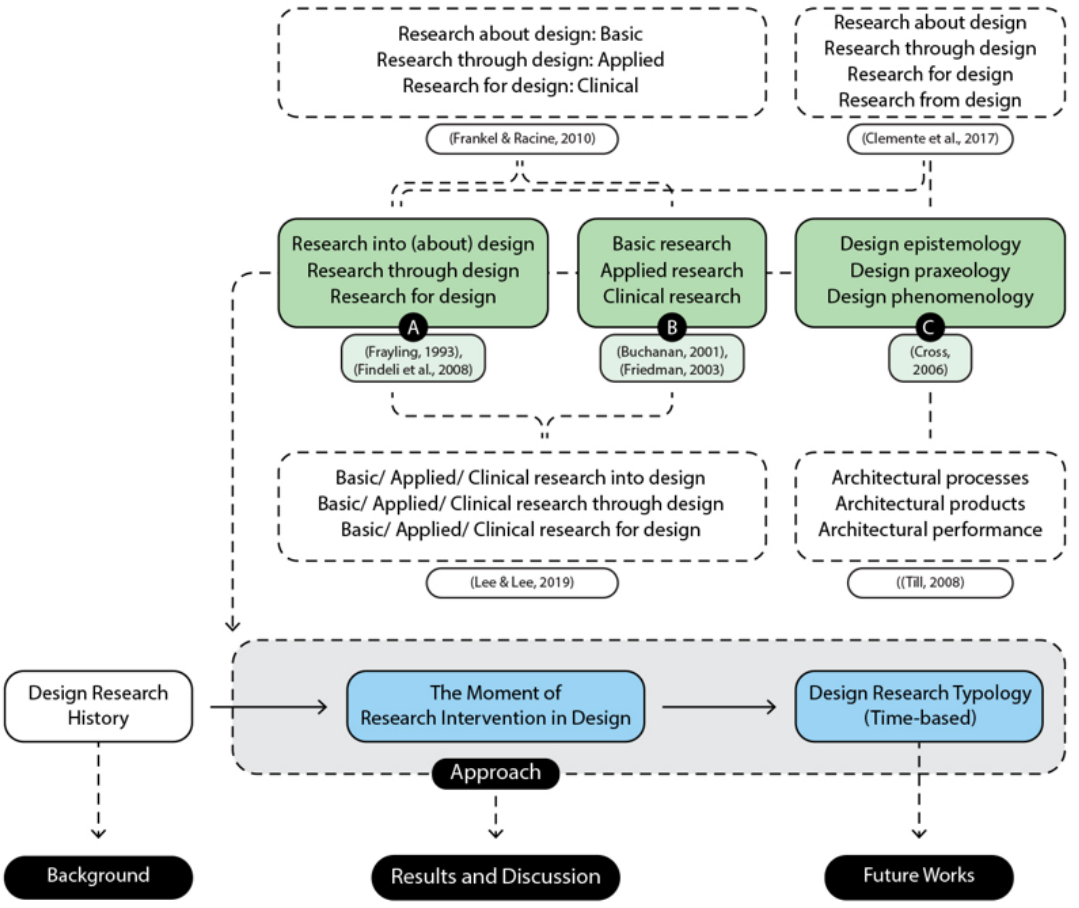


Fig. 1: Conceptual Framework

in 2002 (Groat & Wang, 2013). Approaching the third decade of this century, many scholars continue to explore architectural design, yet the exact connection between architectural research and the broader field of design research remains somewhat unclear. While architectural design is undoubtedly central to the discipline, and research in this area can be seen as part of design research, the relationship between these two fields is often fluid and context-dependent (Luck, 2019). Cross has highlighted the challenge facing design research today: developing a way of discussing design that balances interdisciplinary dialogue with a disciplined, rigorous approach (Cross, 2019).

The current research introduces a conceptual model whose priority factors are positioned above current typologies: when research is embedded throughout the design process? The model provides a time-based matrix that assists in locating studies within the broader context of architectural design research, but it is not intended to replace current models. In doing so, it seeks to offer increased conceptual accuracy, as well as useful direction in navigating the task of conducting research in design fields.

MATERIALS AND METHOD

The PRISMA approach was used as the transparent protocol for this systematic review (Moher et al., 2009). Research for this study draws on existing literature related to various areas of design research that fall under the category of the design process, specifically within the topic of architecture or closely related areas. The study, therefore, addresses the core question: How does the moment of research intervention in design influence the implementation of design research approaches in the architecture discipline?

The Primary data for this study were extracted and updated between April 15 and September 15, 2023. A systematic search was conducted across six databases—Scopus, Web of Science, Google Scholar, ScienceDirect, Taylor & Francis, and Sage. The initial search, before screening, yielded studies published between 1982 and 2023. Upon using screening processes, the final selection of 70 studies spanned the years 1993 to 2023. In line with the research questions and the thematic structure developed, the primary keywords to search the literature were "design process" and "design research." To guarantee the relevance and rigor of the studies included, clear inclusion criteria were established from the outset. These criteria stipulate that studies to be included must be full-text accessible in the English language and sourced from peer-reviewed scientific journals or books/book chapters, identified as research or review articles. The initial search yielded 1021 sources, whose distribution across the databases is presented in Table 1 (It is worth noting that the Google Scholar database was narrowed down to fit within the limitations placed on the other databases from the initial search outcome, reducing the number of relevant sources to 107).

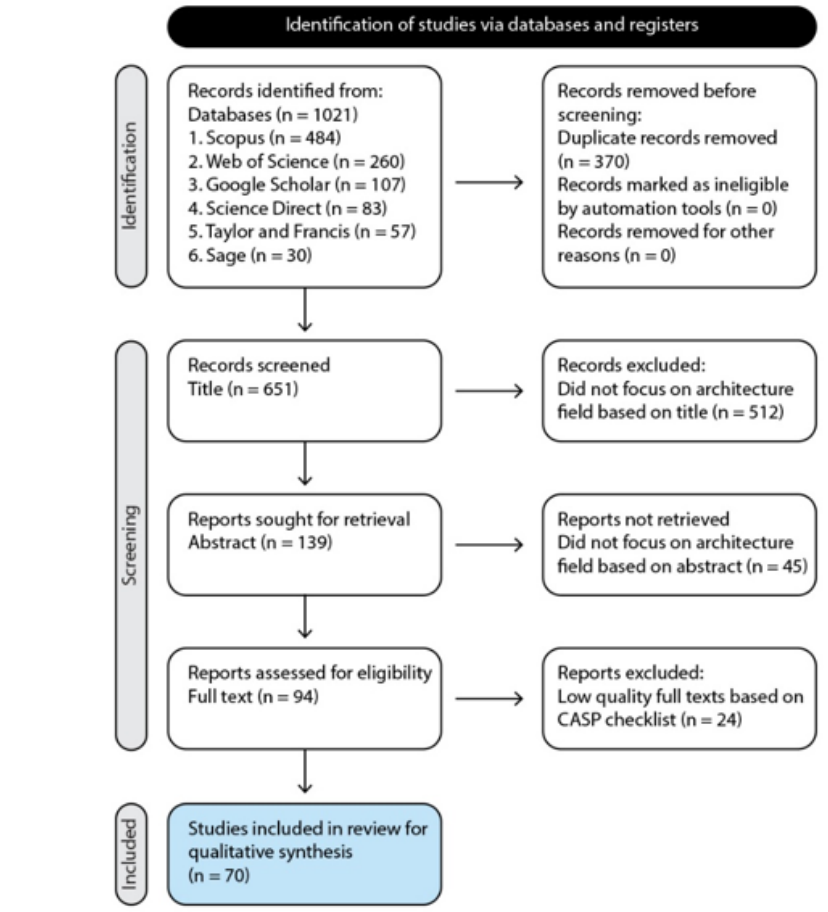
Furthermore, Figure 2 outlines the inclusion and exclusion criteria applied during the study selection process. Following prior methodological consideration, the present paper adhered to the updated PRISMA 2020 guidelines for screening and retrieving relevant studies (Page et al., 2021). Figure 2 provides an overall overview of the screening stages, which involved title, abstract, and full-text screening of the identified studies.

All 94 full-text studies underwent critical appraisal by individual reviewers using the CASP framework (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 (DeSa et al., 2022). After conflict resolution concerning the quality of the studies (either by discussion or consultation with a third reviewer, M.Z.), only the studies of high (n=24) or moderate (n=46) quality (7.5-10 scores) were utilized to explore how design research intersects with the architectural design process, and theoretical synthesis of the studies proceeded on them.

The evaluators' scoring results were used to determine the eligibility of the studies, guided by inter-rater agreement rates and Cohen's kappa coefficients (Warrens, 2011). To define individual study

Table 1: Search strategies in each of the databases

Databases	Search Strategy
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”)
2. Web of Science	TOPIC: (“Design Process” AND “Design Research”) Refined by: LANGUAGES: (ENGLISH) AND DOCUMENT TYPES: (Article OR Review Article OR Book Chapters)
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)
4. Science Direct	Title, abstract, keywords: “Design Process” AND “Design Research” AND Article Type (Research Articles OR Review Articles OR Book Chapters)
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)
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)



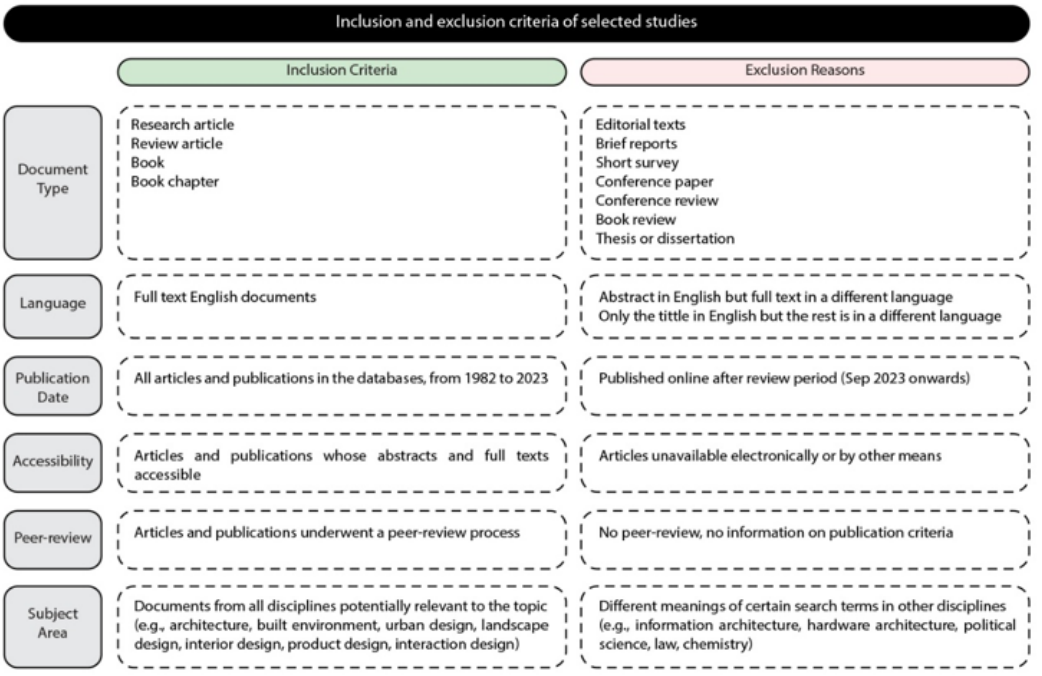


Fig. 2: PRISMA 2020 flow diagram of screening, study selection, and inclusion criteria

Table 2: 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**			

quality throughout this investigation, evaluator scores titled P.A. and N.S. were combined to form low, medium, or high ratings. An inter-rater agreement measure was calculated through percent agreement calculations and Cohen's Kappa. Kappa values were interpreted using established benchmarks, ranging from slight to almost perfect agreement (Conger, 2016; Landis & Koch, 1977). As indeed indicated in Table 2. This study reported an interrater agreement of 89.36%, accompanied by a kappa coefficient of 0.835, reflecting near-perfect consensus.

RESULTS AND DISCUSSION

Following the final stage of screening, seventy studies were included in the synthesis of research, as discussed in the earlier section. Following a full-text screening and author labeling, the systematic organization of findings by various perspectives was deemed necessary, as presented in Figure 1. A time-based approach seems to have the potential to provide sufficient analytical power to advance these results and discussion. Thus, the data in the ensuing sections are analyzed through a framework that is derived from the timing of the research intervention.

Frayling's classification has had a lasting impact on the field (Frayling, 1993), offering a framework that many subsequent researchers have drawn upon and adapted in their typologies of design research (Forlizzi et al., 2009; Frankel & Racine, 2010; Friedman, 2008). This framework categorizes three distinct types of design research: research into, about, or on, research through, and research for design. Using this typology, the selected studies were designated after a complete full-text screening, allowing for more detailed analysis. Analysis revealed that some studies within the sample appeared to align with design research, yet deviated from the theoretical literature. This pointed to the indication of a potential gap in research. Studies fitting these frameworks as set by Frayling and other researchers were organized under one of the three predetermined research groups. A fourth category (purple row), Research X Design, was created to address the outlined discrepancies. The following chart shows the timeline of the studies within these four categories (Fig. 3).

After categorizing the 70 selected studies into design research types (as shown in Fig. 3), reading and marking were performed based on different subjects. Analysis like determining the frequency of design disciplines (single discipline or multi-discipline) shows that in every one of the four design research types, most of the studies are concerned with the discipline of architecture (Fig. 4). It can also be seen that in architecture, the number of research through design is much higher in comparison to the others.

According to geographical distribution and the conducting year of each study (regardless of the academic affiliation of the authors), a significant portion of the research, particularly research through design, has been conducted in the United States, the United Kingdom, and the Netherlands (Fig. 5). What is currently called research X design also has a significant distribution across countries.

Furthermore, according to "Research Methods in Architecture" (Groat & Wang, 2013), "Research Methods for The Architectural Profession" (Akšamija, 2021), and "Research for Designers: A Guide to Methods and Practice" (Muratovski et al., 2022) the specific research approach or strategies adopted in every study were found. The evidence

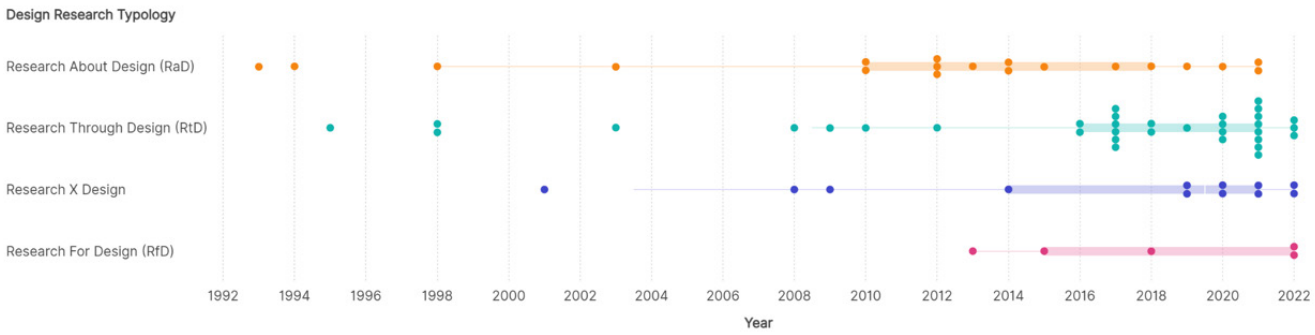


Fig. 3: Labeling of studies based on types of design research by year

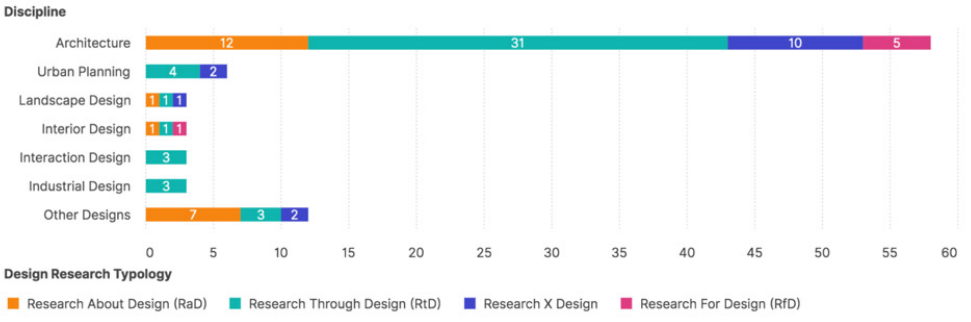


Fig. 4: Labeling of studies based on academic disciplines by different types of design research

Fig. 5: Research conducted in countries by year and type of design research

illustrates that the interpretive-historical research strategy is employed most widely in research about design. On the other hand, research through design incorporates a combination of qualitative research approaches, including case studies, protocol analysis, ethnography, and simulation research. The other two forms of design research, as labeled, represent more recent developments and have been growing since the 2010s. In the following, the duration of the research was analyzed and categorized (Fig. 6). From these studies, research through design can be conducted as linkography or protocol analysis, within less than half a day (12 hours). Although more qualitative approaches in research through design can last for years. Ethnography in this field is the longest approach. Research X design also seems to trend similarly in time, as it has ranged from a few hours to a year.

Furthermore, it was identified to which group of people each study was conducted and how many individuals of each group were included. For instance, most of the studies conducted on other designers, students, and users are relevant to research through design. The same order also occurs in the case of architectural designers, and the second rank is relevant to what is currently called research X design (Fig. 7).

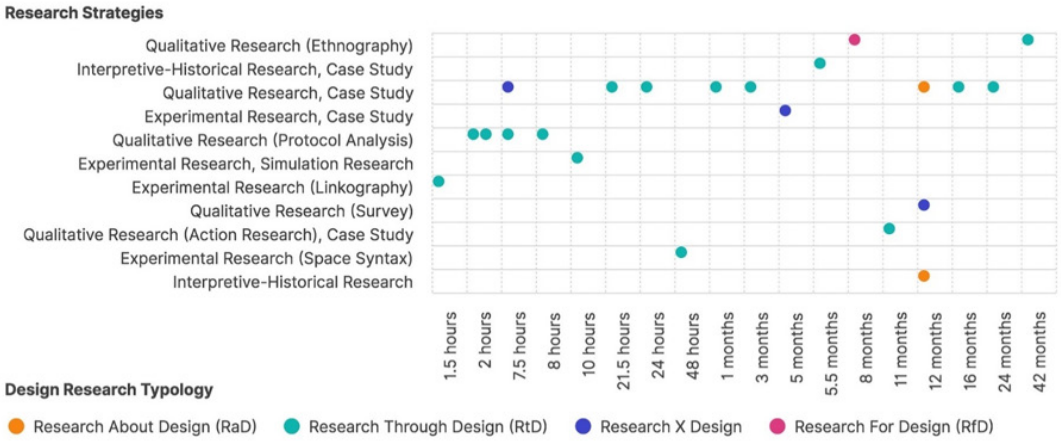


Fig. 6: The duration of conducting research by different types of design research

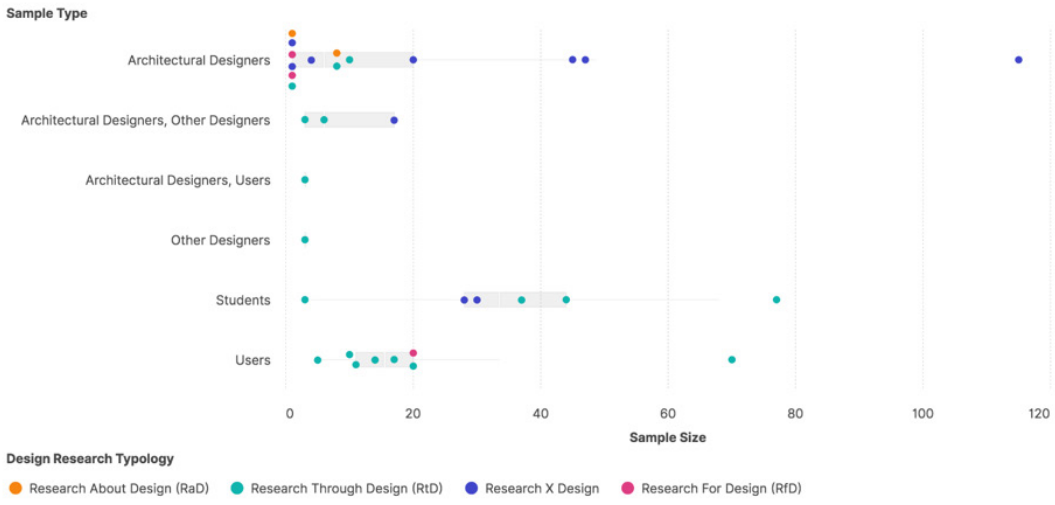


Fig. 7: The frequency of the number of people involved in conducting studies by the types of people and types of design research

CONCLUSION

Through a literature review of design research typologies, at least three types and general perspectives have been identified, which have largely been taken into account, as well as the field's developmental background (see Figure 1).

The first and perhaps the most important of them is based on the three-category model of a group of researchers (mostly Frayling) who, from a research typology perspective, are divided into (1) research about design, (2) research through design and (3) research for design. Another group that mentioned the classification of design research is researchers (especially Buchanan) who, based on the type of problem addressed, named three types: (1) Basic research, (2) Applied research, and (3) Clinical research. At the same time, another group of researchers (above all Cross) have categorized design knowledge into: (1) design epistemology, (2) design praxeology, and (3) design phenomenology. This study uses both design research classifications in A and B rows of Figure 1 and thus values them (as Frankel and Racine have done in their work) by putting the first and second typologies together and then aligning them with the existing structure represented by the framework put forward by Nigel Cross; this provides a more holistic and heuristic understanding of the design research landscape. In this way, based on the review of his research, it seems that the field of people (design epistemology) is more related to research about design and basic research, the field of process (design praxeology) is more related to research through design and applied research, and the field of products (design phenomenology) is more related to research

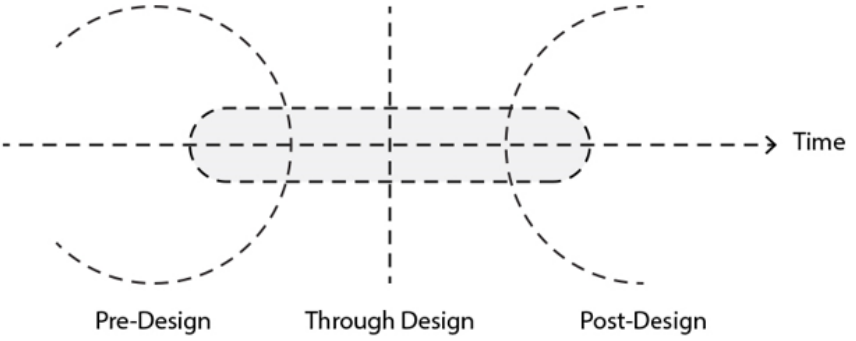


Fig. 8: Conceptual diagram of the moment types of the research intervention in design

for design and clinical research relevance. It should also be noted that this correspondence does not imply that the triplet states within the three typologies necessarily co-occur in all cases; rather, it reflects the dominant characteristics of the selected studies. Therefore, after careful reading and holding several meetings, each study was labeled based on three general typologies (each of which has three internal states), and subsequently, studies were found including the following triples (Green rows of Figure 1):

Research about design - basic research - design epistemology
Research through design - applied research - design praxeology
Research for design - clinical research - design phenomenology

The triple-part logic proposed is restrictive, and many studies have deviated from this format. So, in the spirit of avoiding the same weakness, which would render the research into vagueness over the subject under study, an axis of time with three distinct design stages – pre-design or before, during the design stage, and after or post-design – has been put forward in such a manner as to make for a more enriching understanding of the design research (Fig. 8).

Regarding the viewing and observation of the research intervention in design or a time-based approach, Donald Schön's studies in reflective practice are also worth noting. He uses the term "designing" in two senses: (1) specifically, for example, when observing the teaching and learning of design practice in architecture, and (2) more broadly, to describe the reflective conversation that is at the core of all forms of practice. According to Schön, there are two ways for reflective practice to occur: reflection-in-action and reflection-on-action (Schön, 1983). The first happens when the designer is designing and unconsciously learns through experience. Reflection is first applied implicitly as part of the ongoing design process. An important capacity of reflection in action is that it frees the practitioner from working in a fixed procedural way and instead allows him to reflect on and respond to the specific circumstances and capacities of each situation. The second occurs when the designer steps back to reflect on what was designed and self-consciously learns from the experience. The second level is the retrospective reflection, which focuses on the design experience with a case study. This can be described as a more explicit conscious act that requires practitioners to take the time to examine how and why they acted the way they did (in the past). For designers who want to identify their strengths and weaknesses, this level of reflection allows them to develop an informed understanding of their ideas, expertise, and, ultimately, their practice. Of course, the third layer of reflection is also mentioned, which is a version of Schön's studies in a reflective dialogue with the conditions present in a given design situation. This

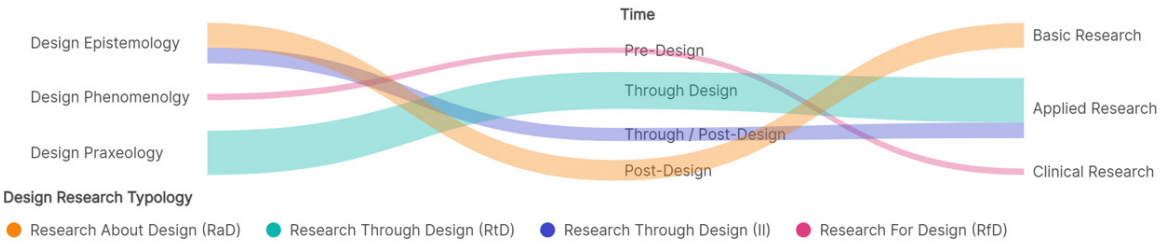


Fig. 9: Conceptual diagram of the time-based design research approaches in the discipline of architecture regarding the historical typologies

layer is primarily guided by research framing and revealed through repetition and retrospective reflection on research components (Schön, 1992).

1. Studies of the first-row group - design as a subject: Reviewing these studies, most were conducted after implementing a specific design or in an environment without a specific design. Due to their basic nature and epistemology, they often focus on explaining and critiquing previous events or during design; hence, they are generally theoretical and scientific. It can be said that in such design research, design itself will be the subject of research.

2. Studies of the second-row group - Design as a tool: The studies reviewed in this group are mostly research conducted during the design process and have an applied praxeological approach. In this group of studies, the design approach is used as a tool or method for knowledge creation (in other words, design is viewed as a tool). For this reason, research and design often occur simultaneously during the design process. In this regard, it is necessary to pay attention to a part of Donald Schön's studies regarding reflective practice. It appears that the first level of Schön's (reflection-in-action) framework has affinities with research through design.

3. Studies of the third-row group - design as an object: This group of studies represents research carried out with design as the primary objective; that is, design is the object of study. It appears that most of these studies, conducted in the environment of design studios and offices, are never published as research articles in scientific journals because they are not required to meet scientific standards. The number available for this study revealed their clinical and phenomenological nature. That is to say, it is a set of studies usually—though not necessarily—antecedent to design; their aim, however, is to look after design—that is, to the product and phenomenon of design.

4. However, cases were identified among the 70 selected studies that did not match the logic of the triple structure. They are studies that, while having the nature of research through design and an applied scale, are neither related to design praxeology nor required to record moments during the action; therefore, they were not included in the second group. The studies in this group, after the completion of the design, with a retrospective view, aim to reveal what happened during the design process, particularly concerning the designer or the design team, and apply their findings in a scientific and research-oriented manner. That's why it seems to focus more on design epistemology than on design praxeology. It seems that the second level of Schön's reflective practice (reflection on action), which has a retrospective view on design, has something in common with this group of studies mentioned in the fourth row. In this way, the brainstorming sessions between the authors and the correspondence of concepts led to the fourth classification, which adapted all the selected studies based on this logic. Therefore, the final typologies for labeling the selected studies were done in the following order (Fig. 9):

Research About Design (RaD) - basic research - design epistemology
Research Through Design (RtD) - applied research - design praxeology
Research for Design (RfD) - clinical research - design phenomenology
Research Through Design (II) - applied research - design epistemology

The categorization of design research approaches is not merely theoretically helpful but also practically notable in research planning and architectural education. Establishing the various types of research, their purposes, methodologies, and outputs helps students, instructors, and beginning researchers make more informed judgments when designing their projects. For instance, students undertaking theoretical theses or historical studies would find research on design models most appropriate, while those involved in experimental studio work would be more inclined towards research through design. Projects seeking design guidelines or technological innovations can be assisted with research for design orientation. Additionally, the differentiation of epistemological, praxeological, and phenomenological types of knowledge may be beneficial for teachers in design research courses that address different types of knowing in design. This diversity is particularly effective in interdisciplinary learning contexts where design is addressed both theoretically and practically. Teachers can use these models not only to map the landscape of design research but also to guide students in selecting appropriate methods and developing clear research questions.

The results of this review also point to an important conflict between the mindsets that research represents and the typologies used to categorize them. While some studies readily fit into typological frameworks such as Frayling's, others are difficult to categorize and instead exhibit methodological tendencies or epistemological presumptions that transcend these boundaries. Because it provides a more profound insight into how researchers approach the generation of design knowledge, whether it be reflective, action-based, or theoretically oriented, this discovery highlights the need to include mindset analysis into design research typologies. New avenues for arranging hybrid studies that span several research objectives and knowledge domains are also made possible by this integration.

For example, research into the user experience of built environments may employ phenomenological methods, while research into the cognitive processes of a designer may require an epistemological approach. By outlining these differences categorically, teachers can remove confusion and improve the overall coherence of the study. From the perspective of curriculum development, integrating these frameworks into architectural education can facilitate a more systematic understanding of design research. It helps students understand research as a regular part of the design process rather than an abstract intellectual endeavor. Moreover, it provides them with the tools to structure and legitimize their methodological choices, an essential requirement for academic assessment and publication. Finally, these frameworks provide a shared vocabulary for evaluating and exchanging design research across scholarly and practitioner communities. By discussing articulated forms of design research, it is easier to compare methods, reproduce studies, and contribute meaningfully to scholarly debates.

AUTHOR CONTRIBUTIONS

A. Alaie was responsible for the literature review, conceptualization, investigation, analysis, and interpretation of data, as well as visualization, manuscript text preparation, and manuscript editing. N. Ziashahabi also contributed to the literature review, conceptualization

and investigation, data analysis and interpretation, visualization, manuscript text preparation, and manuscript editing. A. Ekhlassi, M. Faizi, and S.A. Yazdanfar contributed to the conceptualization, theoretical framework, research methodology, manuscript structure, supervision, project administration, and overall supervision of the research process.

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CONFLICT OF INTERESt

The authors declare that there are no conflicts of interest associated with the publication of this paper. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy, have all been carefully observed and addressed by the authors.

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