

The discipline unfolding: A thematic lens on disciplinary evolution of architectural design

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Abstract

Architectural design is pivotal in architecture, yet its identity remains debated—whether it aligns with art, science, or represents a novel knowledge domain lacks consensus. This paper examines the evolution of architectural design as a discipline from Vitruvius to the present, focusing on three main trajectories: Architecture Culture, Design Thinking, and Knowledge Production by Architecture. Using thematic content analysis and NVivo software, the authors analyzed 157 relevant texts to uncover key themes within each trajectory. The study found that Architecture Culture (from Vitruvius to present) was characterized as subjective, while Design Thinking (1960s-present) and Knowledge Production by Architecture (1990s-present) were portrayed as overly objective. The findings highlight the need to reconceptualize architectural design as a subjective, speculative, and intellectual field of knowledge to guide the discipline's future development.

Keywords

Architectural design, Disciplinary evolution, Architectural theory, NVivo, Thematic content analysis.

1. Introduction

Architectural design is central to the broad field of architecture. However, the nature of the discipline has had a vague condition in the sense that there has not been a consensus on whether it is an art-like, science-like, or a totally new type of knowledge area. Nonetheless, architectural design has always been an active and important part of architecture. Emphasizing the importance of architectural design dates back to the Renaissance, when Leon Batista Alberti separated building (matter) from design (lineament) (Alberti, 1988): In Alberti's terms, matter is the material or objective aspect of architecture, while lineament is the architect's design idea (subject). While architectural design is readable through other disciplines (such as psychology, economics, politics, science, etc.), only few studies focused on the internal realms of architectural design, and tried to discover its nature through inventing, developing and analysis of architectural design ideas. In academia, it has generally been investigated through scientifically exploring design ideas' epistemological and methodological aspects. However, in practice, architectural design has normally been progressed by individual architects, who tried to form a macroscopic, holistic, and non-systematic theories for their projects. In such a condition, with divergent perspectives, it is necessary to construct an internal and discipline-specific foundation to theorize architectural design.

In line with this broad aim, the primary objective of this study is to identify a thematic structure in the extant resources emerged during the evolution of architectural design throughout history. It should be noted that instead of the boarder context of architecture, the main focus of this research is narrowly on architectural design, where developing the basic connections between academia and practice, and invention of new realms are contingent.

In this study, after an initial overview of the relevant literature, three trajectories of disciplinary evolution were hypothesized, dubbed 'Architecture Culture,' 'Design Thinking,' and

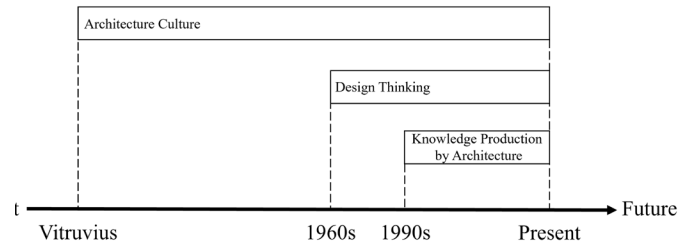


Figure 1. Three trajectories in the disciplinary evolution of architectural design.

'Knowledge Production by Architecture,' and the resources relevant to each trajectory were then selected based on their popularity, reliability, influence, and theoretical foundation. A total of 157 resources underwent analysis through NVivo utilizing word occurrence counting, and after iteratively running the Word Frequency Query (WFQ) in NVivo, the 50 most frequent significant words for each trajectory emerged. These words were then used to construct the intended themes. The themes were constructed by grouping and evaluating the obtained words based on their use in the corpora.

2. The evolutionary trajectories in architectural design

The intricate and ever-changing nature of architecture and specifically architectural design, have always been significant hurdles for a clean description of the discipline. However, referring to the history of architecture, may offer a comprehensive overview of disciplinary evolution, which in turn, facilitates the identification and categorization of pertinent resources for the present study.

The authors have identified three trajectories for the evolution of architectural design over time, based on theoretical evidence from the history of architecture (Figure 1).

2.1. Architecture culture

The first trajectory has been called Architecture Culture, and it relates to the many cultures of practicing architecture throughout history. The expression Architecture Culture is used in the sense that conveyed in Joan Ockman's 'Architecture culture 1943-1968,' (Ockman, 1993). Concerning this trajectory, we examined the general status and implications of architecture

from antiquity to the present using architectural theory resources.

In antiquity, architecture was, somehow, included in a broader kind of knowledge of sciences, crafts, and arts, under the united title of '*Technē*.' (Parcell, 2012; Roochnik, 1996) *Technē*, in fact, refers to a sort of knowledge used by a '*tektōn*' to produce something specific. An '*architektōn*,' made up of *archi-* as chief and *-tektōn* as a builder, was a chief builder or master builder (Parcell, 2012). Parcell (2012) argues that architecture in ancient Greek had been defined as a *technē*, and Tatarkiewicz (Tatarkiewicz, 1970a) attributes a mathematical character to architecture at that time. Vitruvius, who established a systematic theoretical basis for architecture in his seminal treatise, 'Ten Books on Architecture' (Vitruvius, 2005) around 25 B.C., was also impressed by the Greek word *technē* (Parcell, 2012). Moreover, his attitudes did not change architectural practice and theory in antiquity and early Imperial era (Kruft, 1994). Thus, based on the legitimacy of Vitruvius' treatise at the time, it is plausible that architecture remained as *technē* until the Middle Ages.

In the Middle Ages, there were no general treatises on the theory of art and architecture (Tatarkiewicz, 1970b), and Western writings were mainly concerned with specific buildings (Kruft, 1994). Nonetheless, the extraneous resources could generally reflect the character of architecture in the Middle Ages. For example, architecture was included in several early encyclopedias, based on which art historians interpreted the status of Medieval architecture. Among them, 'Didascalicon' (Hugh, 1961), has been the prominent resource that placed architecture in the 'mechanical arts' category. Concerning the influence of Christianity in the Middle Ages, this classification was also impressed by the divinity aspects of humans and their inventions.

In the Early Renaissance, arts gained a degree of autonomy and were freed from their subservient role in the Middle Ages (Kruft, 1994). The advent of 'humanism' in Italy, as the Renaissance's major intellectual movement around the 13th and 14th centuries,

also empowered the realistic approaches and techniques in art. Leon Battista Alberti (1404-1472) was an outstanding humanist influenced by Platonic, Noe-Platonic, Aristotelian, and Ciceronian thoughts who has referred to Vitruvius's stance in architecture, quoting and criticizing him (Grayson, 1957; Kruft, 1994). Nonetheless, being far away from *technē*, Alberti, for the first time, highlighted the distinction between architectural design and building in his famous book 'On the Art of Building in Ten Books' (Alberti, 1988). While Alberti's treatise is an outstanding reference for architectural theory in the Renaissance, it seems insufficient to fully address the state of architecture in Renaissance. Maybe the more comprehensive image of Renaissance architecture is reflected by Giorgio Vasari (1511-1574) in his book 'Lives of the Most Excellent Painters, Sculptors, and Architects' (Vasari, 1996). In this book, Vasari provided artists' biography and simultaneously grouped architecture with sculpture and painting as the physically made arts. In his book, Vasari called these three arts the arts of '*disegno*' (Vasari, 1996). In its original context *disegno* is translated as 'drawing' and 'design' (Baxandall, 2003; Parcell, 2012). Vasari's concept of *disegno*, theoretically, peaked in the sixteenth century (Parcell, 2012) in Europe and shaped the character of architecture in the Renaissance as the setting for painting and sculpture, or in Vasari's words, as the art of *disegno*.

The characteristics of architecture in the eighteenth century and Enlightenment have mainly been influenced by its situation in France. Founding the *Académie Royale d'Architecture* in France in 1671 by Louis XIV (1638-1715) was a 'decisive turn' through which an 'artistic path independent from that of Italy' came to emerge in France (Mallgrave, 2006). Nonetheless, the theoretical texts in France, England, and later, in Italy and Germany, introduced a new term in which architecture was included (Kristeller, 1951). Architecture in the Enlightenment was known as fine art (Kristeller, 1952; Parcell, 2012). Parcell (2012) argues that, at first, architecture was marginal in the fine arts, while painting, sculp-

ture, poetry, and music were the core fields of fine arts. However, the publication of the first volume of the *Encyclopédie* (Diderot et al., 1970) in 1751 formally brought architecture into the fine arts (Kristeller, 1952). Since the late eighteenth, architecture 'became universally recognized as a fine art' (Tatarkiewicz, 1980, p. 162). Also, in the Enlightenment, the Academy attempted to promote the status of the architect from the builder to the liberal professional (Armstrong, 2017). In this respect, Emil Kaufmann by investigating the work of 'three revolutionary architects' (Kaufmann, 1952) underscored the efforts for 'formal autonomy of architecture' in the Enlightenment. Enlightenment's architectural thoughts were an introduction to modern architecture.

Modern architecture was rooted in the late eighteenth century (Curtis, 1982). The Enlightenment philosophers came up with the 'project of modernity' in the 18th century and their goal was 'to develop objective science, universal morality and law, and autonomous art according to their inner logic' (Foster, 1983, p. 9). Modern architecture grew out of the need to balance an idealized view of society with the powers of the Industrial Revolution (Curtis, 1982). Having a radical break with the past, it also provided possibilities for the fundamental principles of architecture to be reconsidered in new ways (Curtis, 1982, p. 6). Later, around the mid-twentieth century, modern theory in architecture, 'including formalism and ideas of functionalism (form follows function), the necessity of the radical break with history, and the honest expression of material and structure' (Nesbitt, 1996, p. 16), placed strong critical views on modern architecture.

Although architecture in modernity was a relatively autonomous field, due to its immaturity, 'architecture, both built and projected, has notoriously been discussed and debated' (Hays, 1998) in the postmodern era. In such a context, architecture pushed to be involved in the imported theoretical paradigms like phenomenology, linguistic theory (semiotics, structuralism, post-structuralism, and deconstruction),

Marxism, and feminism, in Kate Nesbitt's terms (Nesbitt, 1996). The rapid confrontation of architecture with the rich imported paradigms dropped the status of architecture to a vague situation, particularly in academia, and led to the separation of academia and practice. Architecture began to be taught and researched under different departments such as social sciences, humanities, arts, and engineering. However, this is interpreted as a shift from the center to the margin of architecture in the postmodern era (Tschumi, 1992).

The ambiguous situation of architecture in the postmodern time, and the failure of the discipline to improve humanity and society (Sykes, 2010), was an alert for another probable shift in architecture. Besides, in architectural practice and design, the digital culture had already started to make a remarkable shift. Actually, electronic technologies were changing society, economy, culture, and everyday life in the 1990s, and architecture was not an exception (Carpo, 2017). In architecture, the change started with the speculations on 'compositional complexity' (Lynn, 1993, p. 9), and was later followed by a shift in 'the very logic of thinking, doing and making design' (Oxman & Oxman, 2014, p. xxi). With these practice-based shifts, the postmodern theory of architecture was unable to 'occupy its previous role, and thus it too has started to shift [like practice]' (Sykes, 2010, p. 27). This posed a significant challenge to the status of architecture as a discipline. In 1997, Sanford Kwinter, in his talk at the 'Anyhow' conference (held by Anyone corporation) in Rotterdam, warned that '... architecture has begun to vanish as a discipline, and some of us are not mourning...' (Kwinter, 1998). He then declared that '[architecture] is becoming an organon, that is, a system of investigation, invention, and technique' (Kwinter, 1998). Again, this statement was potentially a signal for a new shift in architectural culture, where architecture becomes a 'means to gain knowledge' (Nilsson, 2005) or even a 'form of knowledge' (Tschumi, 2007). This was while a new mode of knowledge production, as 'transdisciplinary,' was already introduced in academia in

1994 to deal with the world's increasing complexity (Gibbons et al., 1994). A prerequisite to that was the disciplinary maturity to be able to fuse with other disciplines (Dunin-Woyseth & Nilsson, 2011). Integrating theory and practice was seen as the primary concern in the disciplinary development of architecture (Doucet & Janssens, 2011; Fraser, 2013; Hensel & Nilsson, 2016).

Less than nine years ago, in his prologue to the special issue of *Log* magazine on 'stocktaking' of architecture in 2013 (no 28), Anthony Vidler referred to Reyner Banham's argument on the condition of architectural design, theory, and practice in 1960 (Banham, 1960). Vidler stated that the same questions 'have emerged in a more or less transformed state' at the present time (Vidler, 2013). The questions manifest the profound problem of the discipline today: the relation of theory (as well as history and criticism) and practice (as well as design) in architecture. The efforts aiming to integrate theory and practice in architecture for producing a new form of knowledge (Collins, 2014; Fraser, 2013; Hensel & Nilsson, 2016, 2019) appear to be the recent endeavors to disciplinary developments of architecture.

2.2. Design Thinking

Design Thinking has been suggested as the second main trajectory that has obviously influenced the disciplinary development of architecture, initially in academia and subsequently in practice. The trajectory began in the 1960s, notably with the Design Methods Movement (Chris Jones & G. Thornley, 1963) in 1962, when design methodology was recognized as a field of systematic inquiry. Advancements in this particular course of study have yielded insights into architectural design ideas and processes and so includes the literature germane to the aims of this investigation.

The noteworthy academic researches on design methodology as a field of inquiry launched in the 'Conference on Design Methods' in 1962 (Chris Jones & G. Thornley, 1963). Although in this conference, the term 'design' was used in a variety of contexts like engineering and product design, architectural

al design was one of the central fields whose in-depth study was launched by this movement. The movement's main goals, such as comprehending and then computerizing the design process, and externalizing it for team participation from the concept generation stage (Alexander, 1971), were very relevant in the case of architectural design.

In the late 60s, the scholars' desire for the scientific foundations of design together with the ongoing developments in scientific theories, such as Kuhn's notion of paradigm shift (Kuhn, 1970), evoked an interest in investigating a logical relationship between design and science. Even on some occasions, efforts were made to convert design from an artistic discipline to a scientific one (e.g., Dixon and Finger, 1989). However, some outstanding researchers were trying to make distinctions between design and science (Alexander, 1964; Gregory, 1966; Simon, 1969). On this topic, Nigel Cross (1993) suggested three substantial approaches as Scientific Design; Design Science; and Science of Design. Cross acknowledges that 'Scientific design refers to modern, industrialized design... utilizing a mix of both intuitive and non-intuitive design methods' (Cross, 1993). According to Cross, design science treats 'design in some sense as a scientific activity itself' (Cross, 1993). Also, 'science of design, refers to that body of work which attempts to improve our understanding of design through scientific (i.e., systematic, reliable) methods of investigation' (Cross, 1993), he concludes. By this implication, Cross' suggested definitions enabled a vast range of researches from the first generation (the 1960s) to the next generation of design studies in various fields to be classified.

In architectural design, the notable example of combining science with design is applying 'cognitive psychology' to design studies. Firstly made by Charles Eastman (1969), the term Design Cognition (also known as design thinking) was used to refer to the investigation of human information processing (i.e., computation) during the architectural design activity. These developments in design studies even offered a new definition of design as a

'form of human cognition' (Goodman, 2013).

According to Rittle and Webber (1973), the 1970s was the decade for the second phase of design studies development. In the case of the architectural design process, the 1970s is of particular importance for such advancements. Omer Akin (1986) identified three categories for architectural design studies during the early 1970s: 'empirical studies'; 'theoretical studies of design'; and 'design education studies'. In the 1980s, a shift from rule-based prescriptive studies of design towards descriptive studies appeared in the field of design. The descriptive studies, indeed, provided the opportunity for developing computational tools in design. Also, in these years, design researchers recalled the cognitive psychology methods to conduct empirical studies and observe the design behavior, particularly in architecture (Rowe, 1987; Schön, 1984). In his book, 'The Reflective Practitioner' (1983), Schön suggested that conscious analysis of the design activity, or in his words, 'reflection-in-action,' in the professions like architecture, will lead to producing 'the knowledge of problems and solutions.' Generally, Schön's studies in the 1980s revealed the value of the profession and its associated practical knowledge in architecture and design.

Since the 1990s, studying, modelling, and analyzing the design activity (Cross et al., 1997; Dorst & Dijkhuis, 1995), especially in the cognition level and ideation phase of design, was the focal point for architectural design researchers (Bilda et al., 2006; Goldschmidt, 1991; Mao et al., 2020; Scrivener et al., 2000; Suwa & Tversky, 1997). This sort of systematic study in the past years has resulted in 'computer-aided architectural design' developments, where artificial intelligence, cognitive psychology, and design are combined. Digital culture and technology brought new approaches to architectural design in the 2000s and the 2010s, such as digital fabrication and parametric design (Camburn & Wood, 2018; Ercan & Elias-Ozkan, 2015; Mathias et al., 2019; Oxman, 2008, 2017). Moreover, the studies on (architectural) design thinking have recently been extended

to the subcategories like design expertise (Atman, 2019; Cross, 2004; Humphreys et al., 2008; Lawson, 2004; Luck, 2012; Smith, 2015), design practice and profession (Hoolohan & Browne, 2020; McDonnell, 2011; Schönheyder & Nordby, 2018; Yang et al., 2005), design research, theory and knowledge production (Cash, 2018; Friedman, 2003; Galle, 2008; Love, 2000; Luck, 2019; Uluoğlu, 2000; Wolmarans, 2016), and the discipline-specific culture in design (Cross, 2019; Luck, 2019).

2.3. Knowledge production by architecture

The last trajectory is dubbed as Knowledge Production by Architecture, and it begins in the 1990s, as depicted in Figure 1. The authors identified this trajectory based on recently emerging trends in both the Architecture Culture and Design Thinking trajectories. The relevant literature in this trajectory put forward the idea of 'architecture as a medium for knowledge production' (Belderbos & Verbeke, 2005; Doucet & Janssens, 2011; Hensel & Nilsson, 2019; Kwinter, 2008; Tschumi, 2007). Additionally, there has been an upward trend in theorizing this subject to develop a fundamental connection between academia and practice, and hence, has gained significant traction within architectural design communities.

Reviewing the state of Architecture Culture and Design Thinking trajectories unveiled the gradual formation of another trajectory in the theoretical development of architectural design: Knowledge Production by Architecture.

'Architecture as a discipline constitutes a field where highly different kinds of knowledge amalgamate' (Dunin-Woyseth & Nilsson, 2011). This characteristic has already linked architecture to other disciplines and led to a dominant interdisciplinary research tradition for producing knowledge in academia. In the report of Formas (Swedish Research Council for Sustainable Development) in 2006, interdisciplinary research has been explained 'as a means to share disciplinary knowledge in order to create new concepts and theories, create a product, or

solve specific problems' (Evaluation of Swedish Architectural Research 1995–2005, Report 7, 2006). However, interdisciplinary research in architecture for its excessive dependence on the scientific paradigms brought about 'too academic researches', making the 'architects incapable of using history as a tool to invent a culture for architecture' (Vittorio Aureli, 2013). Consequently, the in-depth collaboration between architecture and other imported disciplines like social science shifted the area of concentrations from the center to the margins of architecture (Arets & Zaera-Polo, 2003; Belderbos & Verbeke, 2005; Peil, 2005; Radu, 2005; Versteegh, 2005). The critics of this situation (Arets & Zaera-Polo, 2003; Belderbos & Verbeke, 2005; Fraser, 2013; Kwinter, 1998), were persisting on the fact that 'architecture's complex engagement with the world, acting as it does as both profession and discipline, requires it to deal with a broad range of disciplinary and practical forms of knowledge' (Doucet & Janssens, 2011). Their belief was that the imported disciplines undermined or hindered the disciplinary development of architecture. In such wise, the rise of the transdisciplinary mode of knowledge production (Gibbons et al., 1994) preached new hopes for architectural researchers. 'The term transdisciplinarity was coined to give expression to a need to transgress disciplinary boundaries and is interesting in relation to such combinatory and inclusive discipline as architecture' (Hensel, 2012). In this manner, transdisciplinary knowledge production suggested a strategy more congruent with architecture, as it 'entails a fusion of academic and non-academic knowledge, theory and practice, discipline and profession' (Doucet & Janssens, 2011).

Furthermore, since 'transdisciplinarity is nourished by disciplinary research' (Dunin-Woyseth & Nilsson, 2011), it necessitates development and mastery in disciplinary knowledge. These new insights intrigued the studies on architecture-specific knowledge production methodologies (Fraser, 2013). An example of these attempts was to examine the possibility of doctoral research through architectural

design (Belderbos & Verbeke, 2005). Later, publications, such as Harvard Design Magazine (Mostafavi, 2012) and TU Delft's Footprint journal (Hauptmann & Schrijver, 2012; Kaminer & Stanek, 2007), specifically focused on this subject and elaborated on that. Recent studies have drawn on the 'practice-led research' or 'research by design' to examine the knowledge production opportunities through practice and architectural design (Collins, 2014; Hensel & Nilsson, 2016, 2019; Verbeke, 2017). However, this shift in focus may inadvertently downplay the subjective aspects of architecture.

3. Methodology

This study employs thematic content analysis that focuses on identifying themes within textual data. This method was chosen over other methods as the primary aim was to explore and describe the included themes in the architectural design literature, and it allowed for a flexible yet systematic analysis of the data and aligns with the study's objectives.

3.1. Procedure of theme extraction

The procedure of theme extraction involves: a) identifying the trajectories (as already described); b) selecting and collecting the relevant resources within the trajectories; c) importing the resources into an assistant software namely NVivo; d) retrieving the most often occurring words using Word Frequency Query (WFQ) operator of NVivo; e) grouping the acquired words according to their meaning and use in corpora; and f) creating the final themes based on the retrieved word sets.

3.2. Selection of the resources

Once the trajectories of disciplinary evolution were determined, the procedure for data collection started by choosing the relevant resources in each trajectory. This phase of the study is particularly difficult in light of the study's goals and methodology, as the researchers' discretion was required in making the selections in the absence of any legitimated metrics. Hence, a semi-systematic approach was used to mitigate bias.

First, in order to conduct an exten-

sive search, a list of broad keywords and phrases were determined based on their prominence and recurrence in the trajectories (Table 1). A two-step qualitative criteria set was then developed to finalize the general search results. In the first stage of the formulated criteria, some broad characteristics were taken into account about the resources of all trajectories. These characteristics included: the academic reputation and validity of the resource; the academic reputation and validity of the author(s); the relevancy to the identified trajectories; availability of the resource; and its import-ability into NVivo. Moreover, all materials ought to be in English (either original or translated). Subsequently, resources that met the criteria for the initial stage were selected for further assessment in the second phase. The subsequent stage of the resource evaluation was predicated on the distinct criteria pertaining to every trajectory, as delineated below:

- Resource selection criteria for Architecture Culture: include the authoritative and acknowledged treatises, books, essays, manifestos, and papers involved in architectural theory, starting from Vitruvius to the present. The resources involvement in architectural theory is assessed based on the definition of theory by Kate Nesbitt (Nesbitt, 1996, pp. 16–17) because of its clarity and generalizability. Therefore, the resources with speculative nature that offer new thought paradigms to architecture belong to this trajectory.
- Resource selection criteria for Design Thinking: include the texts on design studies, starting from 1962 (Design Method Movement) to the present. Due to the overlaps, the resources in both general and architectural contexts are acceptable. The written materials that provide an in-depth understanding of design methods and processes, with scientific and non-scientific nature, and are basically specific to architectural design should be selected.
- Resource selection criteria for Knowledge Production by Architecture: include the resources focused at explaining the relationship

Table 1. Keywords and expressions for the general search of the literature.

Trajectory	Keywords and expressions
Architecture Culture	- Architectural theory from Vitruvius to the beginning of postmodernism - Postmodernism - Digital turn and technology - Disciplinarity, research, practice, and influence of the pragmatic views
Design Thinking	- Design methods and design thinking - Design and science, design cognition and early phase of design - Architectural design thinking, architectural design process, and idea
Knowledge Production in Architecture	- Knowledge and research by design - Knowledge production in architecture

between architecture, design, and knowledge, mainly from the 1990s to the present. The studies that treat design and architectural design as a means of producing knowledge, and the resources concerning research-by-design, practice-led-researches, research-led-practice, should be chosen.

3.3. Finalized resources

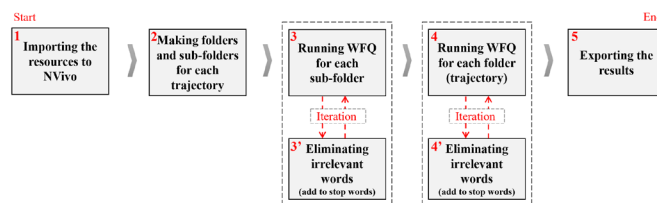
The number of the finalized resources was a major limitation of the study. The authors had access to a limited number of materials and thus they were unable to apply the method to a vast dataset. Conducting the formulated criteria in this study took about two years and resulted in the acquisition of 157 materials across all trajectories, ensuring that they were as comprehensive and relevant as possible. They include 91 resources in Architecture Culture, 42 resources in Design Thinking, and 24 resources in Knowledge Production by Architecture. More than 92000 pages of literature are included in these items. Appendix A contains a complete list of the resources examined in this work.

3.4. Analysis method

When the materials were gathered, they were all converted to text-recognizable PDF forms and uploaded to NVivo for analysis. In NVivo, the resources were first organized in their appropriate trajectories (folders) and their contained keywords (sub-folders) presented in Table 1. Then, Word Frequency Query (WFQ) in the software was applied to the resources to identify the most frequent words. WFQ in NVivo has three major parameters, including the number of the displayed (most-frequent) words, the minimum length of the words (letter), and type or

Table 2. Excluded central words in WFQ process.

Trajectory	Excluded central words in WFQ procedure
Architecture Culture	Architecture
Design Thinking	Architecture; Design; Thinking; Process
Knowledge Production in Architecture	Knowledge; Architecture

**Figure 2.** NVivo application process for the study.**Figure 3.** Word Tag outputs for the trajectories.

grouping of the words (e.g., exact match, stemmed words, synonyms, etc.). WFQ was tried out in several settings to fine-tune the settings. Ultimately, a determination was reached to establish the exhibited quantity of words at ‘50’, with a minimum word length of ‘3’ letters, and a grouping preference of ‘exact matches’. This was done with the intention of producing a refined catalogue of distinct and noteworthy words. The adjustment made the resulting word list non-repetitive and relevant. Following the completion of the adjustments, the WFQ was run for each sub-folder. Because the program allows checking the use of each word in its context, every displayed word may be approved or denied as a significant word. If the word is approved, it will be added to the list, and if it is denied, it will be removed and added to the Stop Words list in NVivo. For example,

irrelevant words like ‘have’, ‘example’, ‘another’ and alike were added to Stop Words list. Following many iterations of WFQ for each sub-folder and subsequent adjustments, a set of 50 most frequently occurring words was validated for each. To generate the ultimate list of the words for the trajectories, WFQ was then run for each folder (trajectory). During this phase, some words appeared to have ambiguous usages in the corpora, necessitating a thorough review of almost the whole database before determining whether to accept or reject them. It should be noted that, the authors simply eliminated the irrelevant words from the process at this point, and all removed words are accessible in the Stop terms list, as previously stated. In addition to the irrelevant words, the central words for each trajectory which their highest frequency was evident, were added to Stop Words (Table 2).

Eventually, after time-consuming iterations, the final words’ list for the trajectories were refined and completed. The process of utilizing NVivo for this research has been depicted in Figure 2.

4. WFQ analysis outputs

NVivo’s WFQ procedure yielded a list of fifty words, with their counts and examples of their use in context, for every trajectory (see Appendix B). Although these words had been WFQ’s primary outputs, its secondary outputs were also used here. First, there is the Stop Words list for verifying which words were removed from the query. Secondly, there are Word Tag diagrams, which serve as visual representations of the ultimate lists (Figure 3). In these diagrams, the words’ count is visualized by their font size.

5. Thematic representation of the discipline

The analysis in this study revealed 150 most frequently occurring significant words as the highlighted concepts within the investigated literature. Concerning their essential significance in the discipline, the highlighted concepts might give rise to the themes specific to architectural design. The themes achieved by this

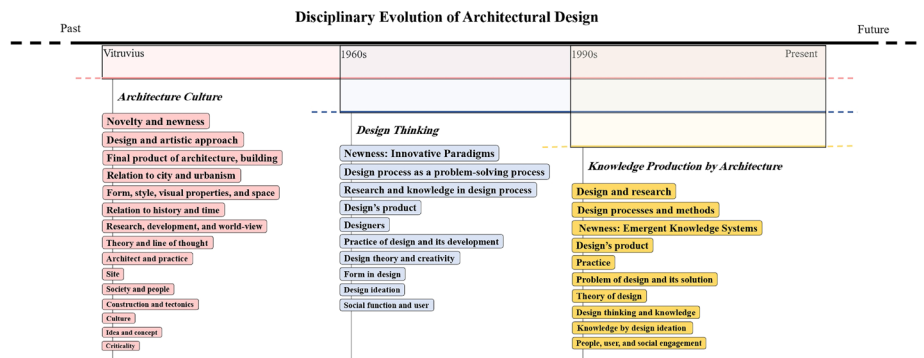


Figure 4. Thematic diagram for disciplinary evolution of architectural design.

study are resulted from clustering these concepts, and are relevant to the disciplinary trajectories, and can construct a thematic diagram for disciplinary evolution of architectural design (Figure 4). In this diagram, the degree of importance for each theme is indicated by its font size as well as the themes' descending order. The details of each theme, i.e., the theme's rank, the included significant word(s), and its (their) usage samples in their context, are available in Appendix C.

Based on the findings, 50 words in every trajectory gave out 15 themes in Architecture Culture and 10 themes in either Design Thinking and Knowledge Production by Architecture, as indicated in Figure 4. The degree of importance of each theme in the trajectories help clarity and thus identifying the essence of each trajectory. Interestingly, the first three themes of the trajectories can clearly reflect their very nature in the disciplinary development of architectural design. These themes are called key themes, and the other themes which support the key themes are named subordinate themes.

5.1. Key themes of the trajectories

As mentioned, for each trajectory, there have been three key themes. Architecture Culture puts a striking insistence on 'novelty and newness', symbolizing a tremendous yearning for pure innovative creation and touching the unexperienced forms, methods, meaning, etc. The frequent references to 'new', 'contemporary', and 'today' reflect an ongoing commitment to evolving architectural practices, ensuring they stay relevant

and forward-thinking. This focus on novelty encompasses new architectural forms, contemporary design practice, and today's discourse, as well as fresh theoretical approaches. By embracing change and seeking out new possibilities, architecture can respond to the dynamic needs of contemporary society, fostering an environment of creativity and progress in the discipline. The second key theme in Architecture Culture, is 'design and artistic approach' which highlights the integral role of artistic principles within architectural design. References to 'design' and 'art' signify a deep engagement with aesthetics and the creative thinking process, treating architecture as an expressive art form. In a discipline-specific sense, it can be interpreted that architectural design literature places the highest value on artistic intuition and subjectivity over technical and objective aspects hinted by the third key theme, 'final product of architecture, building'. This third key theme explores the diversity and complexity inherent in different building types and deals with production. Terms like 'building', 'house', and 'museum' illustrate the range of structures and spatial production process architects engage with. The theme emphasizes objective aspects of architectural design, and highlights the final product of architectural processes.

For Design Thinking, the first three themes can characterize its essence. In this trajectory the first theme, 'newness: innovative paradigms,' highlights the emphasis on innovation and the adoption of new paradigms within design thinking. The only included

word in theme, 'new,' indicate a focus on creating new models, methods, visual experiences, products, and so on that address contemporary challenges. Concerning the content of the theme, it reflects a commitment to advancing design through the development of new frameworks and theories of production. This theme is immediately followed by the second theme, '*design process as a problem-solving process*,' demonstrating a strong focus on problem(s) and solution(s) in design literature and the problem-solving nature of design thinking. The content of the theme translates it as a systematic process to find innovative solutions for ill-defined problems as well as to re-conceptualize problems and solutions in design. This approach to design implies the potential of systematic and mostly scientific ways of inquiry in design challenges. The third key theme in Design Thinking, '*research and knowledge in design process*' emphasizes the critical role of research and knowledge in informing the design process. The included words in the theme, like 'research,' 'information,' and 'knowledge' reflect the reliance on empirical data, theoretical models, and systematic study to guide design decisions. This theme points to various research methods, from empirical research to experimental studies, highlighting the application of scientific methodologies in developing informed design solutions.

In Knowledge Production by Architecture, '*design and research*' is the first key theme and involves eleven highlighted words from the investigated literature. This theme strikingly emphasizes the integration of design and research in architectural design. In this theme, also, the involved words such as 'design,' 'research,' and 'information' reflect a focus on the role of informed and systematic inquiry in advancing scientifically sound solutions for architectural design. The second key theme, '*design process and methods*,' refers to the diverse processes and methods involved in architectural design, emphasizing iterative, analytical, and methodological approaches. In particular, references to 'process' and 'methods' signify the importance of developing and refining design methods

in knowledge production. This theme underscores the possibility of knowledge production through various design processes, from conceptualization to implementation, highlighting their importance in addressing architectural challenges. In Knowledge Production by Architecture, the first two themes, support the third key theme, namely, 'newness: emergent knowledge systems'. This theme highlights the emergence of new knowledge systems within architecture, focusing on innovative curricula, methodologies, and conceptual models. The only included word, 'new,' indicate a commitment to developing fresh perspectives and advancing architectural theory, practice, and education. This theme emphasizes the continuous evolution of architectural knowledge, encouraging the exploration of new ideas, techniques, and technologies.

5.2. Subordinate themes of the trajectories

Subordinate themes can be viewed as interconnected themes that provide elaboration on the key themes. Subordinate themes can, therefore, be described in terms of characteristics of each trajectory delineated by the key themes.

The achieved themes in Architecture Culture endorse an innovative artistic engagement with the '*final product of architecture, building*' by taking into account its '*relation to city and urbanism*,' for manipulation of '*form, style, visual properties, and space*'. It implies that in Architecture Culture, the role of city as the context in creation of space and its visual characteristics, has received greater attention than other issues. The theme, '*relation to history and time*,' then, necessitates the significance of temporal circumstances and history (e.g., precedents, history of possibilities, history of cities, etc.) in architectural design ideas. Moreover, by means of '*research, development, and worldview*,' these themes have the potential to offer a '*theory and line of thought*' to be incorporated into the work of an '*architect and practice*'. Drawing from this interpretation, it can be argued that the examined corpuses in Architecture Culture explicitly tackled the interplay

between academia and practice, and their shared objective of constructing theory and feeding various lines of thought, the characteristics of which are summed up primarily by the major and minor themes. Relying on the findings, the subordinate themes from 'site' to 'criticality' are less autonomous themes in Architecture Culture in a discipline-specific sense; yet, they can be regarded as constituent components of the more significant themes of the trajectory. From an architecture-specific standpoint, the themes 'site', 'society and people', 'construction and tectonics', and even 'culture' perhaps due to their interdisciplinary character, may not necessarily have an essential position in generating architectural design ideas, but rather can be associated with other themes for handling the ideas. The last two themes in Architecture Culture, 'idea and concept' which refers to the highlighted word 'idea' (ranked 33 out of 50), and 'criticality' which encompasses the highlighted word 'critical' (ranked 36 out of 50), based on their respective contents (see Appendix C) can be considered as an excerption from some of the earlier themes. For example, the overlap between 'idea and concept' and 'design and artistic approach' is evident. Similarly, 'theory and line of thought' can be an umbrella theme for 'criticality'. As stated, the interconnection between the obtained themes can signify the importance of a subordinate theme within the earlier themes.

In Design Thinking, 'design's product' is the first significant subordinate theme. Given the nature of the trajectory, it demonstrates that for design theorists and researchers, systematic processes and methodologies of design are of greater value than the ultimate product of design. When it comes to the following themes, 'designers', 'practice of design and its development', and 'design theory and creativity' a notable deficiency in attention to the subjective aspects of design can be more evident. These minor themes of Design Thinking, have the potential to complement the highly significant key themes in Architecture Culture (i.e., 'novelty and newness', and 'design and artistic approach'). However, the findings in-

dicate that a concrete approach takes precedence over an abstract approach in Design Thinking trajectory. Even, the subsequent theme, 'form in design', which seems to be a central theme based on its content (see Appendix C), remains among the least significant themes. Moreover, the last themes, 'design ideation' and 'social function and user' can be construed as complementary themes for the preceding ones in both practical and theoretical aspects. Drawing upon the status of Design Thinking, and the identified themes, it can be argued that this trajectory prioritizes the objective dimension of design and supplies a scientific approach to architecture.

The involved themes in Knowledge Production by Architecture are greatly influenced by design thinking developments, as the key themes in this trajectory indicate. Similar to Design Thinking, 'design's product' is the most significant minor theme in Knowledge Production by Architecture. According to the content of the theme and in an architectural sense, buildings and constructed projects, are emphasized as mediums for generating new knowledge. Next theme, 'practice' referring to design-related activities and experiences of individual designers and design teams, shows the crucial (albeit small) function of practical aspects in producing knowledge. Based on the obtained themes, producing knowledge by architectural design seems to be subjected to considering its associated thought as the 'problem of design and its solution', as a subordinate theme. Surprisingly, this theme has been appeared before 'theory of design' which involve eight highlighted words about architectural design theory such as 'time', 'space', 'structure', and so on. Perhaps this is influenced by the tangible characteristics of design process as problem solving activity rather than the materialization of a subjective theory. The content of the next subordinate theme, 'design thinking and knowledge' (see Appendix C), also, reflects the role of design thinking, design education, design activities, and creativity on form and visual properties in producing knowledge by architectural design. Similar to Design Thinking, 'knowledge

by design ideation' and 'people, user, and social engagement' are placed on the least significant level in this trajectory. The theme 'knowledge by design ideation' emphasizes the value of design ideas in knowledge generation, and the theme 'people, user, and social engagement' reflects the importance of users when it comes to producing knowledge via architectural design. Also, resembling to the other two trajectories, in Knowledge Production by Architecture the themes on the lower levels can provide additional elaboration for the themes situated on the higher levels.

6. Conclusion

This paper reports an endeavor for identifying a thematic representation of the disciplinary evolution of architectural design, examining literature from Vitruvius to the present. Resources pertinent to the determined trajectories of disciplinary evolution (Architecture Culture, Design Thinking, and Knowledge Production by Architecture) were collected and analyzed using thematic content analysis to uncover the related themes.

It should be noted that this study focuses solely on architectural design, and considering the entire architectural discourse may yield more comprehensive results. Additionally, due to the qualitative nature of this investigation, the researchers' discretion was required at multiple phases; consequently, the results may be influenced by the researchers' worldview. Furthermore, accessibility to resources, the absence of reliable numerical records for the resources, as well as English being the sole language of the dataset were other limitations in this research.

This study led to the identification of key themes in each of the three trajectories. Based on their content, these themes revealed distinctions between the trajectories. The identified themes assigned a subjective character to Architecture Culture (Vitruvius-present) while attributing an excessively objective character to both Design Thinking (1960s-present) and Knowledge Production by Architecture (1990s-present). This way, the findings shed light on the character of architectural design as a part within the field of architecture

as a whole.

The key themes identified within Architecture Culture reveal that architectural design, as a discipline, has been evolving around its abstract and artistic core from the past to the present. However, mainly since the 1960s, Design Thinking and Knowledge Production by Architecture have defined quasi-scientific trajectories for disciplinary progression. The thematic structure of the trajectories in this study indicates a moderating role of Architecture Culture over other two trajectories, which implicitly emphasizes the significance of the subjective aspects in architectural design. This suggests that, the associated themes with Architecture Culture can potentially help create discipline-specific theories, methods, and knowledge more effectively than the other trajectories.

Furthermore, Architecture Culture aligns primarily with the discipline's formative phase, a period when architecture held significant societal influence. Reaffirming the value of subjective dimensions in architectural design could help address the current disciplinary crisis, which has seen architecture struggle to defend its intellectual and professional territories. This study identifies the growing dominance of highly objective approaches, which implicitly underscores the importance of revisiting the very nature of architectural design as a subjective, speculative, and intellectual area of knowledge in the future development of the discipline.

Additionally, integrating these subjective features with objective characteristics could enhance the architectural sense for future design projects. For example, it could streamline computerized architectural design processes by eliminating irrelevant phases such as random "form-finding". In academia, focusing on the Architecture Culture trajectory could inspire innovative research methodologies and theories, redefine the future horizons of the discipline, and empower architecture to integrate with other fields as guided by transdisciplinarity (Gibbons et al., 1994) to address complex global challenges.

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