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Research Methodologies in Architectural Studies: A Comprehensive Review

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Abstract

This review focuses on the research methodology in architectural studies such as the shift by traditional design-based approaches to evidence-based and interdisciplinary and technology-oriented frameworks. It addresses qualitative, quantitative and mixed research methodologies and how they are applied in the interpretation of social, environmental, technical and human centric elements of built environment. The review also examines some of the new trends like artificial intelligence, the construction of information modeling, parametric design, data-driven performance analysis, and immersive technologies. The focus is put on sustainability, resilience, and occupant well-being and implies that robust and hybrid approaches should be used to cope with the complex issues of architecture in current research and practice.

Keywords: Qualitative Research, Quantitative Research, Mixed Research, Building Information Modeling (BIM), Computational Simulations, And Data Analytics.

1 INTRODUCTION

Architecture is an interdisciplinary subject that is a combination of art, science, technology and social inquiry, to influence the built environment. Architectural research is critical in developing knowledge about design, as well as enhancing building performance, human well-being and

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global issues like urbanization, sustainability and climate change. Architectural studies have over the years evolved, shifting away practice-oriented and design approaches to rigorous academic inquiry using various research approaches [1]. Consequently, the methods of research of architectural studies have become more complex, interdisciplinary, and situational. Historically, architectural studies used to be rather descriptive and prescriptive, studying design concepts, historical studies and stylistic deciphering [2]. Precedent studies, design experience, and theoretical discourse were also frequently used to derive architectural knowledge. Although these methods are still valuable, the rising need to have evidence-based designs and performance-based architecture has widened the methodological horizon of architectural research. The current architectural research is becoming more integrated with the quantitative analysis, qualitative enquiry, simulation and the empirical validation to solve complex design and environmental problems [3], [4].

The move to sustainability, user-friendly design, intelligent buildings, and resilient city systems has further reinforced the need to have sound research methodologies. Design choices are now supposed to be justified by architects and researchers in terms of quantifiable results concerning energy saving, thermal comfort, daylighting, sound, and behavior of occupants [5]. This change has made the lines between architecture, engineering, social sciences and environmental studies soft and interdisciplinary research frameworks have been accepted. Moreover, the development of digital technologies, building information modeling (BIM), parametric design, computation simulations, and data analytics transformed the process of architectural research [6]. The tools assist researchers in modeling complex systems and simulate environmental performance and in valuing design alternatives in a very precise way. Meanwhile, qualitative methods including post-occupancy evaluation, ethnographical research and participatory design have become dominant on how to analyze human experiences in built environments [7].

Common Types of Research Methodology in Architecture

The field of architecture is one that demands expertise. Discussed in this part are the typical forms of architectural research technique, which are the methodical and exacting procedures for carrying out and assessing architectural research.

- **Qualitative Research Methodology**

Qualitative research methodology is a form of research that emphasizes the exploration and comprehension of the meanings, experiences, and viewpoints of the participants or the phenomena being investigated. It employs techniques including interviews, observations, document examination, and case studies to gather and scrutinize comprehensive and detailed data. It enables the creation of fresh hypotheses and perspectives on the subject [8].

The social, cultural, and psychological facets of the built environment, including user demands, preferences, behaviors, and satisfaction, are frequently studied in architecture using qualitative research technique. It may also be used to research architects' decision-making, creative thinking, and design process. It may offer a thorough and comprehensive comprehension of the intricate and ever-changing interactions among individuals, places, and circumstances [3].

There are several benefits and drawbacks to qualitative research methods. Among the benefits are:

- Both the architectural phenomena and the depth and variety of the human experience may be captured by it.
- It can produce fresh, creative notions and ideas that can influence and motivate architectural practice and instruction.
- It has the ability to be adaptive and flexible in response to new and evolving problems and circumstances in the field.

Some of the limitations are:

- Depending on the researcher's perception and viewpoint, it may be biased and subjective.
- It can be challenging to generalize and apply the findings to different settings and populations.
- Gathering and analyzing a lot of data may take a lot of time and resources.

o Quantitative Research Methodology

Quantitative research methodology emphasizes the systematic measurement and analysis of the relationships, discrepancies, and influences among the variables or phenomena under investigation. It gathers and analyzes numerical and statistical data using techniques including surveys, experiments, and simulations. It offers a dispassionate, scientific perspective on the subject [9].

The physical, environmental, and technological characteristics of the built environment—such as the functionality, effectiveness, quality, and safety of the structures and spaces—are frequently studied in architecture using quantitative research technique. It may also be used to research how innovations and architectural interventions affect society and its consumers. It can evaluate the architectural phenomena and offer trustworthy and legitimate proof [3].

The methodology of quantitative research has some benefits and drawbacks. Among the benefits are:

- The variables and events of interest can be precisely and accurately measured and quantified by it.
- It has the ability to test and validate ideas and hypotheses that attempt to explain and forecast architectural phenomena.
- If the design is robust and the sample is representative, it can be applied to various populations and circumstances.

Some of the limitations are:

- It may be oversimplified and reductionist, ignoring the complexity and depth of both the architectural phenomena and the human experience.
- Confounding and unrelated factors may have an impact on the reliability and validity of the results.
- Designing and carrying out the tests and simulations in the field may be expensive and difficult.

    - **Mixed Research Methodology**

In a single study or set of studies, mixed research technique integrates and mixes both quantitative and qualitative research approaches. Both qualitative and quantitative data are gathered and analyzed using techniques like sequential, concurrent, or transformational designs. It offers a thorough and impartial analysis of the subject [10].

The study of the complex and multidisciplinary elements of the built environment, such as the interaction and integration of the social, cultural, psychological, physical, environmental, and technological characteristics of the buildings and spaces, is frequently conducted in architecture using mixed research methods. This methodology also facilitates the investigation of architectural phenomena's intricacy and variety, employing diverse perspectives and analytical levels. It has the capacity to offer a more comprehensive and sophisticated comprehension and elucidation of architectural phenomena.

There are several benefits and drawbacks to mixed research methods. Among the benefits are:

- It is capable of addressing research concerns and objectives that are beyond the scope of a single research approach.
- It may overcome the shortcomings of each kind of research methodology while enhancing and complementing its advantages.
- By employing many sources and techniques for data collecting and analysis, it can improve the findings' validity and trustworthiness.

Some of the limitations are:

- The design and execution of mixed methods research can present considerable challenges, necessitating a well-defined rationale and a cohesive integration of qualitative and quantitative elements.
- Because it necessitates a high degree of experience and abilities in both qualitative and quantitative methodologies, managing and analyzing the vast and varied quantity of data may be taxing and difficult.
- Because it may provide diverse or opposing results from the qualitative and quantitative components, it might be prone to contradicting and conflicting conclusions.

Emerging Trends in Architectural Research Methodologies

New directions of architectural research methods are also characterized by the use of digital technology, a trend to data-driven decision-making, and the sustainability, resiliency, and occupant well-being. These approaches are replacing traditional, purely qualitative, or artistically-based approaches with hybrid and multi-disciplinary approaches [7]. The major emerging trends in the study of architecture are:

- **Artificial Intelligence (AI) and Machine Learning (ML):** AI is emerging as a revolution in data analysis capabilities to handle large volumes of data, building model optimization, energy demand synthesis, and create design options. AI helps in the automation of more complex processes, where architects can find design solutions to their problems relying on environmental performance data [11].

- **Building Information Modeling (BIM) and Digital Twins:** BIM is becoming more of a collaboration, lifecycle analysis and simulation platform that is centrally managed and data rich. To control the performance of real-time monitoring and enhance operational maintenance, digital twins as virtual equivalents of real buildings are applied [12].
- **Data-Driven Design and Performance Analysis:** The studies are more about quantitative data, which is achieved by applying simulation tools in the analysis of daylighting, energy consumption, and material efficiency during the initial design stages [13].
- **Parametric and Generative Design:** Using algorithms and visual programming (e.g., Grasshopper), researchers can explore complex geometries and optimize design parameters, resulting in organic, high-performance structures [14].
- **Immersive Technologies (VR/AR):** VR and AR are getting common in immersive modeling of 3D designs, which will enable architects and consumers to walk and test the surroundings prior to building [6].
- **Sustainability and Resilience Metrics:** The methods of research have shifted their focus to an appraisal of the so-called embodied carbon and long-term building performance, no longer focusing only on energy efficiency but also on the principles of the circular economy and the adaptation to climate change (e.g., retrofitting against floods) [15].
- **Biophilic and Human-Centric Research:** It is very much oriented towards the examination of the effects of built environments on human well-being, which methodology includes natural components (green roofs, natural light) to enhance mental and physical health [2].
- **Mixed-Methods and Hybrid Approaches:** The current studies have a tendency to employ qualitative, quantitative, and design-based approaches (e.g., AI-based optimization with qualitative surveys of occupants) to develop holistic and versatile designs [10].
- **Socially Responsible and Participatory Research:** Participatory methods are becoming increasingly popular, emphasizing social architecture, inclusivity and meeting the demands of people living in cities like fast-growing ones.

2 LITERATURE REVIEW

(Lima et al., 2026) [14] provides a pedagogical framework for an undergraduate architectural design studio that integrates form grammars, parametric modeling, pattern language theory, and service-learning concepts. The framework, which is used in ARC 4025 (Architecture Studio 5) at Belmont University's O'More College of Architecture and Design, helps students convert empirical observations of an informal community in Ahmedabad, India, into generative and rule-based design systems. Students may encode settlement patterns as transformation rules that produce, test, and assess coherent urban structures at different dimensions because to the methodology's emphasis on process–product reciprocity. As a proof of method, a comprehensive case study called Community at Scale is provided, showing how analysis is transformed into computational logic at the house, block, and neighbourhood dimensions. The study shows how computational design may operationalize morphogenetic thinking within architectural education while being rooted in social responsibility, as opposed to offering a definitive answer. In the article's conclusion, the educational implications are discussed, the technique is placed within the discourse of urban morphology, and its limits and future research paths are outlined.

(Albukhari, 2025) [16] By improving important design strategies including spatial planning, parametric modeling, generative design, and performance-based analysis, recent developments in artificial intelligence (AI) are transforming architectural design. AI enables architects to investigate creative solutions that are sensitive to user requirements and environmental constraints by evaluating vast information and automating intricate procedures. With an emphasis on how AI may improve creativity, automation, and sustainability, this research methodically examines how AI functions in the architectural process. Peer-reviewed research on AI applications in smart cities, urban planning, and architectural design that was published between 2003 and 2025 was examined in an organized literature review utilizing the PRISMA framework. The examined research shows how AI facilitates sustainable architecture, improves generative design, and simplifies spatial organization. But issues like loss of architectural identity, algorithmic prejudice, and ethical dilemmas still exist. In order to facilitate immersive, real-time, and informed design processes, future research should prioritize multidisciplinary cooperation, ethical implementation, and interaction with VR/AR.

(Radlbauer et al., 2025) [17] creates and puts into practice a scalable system architecture for knowledge modeling and dynamic data collection in industrial settings. The design uses communication standards like OPC UA and Modbus TCP to provide wide compatibility with a variety of devices and incorporates contemporary technologies, such as the ibaPDA system for

data collecting. The findings show that the design improves knowledge modeling in addition to satisfying the needs for dynamic data collecting. This results in more effective process control and creates new opportunities for big data management and analysis in production settings. The study underscores the significance of an integrated development strategy and emphasizes the necessity of interdisciplinary collaboration to effectively address operational challenges. These results assist address the issues of Industry 4.0 and propel innovation by offering insightful information to academics, software development, industry, and data science.

(Shinbira, 2025) [18] solves a significant gap in urban design by putting up a multifaceted, systematic framework for data collecting and analysis—a crucial but frequently undeveloped stage. The six primary dimensions of urban design—morphological, perceptual, visual, social, functional, and temporal—were identified in the study, and each was methodically connected to suitable methods of data collecting and analysis, such as behavioral mapping, GIS, BIM, and cognitive survey. By providing a useful, context-sensitive strategy suited to the requirements of temporary cities, the suggested framework improves on current urban planning approaches. It supports more adaptable and sustainable urban development by providing practitioners with organized direction for the first phases of design. It is advised that future studies evaluate the framework experimentally in a variety of metropolitan settings.

(Xu et al., 2025) [13] uses a unique data mining methodology to scan large datasets on LEED projects and firm operations in order to examine the uptake and effect of LEED-certified projects inside top architectural firms from 2000 to 2023. We present two important metrics: the Green Impact Ratio (GIR) and the Weighted LEED Achieved Score (WLAS), which assess a company's sustainability efforts in proportion to its market size and project scale. These indicators provide information on the environmental results of initiatives and how businesses integrate sustainability into their operations. Significant trends in the implementation of LEED standards are shown by our study, demonstrating a growing dedication to sustainable construction. The analysis emphasizes the strategic significance of these practices in achieving a competitive advantage and aligning with international sustainability goals. This article adds to the conversation on sustainable design by establishing a thorough methodology for assessing the economic and environmental elements of sustainability in architecture, as well as new insights into how top businesses integrate and use LEED certification.

(Arisman et al., 2024) [19] Research within the discipline of architecture is essential in advancing architectural knowledge and motivates professionals in the field to create higher-quality architectural works. To produce high-quality research, the appropriate research approach

must be used. The optimal scientific approach for examining the hypotheses offered by a given theory is determined by the research methodology used. The success of a research effort is therefore greatly influenced by the choice of methodology. However, researchers sometimes struggle to choose the optimal research technique for their goals due to the wide range of options available. One approach that may be used in architectural research is the Delphi technique, which is the focus of this study. The Delphi approach is used to poll experts on a certain subject and collect their opinions. This study will examine a number of architectural research publications that have applied the Delphi approach, paying particular attention to each study's methodology section. This investigation will look at the rationale behind using the Delphi technique in each study as well as how it is carried out. The results of this study may inform the selection and appropriate application of the Delphi method within architectural research.

(Millan et al., 2022) [20] provide a novel approach to design tracking that is based on the use of machine learning and data analysis tools on information gathered from snapshots of particular design instances. The knowledge contained in the data was then extracted using machine learning and data analysis techniques. More specifically, methods utilized in higher-quality designs were identified using supervised learning approaches (decision trees), while common solution routes were identified using unsupervised learning techniques (clustering). The findings show that supervised learning methods enable the class of the best projects to be clarified by taking into account the sequence of some of the choices made. Additionally, by clustering projects that employ similar approaches, unsupervised learning algorithms can identify a number of common problem-solving paths. Our study offers a fresh take on design tracking in this way, utilizing quantitative analytic techniques that can enhance and supplement the conventional qualitative approach.

(Zboinska, 2021) [10] The range of research techniques has expanded and developed in tandem with the current surge in architectural research activity. Its primary goal is to offer a critical analysis and comparative summary of the many methodological typologies in order to facilitate their further development. The essay's second goal is to use these design-based techniques to create a "hybrid method" framework for architectural research. This framework advocates for the concurrent implementation of diverse design-based research methodologies, informed by analyses and insights derived from a particular architectural research project conducted by the author. The goal of developing the concept of the hybrid methodological mode is to make it a part of the current repertoire of architectural research techniques, which are currently frequently presented from a "mixed method" perspective that typically divides approaches into qualitative and quantitative categories. Beyond this qualitative/quantitative divide, the essay suggests that

the "hybrid method" covered here encompasses a different typology of approaches, and that its use in design-based research offers significant opportunities for knowledge production and communication that should not be disregarded in the future development of architectural research methods.

(Meekings & Schnabel, 2017) [21] suggested that even if it just relates to one individual, the amount of data being gathered on them is growing enough to be considered big data. It possesses all the characteristics of the big data phenomenon, including vast and varied domains that can reveal unexpected patterns with the aid of machine learning and cross-referencing. In order to influence future architectural workflows, this article investigates the potential applications of personal big data. We illustrate methods by which personal data can be utilized to foster meaningful connections within architectural design processes. Two main concerns are addressed by comparing many single-person data sets: finding pertinent data and three-dimensionalizing it, with an emphasis on linkages. The future of data as a tool to support architectural design processes is discussed in the paper's conclusion.

3 CONCLUSION

This review has found that there have been extensive changes in architectural research methodologies in line with increased requirement of sustainability, optimization of its performance, and human-friendly design. Although qualitative approaches are still necessary in comprehending social, cultural and experiential aspects of buildings, quantitative methods offer measurable information on building performance, efficiency, and environmental impact. The mixed and hybrid methodologies are a holistic approach that brings together all these views thus increasing the validity and depth of the research. The new emerging technologies that include artificial intelligence, BIM, parametric modeling, and immersive VR/AR tools are redefining architectural inquiry as it allows making decisions that are data-informed, simulating, and predictive. Meanwhile, the participatory and socially responsible research methodology focuses on inclusiveness and engagement with the community. Nevertheless, interdisciplinary cooperation, technical background, and morality can necessary in the successful use of these sophisticated methodologies. In general, the future of architecture-related research is in the flexible and integrative approaches that combine technological innovation with human experience in order to promote resilient, sustainable, and evidence-based architectural practice and education.

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