# The Impact of Research: Articulating the Value of Integrating Research into Architectural Education

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Integrating research impacts into the architectural discipline is critical for architectural education. Students must develop a comprehensive understanding of the interdependent relationship between research and design, and gain the skills necessary to link the two. The quality and effectiveness of teaching directly influence the potential for research impact; likewise, impactful research findings can enhance teaching methodologies and student learning. This white paper is the result of a workshop conducted during the 2023 Architectural Research Centers Consortium annual conference (Dallas, Texas), focusing on the impact of architectural research. Ultimately, this paper begins to outline and scope the idea of research impacts for further discussion and clarification within the field.

Opportunities for research impact in architectural pedagogy are broad, with a number of examples already in place highlighting rigorous research methods and interdisciplinary collaboration. With case studies of class projects focusing on the generation of generalizable and transferable knowledge, the authors provide examples of research methods in architectural curricula, the impact on students, and the transferability of research skills to practice. Research impacts through the lens of the funder can be explored through larger, interdisciplinary perspectives that address collaborations, communities of practice, team diversity, and community engagement. Examples will be shared to illustrate ranges of research impact across projects of different scales. Architecture clearly impacts the communities in which we work, though understanding the impact of architectural research around, within, and for these communities is less understood. The authors share examples of communitybased research that both contributes to and informs the design process. By identifying the areas of pedagogy, funding agencies, and communities, this outline hopes to facilitate a broad discussion around how to operationalize and engage research in architectural education.

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## BACKGROUND

Understanding research impacts within the architectural discipline is critical for architectural education. Future practitioners must develop a comprehensive understanding of the interdependent relationship between research and design, and gain the skills necessary to link the two. For decades, various studies have addressed interplay and interdependence between research and design, discussing numerous approaches to improve these linkages in architectural pedagogy. The quality and effectiveness of teaching research and research strategies directly influence the potential for research impact; likewise, research findings can enhance teaching methodologies and student learning experiences. This white paper is the result of a workshop conducted during the 2023 Architectural Research Centers Consortium annual conference held in Dallas, Texas, focusing on the impact of architectural research. Taking the position that research is not adequately incorporated into architectural education, the purpose of this paper is to outline opportunities for the integration of research in design education. This paper begins to outline a series of impacts to be considered by educators around architectural research with an aim to broaden and organize the idea of research impact. Ultimately, this white paper presents an outline for and scope around the notion of research impacts to encourage further discussion and clarification within the field.

The range of research methodologies and data collection in architecture is extremely broad, including positivist approaches like experiments and simulation to constructivist and subjectivist approaches like ethnography, historical, and discourse analysis. As such, opportunities for research impact in architectural pedagogy are also broad, with a number of examples already in place highlighting rigorous research methods and interdisciplinary collaborations. With examples of class projects focusing on the generation of generalizable and transferable knowledge, the authors provide examples of research methods in architectural curricula, the impact on students, and the transferability of research skills to practice.

Understanding architectural research in terms of funding agencies is also important. For example, the National Science Foundation (NSF) is interested in how research strengthens the relationship between the science community and society, or how it translates beyond the boundaries of the profession, team, or specific project. Research impacts can be explored through larger, multidisciplinary lenses that address collaborations, communities of practice, team diversity, and community engagement. Examples will be shared to illustrate ranges of research impact across projects of different scales.

Architecture clearly impacts the communities in which we work, though understanding the impact of architectural research around, within, and for these communities is less understood. Dissemination of research findings to communities that we serve in architecture is often rare, and the value of this sharing is unclear for both the researchers and the communities. The authors share examples of community-based research that informs the design process, and how findings have been shared back to the community, both in academia and practice.

Although a major task of architecture is to look to the future, much of the knowledge used to create new designs still lies in traditions and existing built forms. This paper is not about abandoning, replacing, or a discssion of choosing research or design. Instead, this paper seeks to support and assist architectural design process and design pedagogies that have been developed. Research can help architecture speak to critical challenges by identifying necessary changes, forecasting possible trends, and anticipating future needs of the built environments and communities. By identifying the areas of pedagogy, funding agencies, and communities, this outline begins to scope the notion of research impact within architecture to better articulate ideas around how to operationalize and engage research in architectural education.

#### ARCHITECTURAL PEDAGOGY

The integration of research within architectural pedagogy continues to evolve significantly, reflecting a growing awareness of the need for research-driven approaches to design education (American Institute of Architects 2019; Association of Collegiate Schools of Architecture 2018; National Architectural Accrediting Board 2020; Vernooy, Shanahan, and Young 2021). Incorporating research into architectural curricula creates opportunities for students to broaden their knowledge and awareness of the complexity of architecture. Engaging in research-based activities, students are exposed to a wide range of subjects and topics that reflect diverse aspects of architectural knowledge. Exploring opportunities for research impact in architectural pedagogy, this section emphasizes the inclusion of research methods, the impact of this content on students, and the benefits of transferring research skills to practice.

**Research Methods in Curricula:** Research-driven, cross-disciplinary insights enable students to understand both tangibles and intangibles influencing the built environment such as human behavior, habits, lifestyles, emotions, and perceived experiences. Future practitioners need fundamental research principles and robust methodologies to transform these insights into

meaningful design as their skills mature, understanding complexity across different types of knowledge. Research processes equip students to scrutinize empirical data, address biases, and determine the most pertinent knowledge needed (Tvedebrink and Jelić 2020, 73). Incorporating a review of research methods and their benefits into architectural curricula is essential for nurturing the next generation of architects (Vernooy, Shanahan, and Young 2021; American Institute of Architects 2019).

Although architectural education does not currently frame its pedagogical practices through a research lens, many research strategies and data collection methods are historically embedded in its approaches (Vernooy, Shanahan, and Young 2021, 82-85). Strategies include historical research for understanding significant place details and context and case studies for precedent analysis, while data collection methods include observations for mapping and analysis to comprehend space usage and interviews with stakeholders for understanding experiences and perceptions. Many architectural design studio frameworks have been developed based on building research that addresses environmental performance, structure, and construction issues by utilizing positivist methodologies (Chung, 2014; Homer, 2006; Jo & Jones, 2023; Jo, Jones, & Grant, 2022; Stivers, 2012). Other studio and architecture course projects focus on more constructivist epistemologies and explore experiences, insights, and context-based descriptions to improve future designs (Herr, 2013; Powell, 2010)

While students gather and synthesize data in design preparation, findings are typically applied only to a specific project and do not create new knowledge for broader application, missing the fundamental mark of research – to generate new knowledge. Lawson (2013) notes that currently:

most designers are not well educated in terms of research methods in general. They probably lack the rather sophisticated skills needed to read and critically evaluate work involving the measurement of human performance, feelings, perceptions and attitudes and the consequent use of descriptive and inferential statistics (p. 34).

The same lack in critical evaluation applies to research utilizing constructed knowledge and thick descriptions around context. More intentionally embedding rigorous research methodologies throughout architectural curricula can expose students to a wider range of strategies, equipping the next generation of architects with a diverse skill set for conducting, interpreting, and using meaningful research.

There, however, are several examples of research methods being introduced and integrated into architectural curricula. Simulation methodologies are notably popular. Homer (2006) worked with interdisciplinary teams of architecture and engineering students to explore structural design and materials through physical modeling and simulations of structural performance, affording the



Figure 1. Synergistic relationship between students, pedagogy, research, and practice. Image by authors. .

creation of more expressive structural elements. Roberts and Marsh (2001) also led students to investigate the effectiveness of proposed environmental approaches through physical modeling and digital simulations. Student evaluations indicated that this exposure to research positively contributed to students' design processes; 95% of the responding students would use the strategies in the future. When research results differed from the students' intuitive judgements, the misalignment encouraged further investigation of the cause of these differences to gain a better understanding of the environmental approaches. Also in simulation, Wall, Hill, and Jing (2023) collaborated with a group of graduate students to recreate St. Paul's Cathedral in London circa 1620 via visual three-dimensional digital models. Students engaged in historical research along with document and content analysis to investigate architectural form, construction methods, acoustical performance, and era-specific events to develop an immersive experience of a significant architectural structure and space.

In constructed knowledge, Caldwell et al. (2016) worked with Master of Architecture students who completed year-long research projects utilizing literature reviews and qualitative methods, and explored a departure from the traditional oneon-one research model, resulting in a 10,000-word article. To facilitate students' transition to the focus on research, the authors borrowed familiar tactics from the studio environment, such as collaboration and routine meetings, concluding that the design studio structure is "a rich source of inspiration for research supervision" (Caldwell et al. 2016, 1364). These examples illustrate that when research is intentionally integrated into architectural curricula, the inclusion can have a significant impact on student comprehension of content and excitement about architectural research.

Impact on Students: The integration of research transforms design education into a proactive, robust, and meaningful experience providing tools and evidence-based strategies to enable students to navigate complex design challenges (Rowe 2020, 61). Architectural research prepares students to develop new perspectives by learning from other disciplines, encouraging interdisciplinary skills to address complicated challenges of design. Architecture students want their education and learning to be "exciting, applicable, social, and interactive" (Vernooy, Shanahan, and Young 2021, 5). Therefore, engaging in research through projects and working alongside professors engaging in research can provide students a truly meaningful experience. When integrated strategically, research can align with and strengthen design projects, enhancing the student's creative practice while increasing greater enthusiasm and motivation (Caldwell et al. 2016).

Intentionally applying processes often seen in the design studio, such as collaboration and creativity, to research strategies in architectural courses has resulted in a positive experience where students understand the significance of research and see research as exciting (Caldwell et al. 2016, 1362-1364). Guiding students to explore deeper research connections between complex considerations and various methodologies can make class projects more informed and meaningful. A multidisciplinary research approach empowers students to access more information and expertise, enhancing students' problem-solving skills while leading to innovative outcomes compared to traditional research courses (Caldwell et al. 2016, 1362). Students can apply research findings directly to their projects, recognizing the impact of their education on their future practice.

**Transferability of Research Skills to Practice:** One critical objective and benefit of incorporating research into architectural pedagogy is to equip students with skills that can be transferred to professional practice (Figure 1). Research helps students identify trends in architecture and its changing contexts, and understand the changing needs of future users, communities, and environments. The American Institute of Architects (2019) calls for the profession to "prioritize research within the architecture culture, starting in school and continuing within practice" (2). By introducing research in pedagogy, students can learn to formulate research questions, collect and analyze data, generate insights, and draw evidence-based conclusions. Applied to practice, these skills are invaluable as architects look to enhance occupant well-being, maximize building efficiency, and minimize cost (American Institute of Architects 2019).

Vernooy, Shanahan, and Young (2021) note that "when employers are asked what skills they want future employees to have, many list teamwork, creativity, problem-solving, critical thinking, as well as written and oral communication," all of which

EU Programs	Architecture Related / Total	EU Programs	Architecture Related / Total
Citizens, Equality, Rights and Values Programme	1 / 964	HORIZON	115 / 124886
Creative Europe Programme	3 / 1910	Digital Europe Programme	1 / 333
Support for information measures relating to the common agricultural policy	1 / 48	Programme for the Environment and Climate Action	2 / 477
Erasmus+ (ERASMUS+)	3 / 2928	Single Market Programme	1 / 890

Table 1. EU funding opportunities found through search of "architecture" and "built environment". Image by authors. [1,2]

are enhanced by engaging in research (5). Integrating research models from professional architectural practice helps students understand how real-world research informs design decisions (Vernooy, Shanahan, and Young, 2021, 172-173), exposing students to the complexities of the field, bridging the gaps between academia and practice, theoretical knowledge, and practical application (Tzonis 2014, Tvedebrink and Jelić 2021). Collaborations with industry partners who mentor students can provide valuable insights and significantly enhance the importance of research as it is applied to practice (Rowe 2020, 54). Architecture firms specializing in healthcare, education, retail, and hospitality are particularly valuable collaborators for educators interested in research due to the potential application of outcomes. These firms often seek graduates with expertise in these specializations, complete with research skills, making these partners open to collaborating with students who share their interests, potentially leading to continued collaboration after graduation (Vernooy, Shanahan, and Young 2021, 171). This alignment between academia and practice not only fosters a sense of relevance and applicability from research-based design but also exposes students to diverse practitioners, cultures, and clients, preparing them for work in both local and global contexts (Rowe 2020, 54). A theoretical grounding in research for architectural education yields critical design evaluation skills and informed decisions for professional practice.

The opportunities for research impact in architectural pedagogy are vast and multifaceted. By incorporating rigorous research methods, interdisciplinary collaboration, and real-world relevance, architectural education can better prepare students for the complex challenges of the twenty-first century. Researchdriven pedagogy enhances students' design skills, equips them with the transferable skills and knowledge necessary to excel in their careers, and empowers the architects of tomorrow to develop innovative solutions based on evidence.

## FUNDING

Funding resources for architectural research in the United States can come from various public and private sources, and each has their own lens that addresses collaborations, communities of practice, team diversity, and community engagement. To help guide architectural inquiry, the AIA has identified gaps in architectural knowledge and called for an increased investment in architectural research, prioritizing research within the architecture culture, and continued dissemination and exchange of findings. As the seat of the profession, AIA and its associated organizations provide grants, scholarships, and awards for architectural research and education across three scales of influence: individual/human, industry sector and building function, and community and societal. They often support projects that focus on sustainability, innovation, and community engagement with the AIA Upjohn Research Initiative being their largest research grant.

While the US federal government offers funding, there is no program specific to architecture. Depending on the nature of the research, architectural researchers may apply for general research grants from federal agencies like the National Institutes of Health (NIH) or the U.S. Department of Energy (DOE). The National Science Foundation (NSF) offers grants that may support interdisciplinary and/or multidisciplinary research involving architecture, particularly in areas related to technology, sustainability, and engineering. The National Endowment for the Arts (NEA) has a Design category that offers grants to support innovative research and projects in architecture and design. The NIH supports better understandings of the linkages between the built environment and the public's health, and the relationship of how spatial qualities are associated with human health and life. Likewise, the National Endowment for the Humanities (NEH) provides funding for research and preservation in the humanities, which can include architectural history and related fields. NEH encourages advancing humanistic knowledge by research and creative activities. They have specific grant programs aimed at advancing the field of architecture and promoting design excellence.

Funding and sponsorship opportunities under the EU programs are similar. In a search with the keywords "architecture" and "built environment", forty EU programs were returned between the programing period of 2021-2027. In the forty programs, 134,094 total grants were made with only 127 of the grants being architecture related. The eight programs found with funding are shown, along with the number of architecture-related grants in Table 1. Findings from searches using the chosen keywords indicate that the quantity of architecture-based projects receiving support from the European Union is quite low. While a similar



Figure 2. Bedford School-to-School (S2S) master plan (Source: Hill Studio).

numerical analysis for the United States is notably difficult, it is known that securing funding for only architecture-focused research is a challenge.

Often funding agencies including foundations and private sponsorships are interested in linking their work to architecture, though architecture may not be its focus. These opportunities are plentiful but can be more laborious, given the work needed to find and frame the research to be in line with the funder. Opportunities for specific inquiries abound through funding opportunities like the National Endowment for the Arts – Design, ArtsEdSearch, or The Institute of Education Sciences (IES). State and local government agencies may have grant programs aimed at supporting architectural research and development projects, especially those related to urban planning and infrastructure. In addition, many universities and colleges offer internal research grants and fellowships for faculty and students engaged in architectural research.

Besides AIA, other professional associations related to architecture, urban planning, and design may offer funding opportunities for research and scholarly activities. Architectural firms, construction companies, and technology companies may collaborate with researchers or offer grants for research projects related to their areas of interest. Philanthropic foundations are another significant opportunity for funding architectural research, particularly in the US. Because of their flexibility, these funding organizations are often seen to be more suitable for exploring questions around complex architectural topics. While some foundations are focused on architecture, such as the Graham Foundation, the Landscape Architecture Foundation, and the Architect's Foundation from the AIA, others have more broad missions that can easily include architecture, depending on the researcher's focus area. Architecture Research Center Consortium (ARCC) has been providing research incentive funding architectural researchers across a wide range of domains in support of advancing knowledge of the built environment. Since 2019, ARCC has provided funding to researchers at the University of Washington, University of Massachusetts Amherst, University of Illinois at Urbana-Champaign, Pennsylvania State University, Louisiana State University, University of North Carolina Charlotte, and Iowa State University.

It can be beneficial to develop interdisciplinary and/or multidisciplinary collaborations to fund architectural research. It has been fruitful for some architectural researchers to conduct collaborative research in various fields, rather than relying on narrowly focused architectural inquiries. Collaborating with other disciplines that are more traditionally funded, such as engineering and public health, can diversify research funding opportunities and increase impact. For example, Rider, et al. (2022) crafted a partnership between architecture and public health to explore how the design of the built environment can be an intervention for supporting community health, supported by a three-year grant from the Robert Wood Johnson Foundation. Another example, the ARCC 2023 New Researcher Awardee, Dr. Adel, formed a collaboration with computer science and construction management, conducting a National Science Foundation-funded project aimed at investigating the potential of intelligent humanrobot teams to enhance productivity and streamline processes.

Industry collaborations are another lucrative way to fund research such as the work of Resource-Based Design Research Lab (RBDR/Lab) at Texas A&M University School of Architecture. The RBDR/Lab aims to repurpose waste from various industries through participatory research. To achieve this goal, companies from different industries support these studies. Students are involved in the design for the repurposing process of RBDR/Lab's "waste to opportunities" projects, such as the creative reuse/ repurpose of matrix tray (Ali et al., 2021), wind turbine blades and solar panels (Salgin, 2023).

Regardless of the funding sources, it is essential to carefully review the eligibility criteria, application deadlines, and guidelines of each funding source. Additionally, it is critical to align research projects with the specific goals and priorities of the funding organization as this can significantly improve the change of securing funding. Calls for specific types of projects can also support the development of new partnerships and methodologies, increasing the impact and reach of architectural research.

#### **COMMUNITY IMPACT**

Beyond finances and given the public domain of architecture, architectural research can impact communities in a variety of ways. Methodologies such as Participatory Action Research (PAR) encourage communities to actively participate in community design processes sharing their experience, knowledge, and voices to find a solution together, other impactful research may inform future design for resilience or community inclusion. Community-engaged research activities can strengthen the sense of belonging, help community members address growth



Figure 3. Bedford School-to-School (S2S) project community workshop (source: Hill Studio)

challenges, and provide data to be utilized for policy development and community design.

The Bedford School-to-School (S2S) project in Virginia designed by Hill Studio (2018) is an example of participatory research that impacted the Bedford community design process. The goal of this project was to revitalize the declining Bridge Street area in downtown Bedford. The Bridge Street corridor served as the physical connection between the segregated north and south communities in Bedford. The North Bridge Street area had been perceived as a higher-income area with various cultural and historic resources, while the South Bridge Street area had been perceived as a lower-income, predominantly minority area. Two schools, located at each end of the Bridge Street corridor, represented the south and north communities – Figure 2 shows the final master plan for the community design and development for the Bridge Street corridor revitalization. Bedford Middle School at the north and the historic African American Susie G. Gibson High School at the south, fitting for the project name "Schoolto-School" (S2S).

The project started with a community-wide event and workshop, held at the Susie G. Gibson School gymnasium (Figure 3). The workshop consisted of invited talks and various design exercises to identify the current and future needs of the community. More than 100 people from both north and south communities participated in the event, which also became an opportunity for the unification of the segregated communities under the same objective. Community members shared ideas with sticky notes and sketches, sharing group summaries at the end of the workshop.

The design team categorized and coded the collected data in the community workshop, and this analysis became the basis for determining five goals of the project, which include: a sense of community, economic growth, unique character, attracting visitors, and a healthy and vibrant community. Feedback from community members about a draft plan and project goals was received via online and in-person surveys. For in-person surveys, eight popup events were held in different key locations, including markets, public centers, municipal buildings, and schools. The final plan addressed an urban design framework, historic resources, parks and public spaces, transportation and parking, economic develop-



Figure 4. One image from Allen and Queen's (2018) Mapping Symbols of the Confederacy project. Soon to be published in Empty Pedestals: Countering Confederate Narratives Through Public Design. Boone, K. and Deming, E (eds), LSU Press, expected publication: 2024..

lyst projects, and implementation strategies. Public art, pedestrian connection, green network, public transportation, adaptive reuse of historic buildings, enhanced gateways, and housing improvement projects were suggested as the initiatives. This community-based research process helped the community of Bedford strengthen the sense of belonging and collaborate for finding the solutions to their challenges together.

Allen and Queen (2018) use mapping as a critical and participatory research methodology, both in classes and as community impact (Figure 4). This analysis contributes to a new theory of critical placemaking that the investigators use to build upon participatory design, placemaking and critical cartography, maintaining that placemaking through mapping "promotes citizen/ community agency and dialectical engagement in design."(Allen and Queen 2018) Research projects include Mapping Symbols of the Confederacy, a series of maps using primary and secondary data to examine visible and invisible systems of oppression and racism in the built environment, and Housing Equity and Access: A Case Study of Raleigh, North Carolina which explored the rates of change of home values around the age, location, and demographic makeup of Raleigh's different neighborhoods. While these projects are not based on community engagement, the evidence-based analysis and findings certainly provide critical information for both design and policy for future built environments.

#### CONCLUSION

The complexity and reach of architecture are hard to define as it includes so many intangible elements, such as cognitive design processes, and complicated relationships, such as spatial conditions and users' behaviors. Architectural research is essential to help define and describe architecture, as well as look toward actionable design strategies for the future. Rigorous research in architecture provides theoretical foundations and tangible evidence on which students, practitioners, and educators can observe the successes, failures, and impacts of architecture, formulate structured approaches and methodologies around architectural inquiry, and apply the generated knowledge to improve architectural offerings for the future. Integrating rigorous research methodologies and impacts within architectural education is critical for the future of the architectural profession.

#### ENDNOTES

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- https://cordis.europa.eu/search?q=contenttype%3D%27project%27%20 AND%20language%3D%27en%27%20AND%20(%27architecture%27%20 AND%20%27built%20environment%27)&p=1&num=10&srt= Relevance:decreasing

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