

FROM STUDIO TO SYSTEM: A Research - Based Model for Architectural Education

ACSA
Practice & Leadership Award



From Studio to Systems

A Research-Based Model for Architectural Education

This submission presents a reimagined model of architectural education that replaces traditional, form-driven studio pedagogy with interdisciplinary, research-based, and practice-engaged learning. Developed at the University of Notre Dame, this approach addresses critical gaps identified in the 2023 ACSA white paper, including the lack of standardized pedagogies and limited student exposure to real-world stakeholders and data-driven methods.

Guided by three central questions, the model introduces new course formats and collaborative frameworks. Architecture students are embedded within interdisciplinary teams alongside engineers, real estate professionals, and environmental scientists to solve sustainability challenges at both building and urban scales. Courses such as ARCH 43611: Carbon Neutral Development and SU25-34500: Real Estate and Sustainable Development emphasize real-world decision-making, while ARCH 81153: Adaptive Reuse Studio turns the graduate studio into a data-rich research lab.

Experiential learning is further enhanced through immersive virtual reality (IVR) modules and international fieldwork in Singapore, where students study sustainable urbanism in action. Supported by academic and industry partners like CapitaLand, PGIM, and the National University of Singapore, this model cultivates student fluency in systems thinking, stakeholder engagement, and environmental performance. The result is a replicable framework that prepares students to lead in an increasingly interdisciplinary, data-informed, and sustainability-focused design world.

90+ students from architecture, engineering, real estate, finance, environmental science, and sociology have participated in transdisciplinary, project-based courses since 2022.

100% of architecture students worked in interdisciplinary teams with real stakeholders and industry mentors—zero isolated studio work.

8 global industry and academic partners including CapitaLand, PGIM, NUS, JLL, and the

“This course taught me more about sustainability and collaboration than any traditional studio ever did.”

— Architecture student, Class of 2024

“We didn’t just design buildings—we analyzed carbon impacts, debated policy trade-offs, and presented to real developers.”

— Student reflection, ARCH 43611

“This model doesn’t prepare students for the future. It prepares them to lead it.”

— Industry partner, CapitaLand Group

From Studio to Systems

A Research-Based Model for Architectural Education

A **2023 ACSA** white paper identified the absence of standardized, research-based pedagogies as a critical limitation in architectural education. Reflecting on this, we observed two persistent challenges in traditional studio-centered pedagogy. **First**, despite investing extensive time in studio, students rarely engage in interdisciplinary collaboration or work with real stakeholders—skills essential to addressing complex challenges like sustainable development. **Second**, the studio's form-driven, isolated projects often leave students unprepared in data analysis, research methodology, and communication—competencies increasingly demanded by the profession.

In response, the University of Notre Dame interdisciplinary teaching team together with collaborators have developed a pedagogy that shifts architectural education away from isolated studio projects toward interdisciplinary, immersive, and industry-engaged learning. This work asks three central questions:

This practice-informed and leadership-driven transformation aligns with ACSA's call for pedagogical innovation. It offers a replicable model that prepares students to work across disciplines, communicate with real stakeholders, and design in service of environmental and social equity.

Question One:

How can we provide different learning environment for architecture students to gain the analytic, research and interdisciplinary skills?

Collaborative Pedagogy - Engineering, Real Estate, Environmental Science

Question Two:

How can we shift from form-driven design to research-based pedagogy?

Data-Driven Design – Systems and Solutions

Question Three:

What does experiential learning look like without relying on the traditional studio model?

Experiential Pedagogy – Virtual and Real

Teaching Team

Architecture Instructor



Ming Hu
Associate Professor
School of Architecture

Teaching Collaborators



Brett Peter
Assistant Director
the Linked Experimental Ecosystem Facility (ND-LEEF)



Alex Hardy
Program Director
Notre Dame Environmental Change Initiative (ND-ECI)



Jennifer L Tank
Professor of Biological Science
Notre Dame Environmental Change Initiative (ND-ECI)



Diogo Bolster
Professor of Engineering
Notre Dame Environmental Change Initiative (ND-ECI)



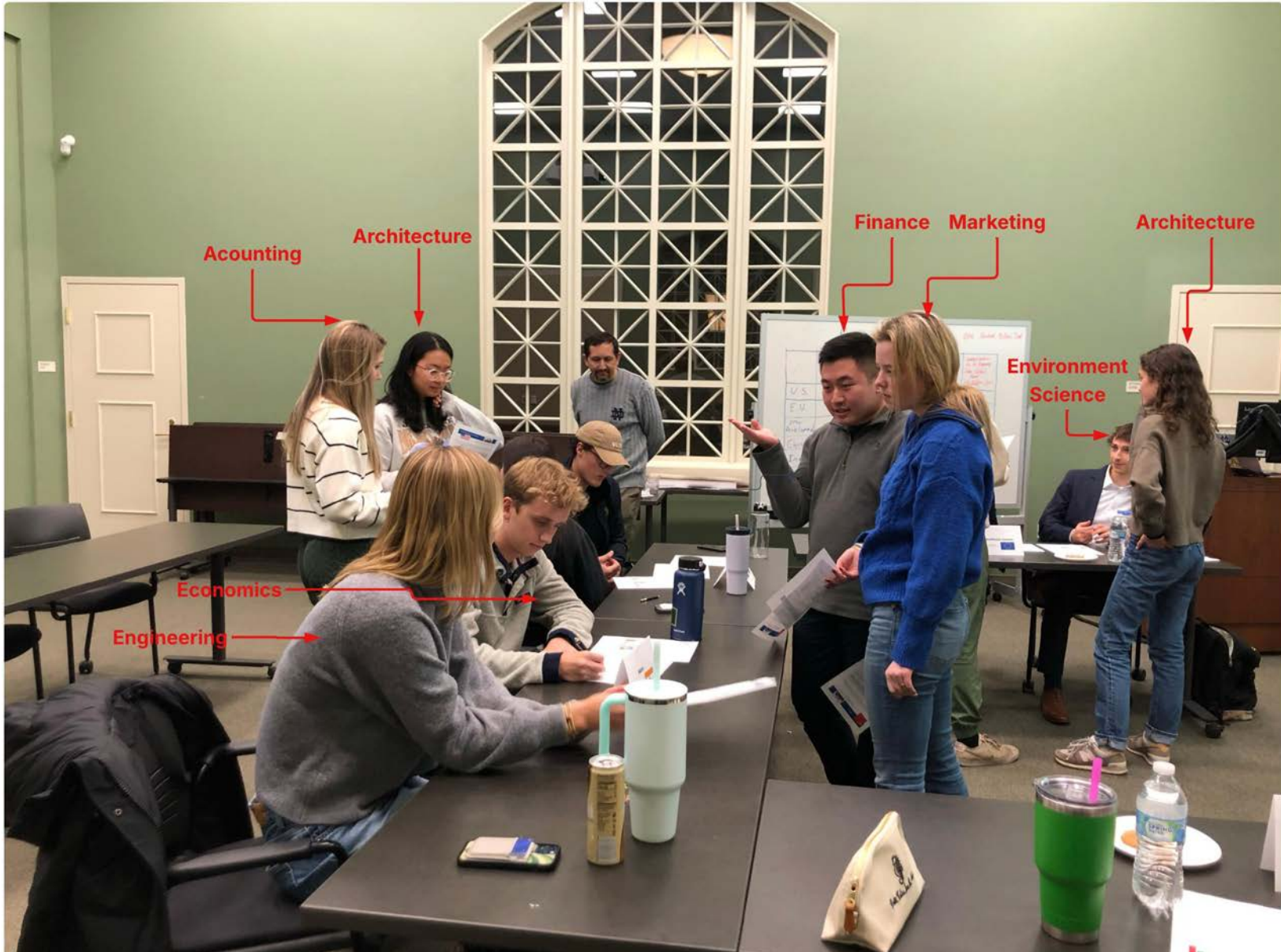
Eugenio Acosta
Senior Associate Director
Fitzgerald Institute for Real Estate)
Director for the Minor in Real Estate



KC Fryer
Director of Academic Media and XR
Notre Dame Learning, Office of Digital Learning



Adam Heat
Digital Project Specialist
Notre Dame Navari Family Center for Digital Scholarship



ARCH 43611: Class activities

QUESTION ONE: How can we provide different learning environment for architecture students to gain the analytic, research and interdisciplinary skills?

Transdisciplinary courses

ARCH 43611: Carbon Neutral Development

We developed transdisciplinary courses and initiatives that embed sustainability at the heart of collaborative learning. By partnering students with engineers, data scientists, and environmental researchers, these efforts equip students to address real-world design challenges through integrated, team-based problem solving.

Student Composition: 12–14 students total, with no more than 4 architecture students. Students are divided into 3 to 4 interdisciplinary teams, each including one architecture student.



ARCH 43611: Class activities

QUESTION ONE: How can we provide different learning environment for architecture students to gain the analytic, research and interdisciplinary skills?

Transdisciplinary courses

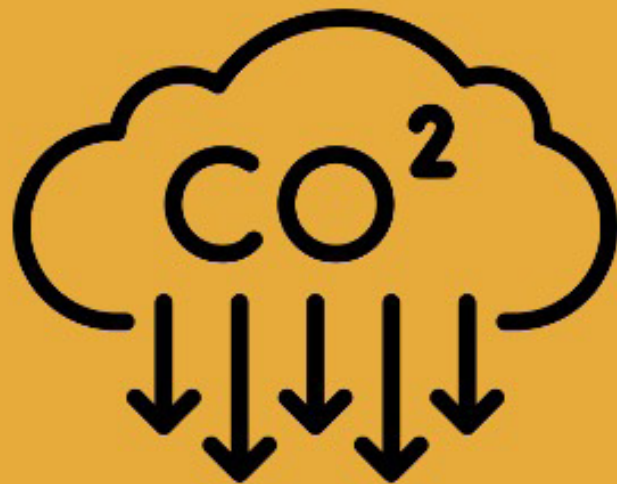
ARCH 43611: Carbon Neutral Development

This course adopts a transdisciplinary framework to explore strategies for decarbonizing the built environment. Emphasizing perspectives from engineering, architectural design, and the social sciences, students engage with complex, real-world case studies—such as pollution linked to rapid urbanization in China and the challenges of revitalizing aging building stock in Germany. The course fosters systems thinking, critical analysis, and collaborative decision-making across disciplines.

This course comprises two modules: (1) **Carbon-neutral development** at an urban scale is examined through three real case studies to explore the different development principles, design strategies, and patterns. (2) **Net zero building design** and related environmental impact are examined in the research literature and real case projects.

Carbon Emissions Diary

Ashton Guo



ARCH 43611: Homework example - carbon footprint tracking (one week)

02
Food

03
Transportation

04
Energy Use

05
Compared To Others



Food

Largest Source of Carbon Emissions:
- My diet consists heavily of meat
Beef Consumption: 0.7kg This Week
Resulting: 46kg of CO₂

Energy Use

Sources of CO₂ Emissions:

Refrigerator: 6.53
Cooling/Heating: 3.8
Computer Usage: 3.6
Dryer (2x this week): 3.5
Washer (2x this week): 3.3



Transportation

Walking Campus

The majority of my transportation consisted of walking, so CARBON EMISSIONS FREE!



Traveling

I traveled to Chicago via Bus for a SIBC project:
Bus (Avg 0.3kg/per mile)
42kg CO₂ Emissions



Final Thoughts:
Measuring food was really hard - I wished there were standardized CO₂ emissions labels like food labels or like a calorie tracker!

Chocolate chip cookies

CarbonCloud Benchmark

Netherlands

Footprint at store



Live footprint: 7.83 kg CO₂e/kg



SU25 34500: Real Estate and Sustainable Development

QUESTION ONE: How can we provide different learning environment for architecture students to gain the analytic, research and interdisciplinary skills?

Immersive teaching and industry partners

SU25-34500: Real Estate & Net Zero Development

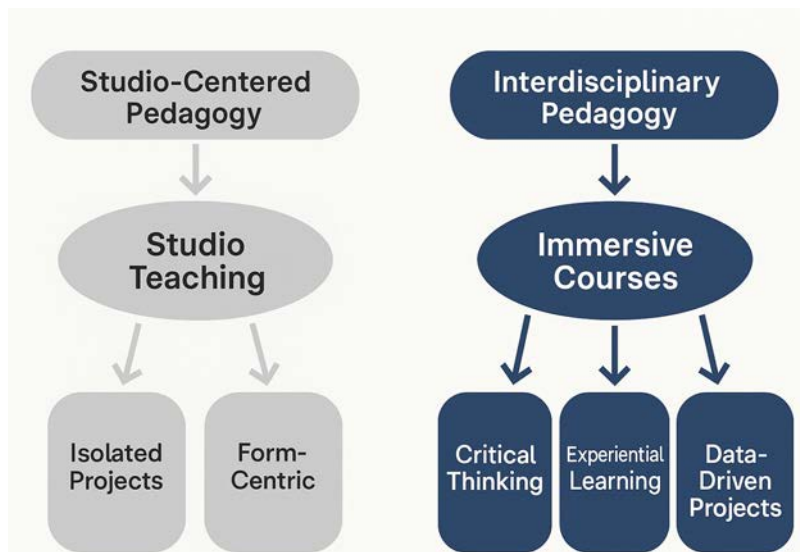
This two-credit summer elective examines the full real estate development cycle through the lens of sustainability and global challenges such as climate change and resource scarcity. Set in Singapore, a global leader in sustainable urban planning, the course offers students firsthand exposure to projects across sectors—hospitality, retail, office, entertainment, and residential.

Student Composition: 27 students total, 9 architectural student, 1 sociology, 1 computer science, 6 Finance, 5 Economy.

The nine architecture students are from different levels, freshman to third year, and they are intentionally being grouped into separate project teams.



industry and academic partners



SU25 34500: Real Estate and Sustainable Development

Course emphasis is placed on the interaction between public policy and private development, particularly in advancing Net Zero goals. Topics include sustainable construction, zoning, transportation, and housing policy, with a comparative lens on practices outside the U.S. All of those typically can not be learned from studio teaching. Even though there are study abroad studio, however, students are often constrained to focus on design task, and working in isolation in the overseas classroom, or focus on particular site or project. It rather limit the opportunities for students truly immersed in an different context that tremendous lessons can be learned.

Students work in interdisciplinary teams to understand how design decisions are shaped by collaboration with stakeholders, consultants, and clients. The course emphasizes that sustainable development is not an isolated design exercise, but a collective, systems-based practice informed by architecture, engineering, and the social sciences.





ARCH 81153: Adaptive Reuse Studio

QUESTION TWO: How to shift to a research-based pedagogy?

Research-based studio

ARCH 81153: Adaptive Reuse Studio

Data-Driven Design – Systems and Solutions

We restructured traditional studios into research-based laboratories where students explore urban and environmental systems, conduct building performance analysis, and communicate evidence-based proposals.

In 2018, Congress recognized architecture as a STEM discipline, validating its foundation in scientific and technical knowledge. However, architectural research activity remains limited compared to other STEM fields such as engineering and also lags behind social science. This gap reflects both a lack of research culture within many architecture programs and the prevailing view of architecture as primarily a professional practice rather than a research-intensive discipline. ARCH 81153 responds directly to this gap by cultivating a studio culture grounded in data collection, interdisciplinary inquiry, and evidence-based design.

FROM INTUITION TO INQUIRY: Evolving Architectural Pedagogy

Traditional Studio Pedagogy

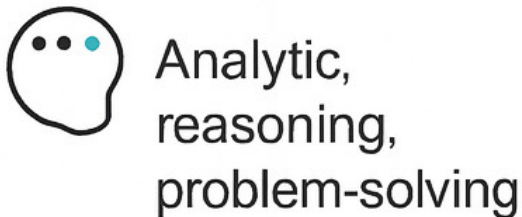
Student Role:



Project Type:



Skills Emphasized:



Assessment:



Outcomes:

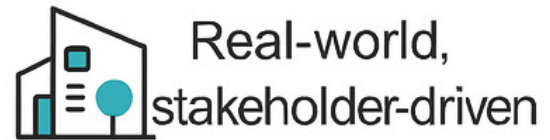


Research-based Studio pedagogy

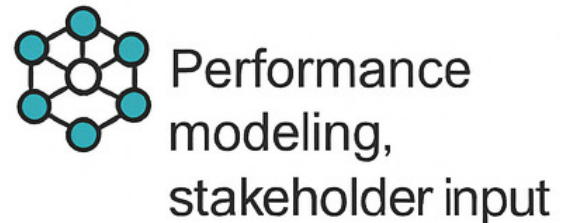
Student Role:



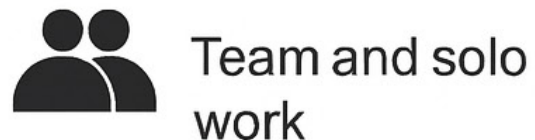
Project Type:



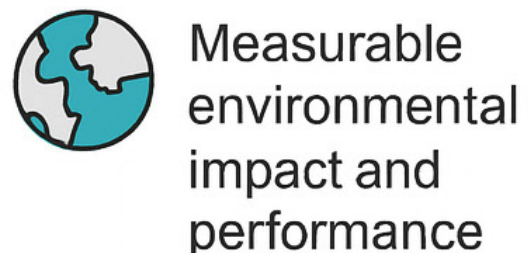
Assessment:



Collaboration:

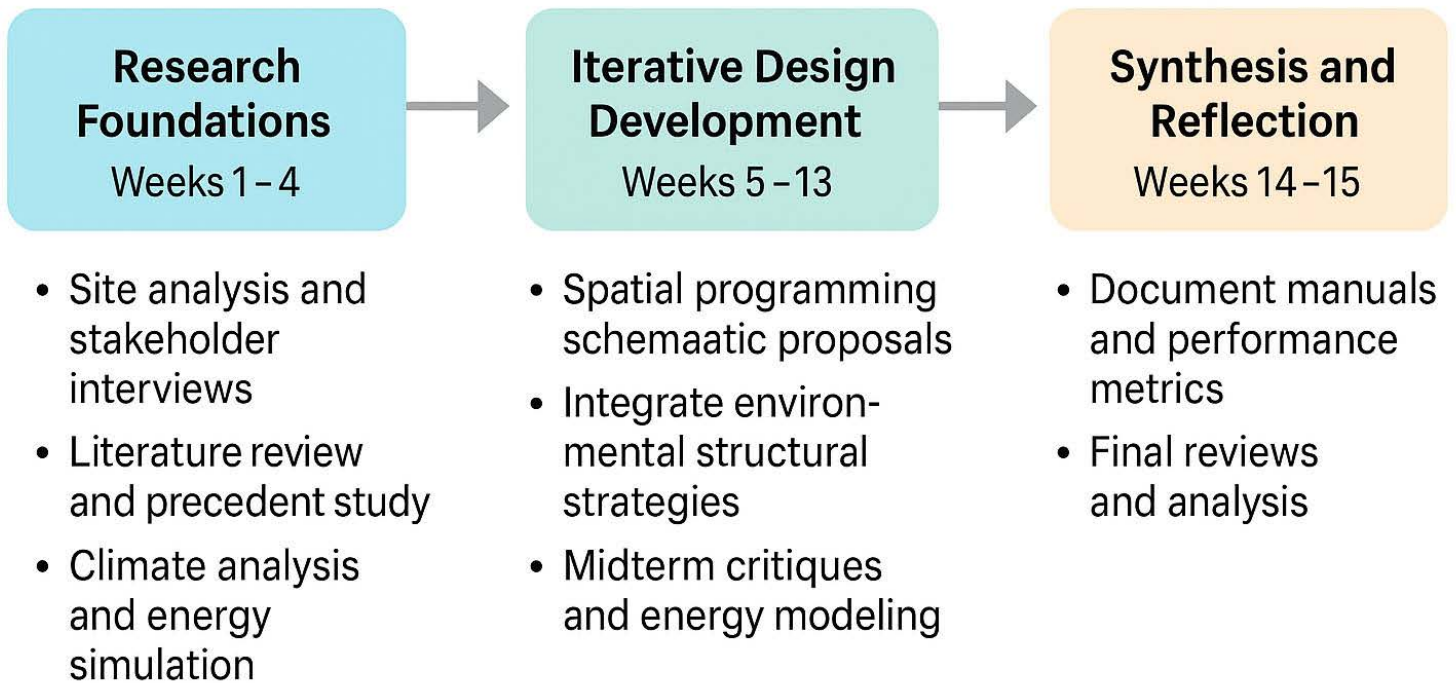


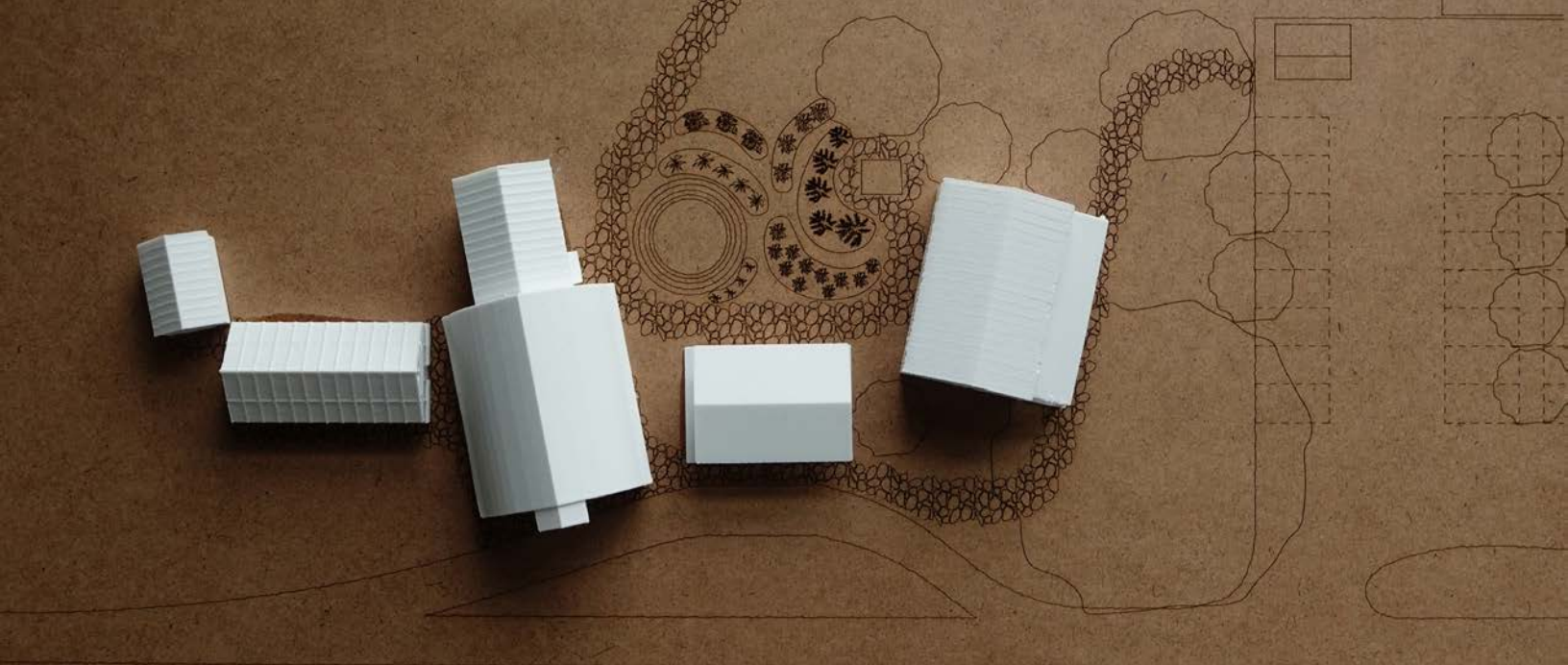
Outcomes:



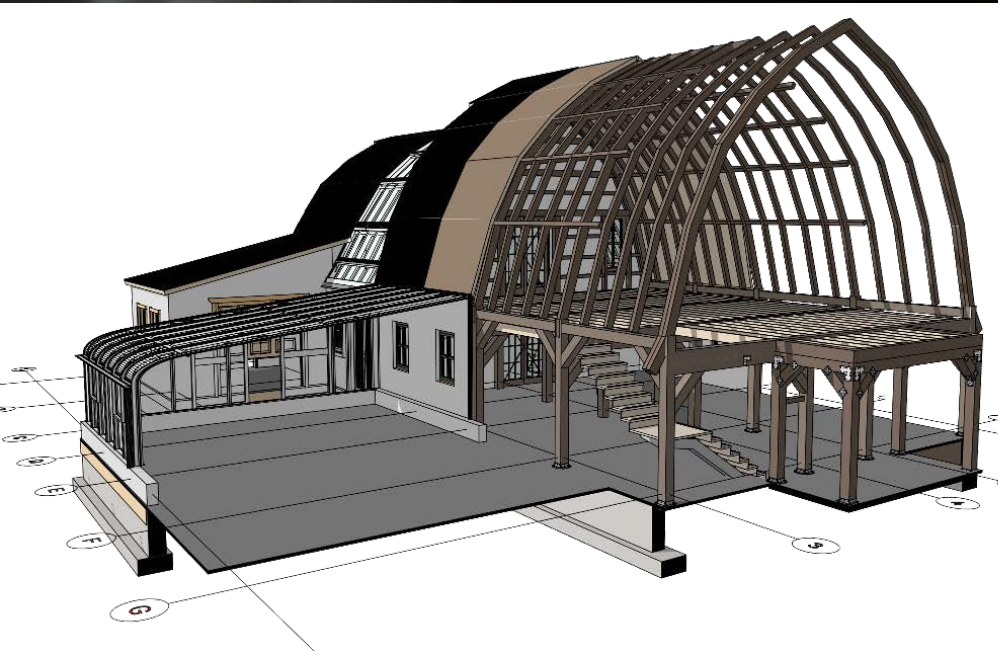


ARCH graduate studio: Adaptive reuse





ARCH 81153: Adaptive Reuse Studio





ARCH 43611: Carbon Neutral Development

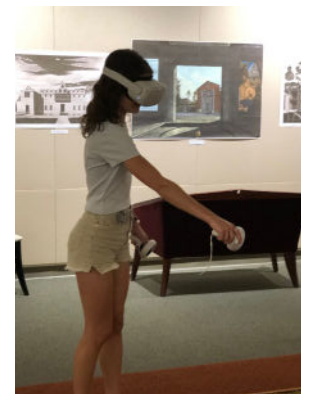
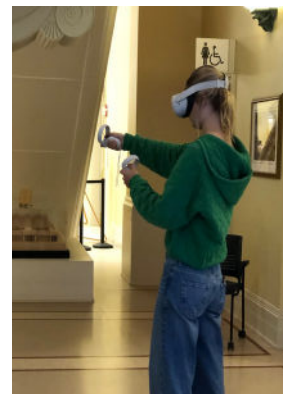
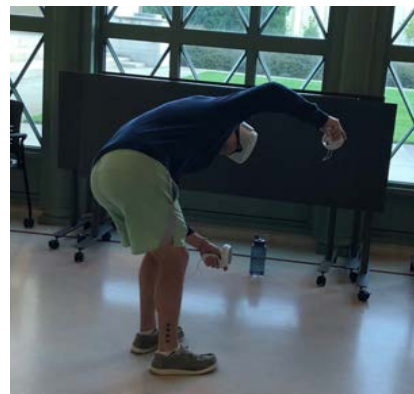
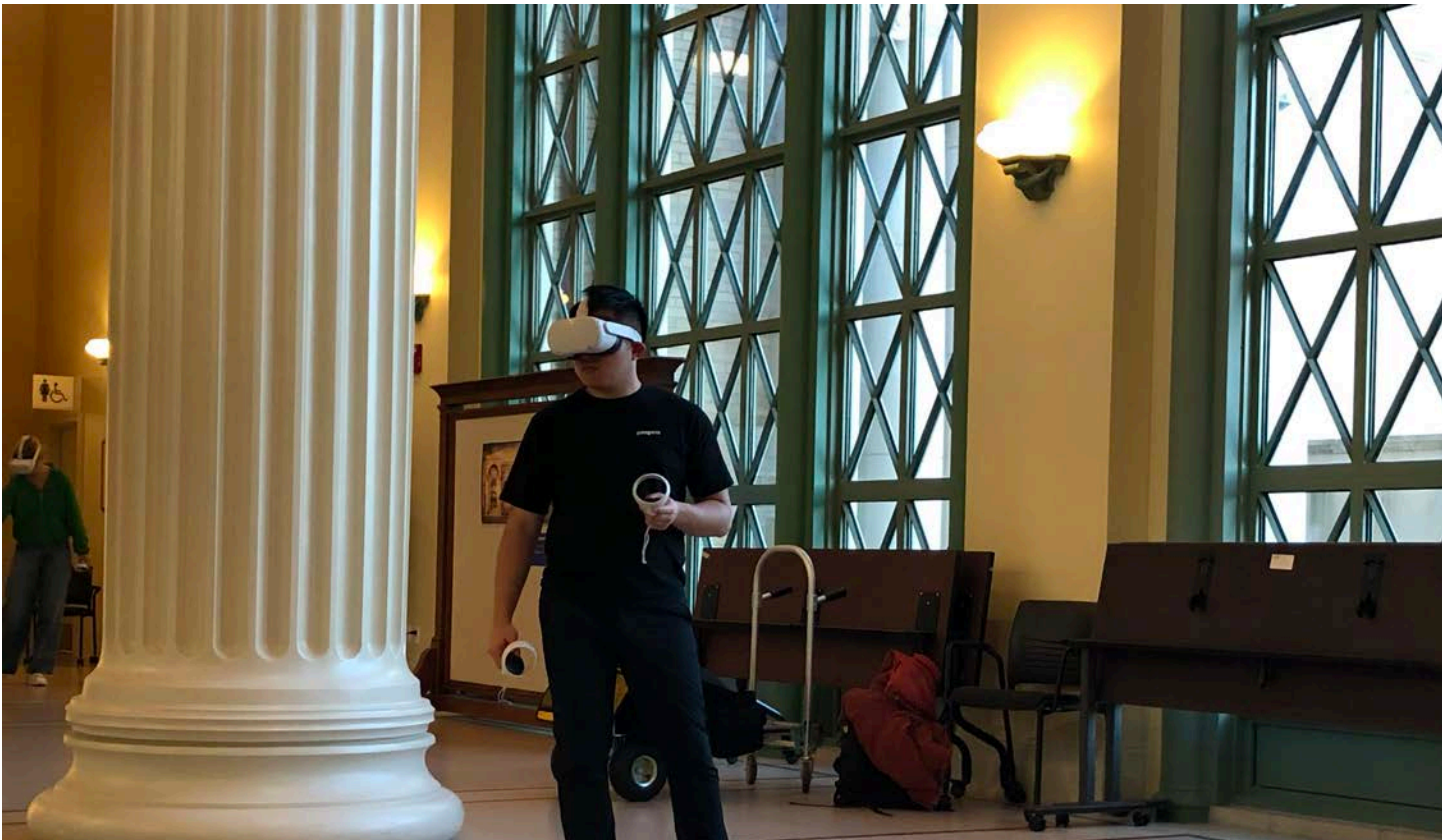


QUESTION Three: What does experiential learning look like in architectural pedagogy without relying on studio teaching?

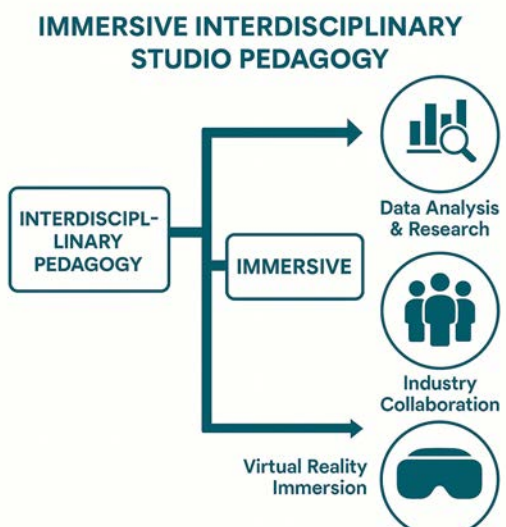
Virtual Reality Immersion

Experiential learning theory emphasizes the central role of experience in the learning process, representing a shift from traditional models focused primarily on cognition or behavior. In architectural education, studio teaching has long served as the primary vehicle for experiential learning. However, as studio culture becomes increasingly isolated and technology continues to evolve, it is essential to explore new modes of experiential engagement for architecture students.

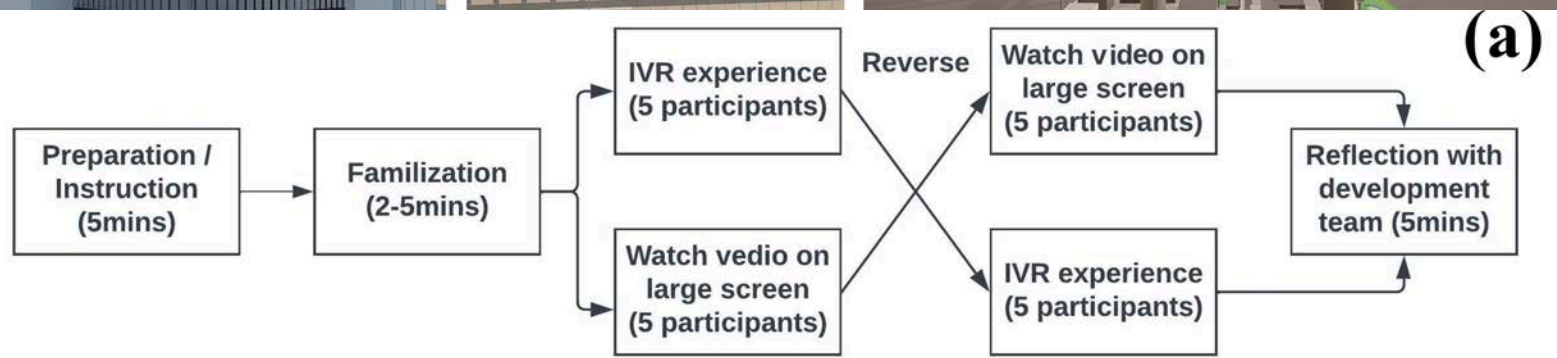
Immersive Virtual Reality (IVR) offers a promising alternative. By creating interactive, high-fidelity environments, IVR enhances spatial understanding and supports deeper learning—especially in disciplines like architecture and engineering, where visualization is critical. Research has shown that IVR can significantly improve cognitive and procedural learning, as well as student motivation and engagement. While challenges remain, IVR's ability to simulate real-world scenarios makes it particularly well-suited for addressing complex, interdisciplinary subjects such as sustainable development.



Virtual Reality and In-person Immersion



In ARCH 43611, five IVR modules are developed to teach sustainable principles: (1) Green spaces and urban planning, (2) Renewable and efficient energy supply, (3) Low-carbon transportation, (4) Energy-efficient design and construction, (5) Sustainable building materials. Hafencity is selected as case study for virtual reality immersion.





JLL office visit / NUS Net zero building tour / Sustainability museum / Digital city visit

QUESTION Three: What does experiential learning look like in architectural pedagogy without relying on studio teaching?

In-person Immersion

SU25-34500: Real Estate & Net Zero Development

Why study abroad in Singapore: Singapore’s commitment to sustainability, guided by its Inter-Ministerial Committee on Sustainable Development, provides a living case study. The city-state’s “Garden City” vision, integration of green space, and pursuit of a Green Economy by 2030 align with global frameworks such as the Paris Agreement and the UN Sustainable Development Goals—making it an ideal setting for immersive learning.

INDUSTRY & ACADEMIC COLLABORATORS

Access to development projects and case studies
Access to development projects and case studies
Hospitality partnership expert
PGIM Real Estate (Global REIT)
CapitaLand Group (Developer)

Hinrich Foundation (Sustainable Global Trade)
JLL (Brokerage & Capital Markets)
Urban Land Institute (ULI)
National University of Singapore (NUS)



Funded Pedgogical Research and Award

\$10,000 University of Notre Dame, Digital Learning Sprint Award
P.I. Ming Hu.

\$10,000 Kellogg Institue for Internal Studies provides undergraduate students authentic research experience, broad mentorship.

Student Presentation and Publication

Bennett Schmitt, Yeji Kwon, Irene Chinchilla Mejia, Caroline Boulton, Nico Villarreal, Sydney Heim Obtained LEED Green Associate certification in 2023, 2024

Student Career Path (sample)

Caroline Boulton
Craig & Company

Bennett Schmitt
University College Dublin, M.S

