

# Reflecting on the Intent of Undergraduate Design Research Coursework

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*ABSTRACT: This paper discusses two research-focused Advanced Architecture Systems seminars in which the instructor's personal research agenda was the impetus for the courses. With comparable student enrollment (year-level, total number, and construction experience), a common foundation to the research was established with consistent background knowledge given to the two upper-level elective courses. By mapping a shift of quantitative vs qualitative investigations, along with a subtle change in the timing of student buy-in, the author draws correlations to the substantial difference in the objectivity and sustained rigor adopted by the students in their final independent research.*

KEYWORDS: pedagogy, undergraduate research, research methods, design as scholarship.

## INTRODUCTION

In the last two decades, students who engage in Undergraduate Research Opportunities (URO's) have demonstrated an increase in overall academic engagement and success at the graduate level (Russell 2007). As an instructor who has focused on introductory courses in the areas of design, technology, and techniques; when appointed to instruct an Undergraduate Research-focused Course (URC), I found myself asking, "At such an early stage of engaging the concept of design research, what role does the foundational levels (*remembering, understanding, and applying*) of Bloom's Taxonomy play?"

This paper discusses two Advanced Architecture Systems electives in which my scholarship in fabric-lined tensile formwork for cast-in-place concrete was the focus. Positioned as Scholarship of Integration, my research draws together structural concepts explored by Frei Otto, flat-sheet fabrication studies by Mark West at CAST, and decades of professional experience in the construction industry (Boyer 1997; Roland 1970; West 2016). When centering my work in these two URC's, I debated if I should expect the students to remember all background knowledge of my interests, to understand my nuanced point of view, and for them to apply new concepts furthering my research? Or, are these URC's an opportunity to use the content (my research) as a means to establish a strong foundation to research practices (Weimer 2013)? At face value, this question sets the direct advancement of the instructor's research agenda against focused effort towards establishing research methods.

The two URCs discussed in this paper saddle a moment in my teaching when I expanded my methods of investigation beyond familiar qualitative deliverables (that too easily fetishized the object) to assignment briefs that nurtured student's interest in communication of quantifiable investigations. In the first attempt at instructing a URC, I focused on qualitative methods and a more studio-like, "research through architectural inquiry" (Frayling 1993). In the second attempt, I aimed to strengthen the students' understanding (and therefore appreciation) of Frayling's "research for architecture" with various approaches to quantifiable design research. With comparable facilities, enrollment, and student experiences, the two courses act as case studies into the impact of the agenda and methods within a URC. Reflecting upon the objectivity and sustained rigor adopted by the students in their final independent research, correlation can be made between the impact of qualitative vs quantitative investigations and the focus of the agenda on the depth of the student learning.

## 1. METHODS

This study establishes commonality between the two courses (*Course A* and *Course B*) by documenting their student demographics, facilities, funding, and the background knowledge seeded at the introduction. The assignments in each course are identified as either those with qualitative deliverables (open and supporting unencumbered design exploration) versus assignments that demand objective quantitative documentation as the deliverable product. In addition, the semester schedule for each class makes note of when student buy-in occurs and their role in the ownership of course content. Conclusions are drawn for a comparative assessment of the objectivity and sustained rigor exhibited in the evolution of students' initial directed work into their later independent research, along with student evaluations.

## 2. FRAMEWORK

### 2.1 Facilities & Funding

Both courses were assigned to equivalent rooms for instruction. Although these rooms were dedicated solely to these courses—allowing supplies to be stored—they did not have plumbing or work benches for construction level activities. No equipment or funding were provided for the students either semester.

### 2.2 Existing knowledge

In both courses, existing knowledge regarding tensile structures was established through the same three readings: History of Fabric Formwork in Mark West's Fabric Formwork Book, Selected projects from Conrad Roland's Frei Otto: Tension Structures, and Fabric-Lined Tensile Formwork for Cast-in-Place Concrete Walls, an article I published in Technology|Architecture + Design.

#### Student Enrollment

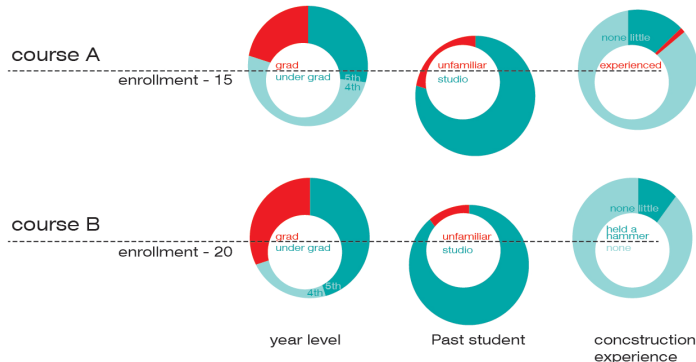


Figure 1: Diagram highlighting similarities between student participants and their construction experience. (Author 2023)

### 2.3 Credit and Schedule

Although both courses were listed as 3 credit advanced architectural systems courses, *Course A* was held for 1.5 hr on Tuesday and Thursday afternoons, while *Course B* was held only on Wednesdays for a single three-hour session.

### 2.4 Method of Investigation

Although the principal research is cast-in-place concrete, in both courses a frame was required as a stand in for a physical site. Students were asked to use the frames to deploy fabric formwork systems and cast concrete forms.



Figure 2: Frame systems utilized as a stand-in for physical site conditions. (Author 2023)

### **Course A semester schedule\_**

#### **A\_ wk o1-o3\_ INTRODUCTION (quantitative + assessment)**

Existing Knowledge was presented through lectures, readings, and hands-on modeling demonstrations. Students were asked to demonstrate their understanding of the existing knowledge by diagramming the structural systems for several of Frei Otto's built work, constructing variations of tensegrity structures, and taking a short quiz. Once the students demonstrated an awareness of the concepts, this Introduction phase ended with a group effort to construct the frames for their future projects.

#### **A\_ wk o4-o6\_ TEAM EXPLORATION (Qualitative)**

In pairs, the students were charged with exploring their ideas on how tensegrity systems might influence the tensile assembly presented in my research. Using their frames, the students wove unique tensile systems as formwork for casting concrete. One cast was required to be submitted. Class time was spent conducting individual team design critiques.

#### **A\_ wk o7-10\_ INDEPENDENT EXPLORATION (Qualitative)**

Having matured an idea in teams, the students were given four weeks to either refine their previous work independently or begin a new direction. One cast was required to be submitted. Class time was spent conducting individual team design critiques.

#### **A\_ wk 11-14\_ PRESENTATION (open)**

The final four weeks were given to documenting and diagramming the logic of their assembly system used in the final casting. A poster presenting how ideas in the existing knowledge (West, Otto, Tensegrity, and the Fabric-lined system) influenced their design decisions.

### **Course B semester schedule\_**

#### **B\_ wk oo\_ PRE-COURSE**

Students were asked to complete a survey and consume the assigned reading prior to the first day of class.

#### **B\_ wk o1,o2\_ BASELINE (Quantitative documentation + assessment)**

Drawing from the pre-course survey, students were divided into two groups--each with an equal cross-section of students with construction experience. On the first day of class, the 'Shadow' group watched me deploy the assembly system to be tested. During this same class, the other 'Blind' group began attempting to construct the same assembly system from written instructions. Both Shadow's live discussions, and the Blind cohort's written instructions, outlined five phases for the construction of a tensile assembly system. The students had two weeks to attempt the formwork a minimum of three times. With each attempt, they documented their times and noted specific troubles for each phase. All data was verified by a second student and collected in a class-wide excel file.

#### **B\_ wk o3\_ DATA VISUALIZATION (Quantitative documentation + assessment)**

Students were tasked with visually analyzing of all the data collected (time and notes) to assess where common problems might have occurred. The only constraint to the visualizations was that the data had to remain a direct import from Excel to Illustrator. First attempts were printed and discussed for their ability to communicate anomalies and/or consistency in the data before submitting a final digital copy.

#### **B\_ wk o4-o6\_ REVISIONS (Quantitative documentation + assessment)**

Taking note of issues highlighted in the data, students were asked to individually proposed revisions to the original five phases to improve how to communicate the deployment of the tensile system. Each student developed an instruction manual which was printed, reviewed in-class, and revised.

#### **B\_ wk o7\_ DEMONSTRATION (Quantitative documentation + assessment)**

As a group, we deployed the tensile assembly system and cast one test together. During the process we discuss various methods and techniques of mixing, pouring, and cleaning-up the concrete along with the potential architectural impact of the system.

#### **B\_ wk o8-10\_ TEAM RESEARCH (Quantitative documentation + assessment)**

Following a class-wide brainstorming session in which students identified multiple areas of interest, students self-selected a research agenda and groups were formed. A one-page research agenda was written and reviewed before the group moved forward. Over three weeks, the students were prompted to assess initial tests for their effectiveness and attempted again to correct errors, establish consistency, or to greater focus the research. A single research document was submitted by each group which documented the initial agenda, the first experiment, findings, revision to the agenda, second experiment, and findings.



## 2.6 Student Evaluations

Three questions have been selected from the two courses' student evaluations. Please note: Between the instruction of these two courses, the university elected to comically flip the scale from (1 High – 5 low) to (5 high – 0 low).

### Course A

Assignments were pertinent to topics presented in class_	1.0	(1 high - 5 low)
Assignments were well spaced throughout the course_	1.33	(1 high - 5 low)
The demands made upon my talents were exciting and challenging_	1.33	(1 high - 5 low)

### Course B

Assignments were pertinent to topics presented in class_	5	(5 high – 0 low)
Assignments were well spaced throughout the course_	4.67	(5 high – 0 low)
The demands made upon my talents were exciting and challenging_	5	(5 high – 0 low)

## 3. ASSESSMENT

### 3.1 Deliverables

Similar in outline, these two courses each dedicated time to establishing Existing Knowledge followed by two phases of research: first as a team then independently. A significant difference between the curricula can be found in the deliverables for the exercises within the Existing Knowledge phase. *Course A* drew from my studio experience with the first week dedicated to introductions to my research and group discussions regarding the readings. Once the conceptual idea was clear, we then spent time together bonding as a group while constructing frames for their projects. *Course A*'s three weeks of Existing knowledge phase ended with the submittal several aggregated items (a series of structural diagrams of several Frei Otto tensile structures and initial structural concept models that explored principles of tensegrity) along with a quiz on the history of fabric formwork. Little weight was given to the grading of these items, as they were seen as loose contextual experiences to inform their future research through architectural inquiry.

In comparison, prior to the first day of *Course B*, the students were required to complete the assigned readings and take a survey regarding their construction experience. With this survey already completed, attempts to construct the tensile cushion formwork began immediately. Unlike *Course A*, where the assembly system was merely a starting point for them to explore, *Course B*'s Baseline demanded rigor in the examination of their personal learning process. The "product" of their efforts was the data they produced documenting their time and struggles. From the initial assignment forward, *Course B* focused on the student's ability to communicate the data collected. Not only did the second assignment, Data Visualization, explicitly do this, this assignment also demonstrated the usefulness of collecting data as the students were asked to find similarities between their struggles and revise the instructions they were given. The Revision assignment reinforced their ability to communicate the logic of the assembly system and take emotional ownership of the concepts involved. Unlike *Course A*, where the students only diagrammed Frei Otto's work, both the Data Visualization and Revision assignments gave the students opportunity to strengthen and find success with graphic skills in the clear communication of the complex information that they had accumulated. A live Demonstration was held the final week of the Existing Knowledge phase where I constructed and cast an example wall. It was only then, 7 weeks into the semester, that the finish "object" is brought into focus. And even when it is, the focus of the discussion was on how to demonstrate mastery of the process with accuracy and speed.

### 3.2 Student Buy-in

Not an assignment, but in both semesters lectures and discussions were held inviting the students to dream about the possibilities of the research agenda's potential. *Course A* initiated this the first week with passionate talks about how the work of Frei Otto, Mark West, and concepts like tensegrity have personally inspired the author's personal research. Beautiful imagery was used to seed their imagination while open ended questions helped fever speculation on the possibilities that might grow from their work. In effect, the student's energy was direct, from the first week, towards exploring new frontiers. This place "research through architectural inquiry" as the agenda for the course almost immediately.

*Course B* withheld this moment of buy-in until the 7th week of the semester. In the build up to these discussions, the assignments nurtured the student's creativity in, and they were rewarded with praise for, the skills with which they communicated the quantifiable data they collected. When the "buy-in" finally happened in the 7th week of *Course B*, a rigorous process supporting "research for architecture" had been set for the semester (Fraybil ). The students' creativity was focused on strengthening a recursive research agenda and communicate their findings.



### 3.3 Student Work

Although students in both courses worked diligently throughout their respective semesters, the Independent Research assignments in *Course A* demonstrated an distinct lack of sustained rigor in their investigation. Whether during in-class design critique or in the transition between their Team Research and selecting a final Independent Research Agenda, the students routinely discarded their previous work when the artifact created did not live up to their preconceived design intentions (loss of objectivity). In comparison, the work in *Course B*'s final Independent Research explicitly walks through the primary research developed in the Team Research Agenda, their new proposal, results, as well as conclusions outlining future research areas.

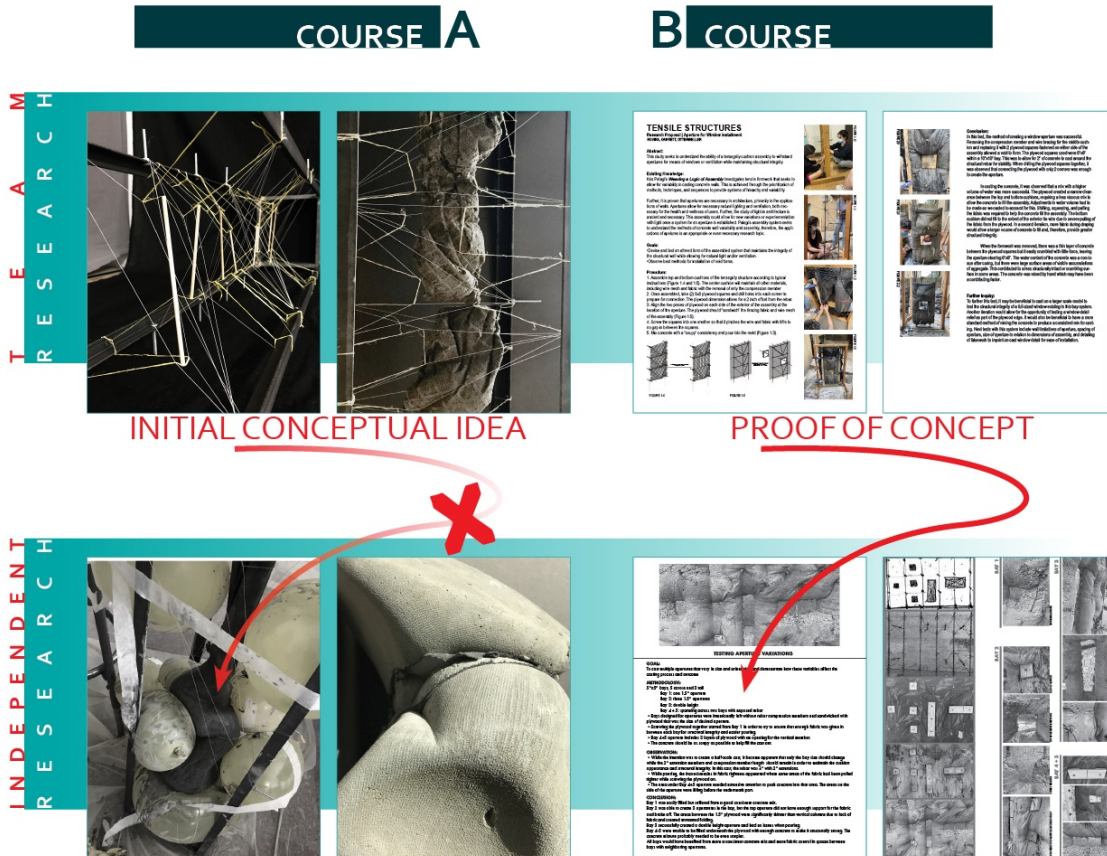


Figure 3: Selected student work depicting the continuation of student agendas through the semester. (Author 2023)

### CONCLUSIONS

As a professional transitioning to academia, like many others, understanding the methodologies relevant to scholarship within architectural design has remained a hurdle (Buday 2017). But more so, the effort to break away from a mindset in which all design efforts must conclude in a refined, completed product. This remnant of my professional experience has had a direct influence on my pedagogy, the deliverables assigned, and how they are assessed. Within the design studio, I approach the concept of rigor in one's design process through pragmatism and plurality (James 1907; Jenck 2013). The first by assessing qualitative investigations against an ever-increasing body of experiences and the latter, the systematic competing of multiple, opportunistic paths. I mention this to stress that I feel a critical design process, Farley's "research through architectural inquiry" holds a place in design as scholarship. When considering URO specifically, I have found the specific questions regarding the agenda and the method employed in the research need to be thoughtfully considered. For an undergraduate class, should the agenda focus on the progression of the specific scholarship or is the content best used to establish fundamental research skills (Weimer 2013)? Regarding the methods employed, although both qualitative and quantitative investigations are fruitful in design as scholarship, is one approach more effective at developing a foundational knowledge of research methods?

Reflecting on the consensus with which students in *Course B* independently approached their final research projects with continued systematic rigor, I believe spending the first 7 weeks focusing on how we conduct research, may superficially take class time away for the research agenda, but had impact on the depth with which the students independently pushed their work. When introducing research that would fall into Frayling's

notion of “research for architecture” to undergraduate students, reinforcing a scientific quantifiable investigations early as with *Course B*, appears to allow the recursive nature of research for architecture compared to familiar and loosely defined qualitative methods.

With the second course conceptually shifting the students focus from presenting the object to presenting the data, I was surprised to find the students evaluations maintain an equally high level in both courses when considering the “demands made upon my talents were exciting and challenging” and “Assignments were well spaced throughout the course”. Each of which I would have expected to have been more positive in the familiar studio-like environment of *Course A* than the highly structured, quantifiably focused *Course B* curriculum. Which leads me to conclude, when developing curriculum for courses focused on UGO’s around an instructor’s agenda, time spent early in the semester nurturing the communication methods with which you plan on documenting your later research (rather than convincing the students of your research’s potential) is effective in establishing rigor in how they examine what they themselves find inspiring.

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## REFERENCES

- Boyer, Ernest L. 1997. *Scholarship reconsidered: priorities of the professoriate*. 1st edition. Princeton, New Jersey: Carnegie Foundation for the Advancement of Teaching.
- Buday, Richard. 2017. *The Confused and Impoverished State of Architectural Research*. CommonEdge <https://commonedge.org/the-confused-and-impovertished-state-of-architectural-research/> (07.27.2017)
- Frayling, Christopher. 1993. *Research in Art and Design*. Royal College of Art, Research Papers, Volume 1, Number 1, London.
- James, William. 1907 (2019). *Pragmatism: a new name for some old ways of thinking*. Gorham, ME: Myers Education Press.
- Jencks, Charles, and Nathan Silver. 2013. *Adhocism : The Case for Improvisation*. updated ed. Cambridge, Massachusetts: The MIT Press.
- Palagi, Kristopher. 2020. *Fabric-Lined Tensile Formwork for Cast-in-Place Concrete Walls* Technology|Architecture + Design, 4:1, 56-67, DOI: 10.1080/24751448.2020.1705719. 2020.
- Roland, Conrad. 1970. *Frei Otto: Tension Structures*. New York, Praeger Publishers.
- Russell, Susan H., Mary P. Hancock, and James McCullough. 2007. *Benefits of undergraduate research experiences*. Science 316.5824 (2007): 548-549.
- Weimer, Maryellen. 2013.  *Learner-centered Teaching: Five Key Changes to Practice*. Second edition. San Francisco, Jossey-Bass.
- West, Mark.2016. *The fabric formwork book*. New York: Routledge. Print. Pgs. 17-37