Deconstructing Design Research in Design Studio Pedagogy: Lessons from an Action Research

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Inclusive, introspective, and meticulous research plays a crucial role in the types and qualities of insights and the rigor of the knowledge created by architecture's design creations. Design research deliberations in multidisciplinary contexts (including architecture) have explored positive dispositions while likewise acknowledging both definition and methodology-related uncertainties coupled with an identified immaturity for design research in general. With regards to research expectations for design process, what might be understood in a rather straightforward or intuitive manner by an expert researcher or experienced designer can pose difficulties for a novice, while resulting in even more misunderstandings for a beginner-level learner in architecture school. Even at expert levels, such characterizations as research *for*, *into*, and *through* architectural design can be perceived inexplicable, and certainly more daunting for novice learners. For the latter, doubts on research constituents and processes can quickly escalate, clashing not only with prior misconceptions on the idea of research itself, but also on design process, raising issues as to what design itself is supposed to be and what a design process should look like. All such doubts are part of what learners carry with them into design processes early on upon entering any design studio. Intertwined with their pre-knowledge impacting their essential effective skills, such misunderstandings must be addressed in advance before they can get in the ways of learning.

This article draws on and shares the process and outcomes of an action research project conducted during the 2020-2021 academic year supported by Drury University ITC's "Action Research Fellowship" program. Focused on exploring the teaching of research skills in design-centered learning environments as its umbrella theme, the study-in-action examined how curriculum design and instructional activities might better assist novice architectural learners in making sense of nuanced complexities of design research expectations to make better use of applied research prospects in design. The need for conducting the study was identified during the author's first year at the new institution, based on primary reflections on the different instructional needs. The scrutiny was comparative to schools with STEM-based or more technology-driven curricula, or those specifically cultivating more demanding research environments due to, for instance, housing doctoral programs. Two questions guided the study: What pedagogies can help tackle misunderstandings early on, and help demystify and streamline the process of design research? What effective teaching methods can enable and further enhance learners' research aptitudes? The study began by pre-assessment probes to locate misunderstanding patterns and identify learner perception variations, for example, on what they see as act of design (as creative and open-ended, and meticulous?) or [pure] research (as rigorous, systematic, logical, or creative?).

THE ACTION RESEARCH PROJECT

Agile reflections on teaching experience during first academic year at the new institution motivated this project. Holistic first-impressions exposed learner pre-knowledge and attitude traits regarding methodical and rational investigation. After a proposal submission, the project was selected as part of Drury's 2020-2022 "Action Research Fellowship" cohort, allowing dedicated time and efforts for a reflective teaching practice (Schön 1987).[1] Despite being precipitate in nature, early reflections helped not only get acquainted with the academic culture of, but also nimbly assess and adjust relevance and effectiveness of personal teaching styles for the new context. The project simultaneously examined, applied, and tested pedagogies on teaching design research aptitudes. The research-in-action[2] resulted in the examination and discovery, along with readily-usable pedagogical models, enabling simultaneous application and valuation of learning impacts. Research aims were twofold: instructional design examination influencing beginner learner design-research learning experiences, and pedagogical application enhancing learner aptitudes in making sense of nuanced complexities of research in design studio. Research began with two premises: indispensability of earnest research in design success and relevance to society, and nebulousness of architectural research in process and intent. Sound methodologies and learner value changes were considered needed to dismantle any anecdotal perceptions, demanding more trustworthiness and objective directionalities.

Elusive nature of architectural design research may challenge even savviest researchers and practitioners. Misunderstandings persist at all levels while conceding the important role of
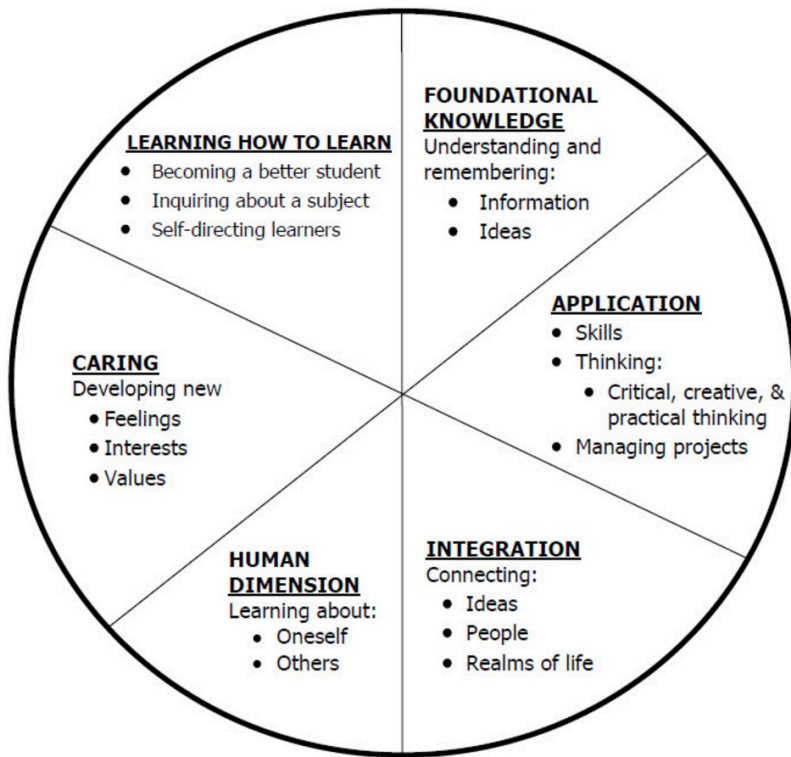
Figure 1. Taxonomy of Significant Learning
(Fink 2013, 30)

inclusive, effective, and rigorous applied research impacting the types and qualities of the insights and knowledge created by design. The study promoted Fink's (2013) identification of "significant learning experiences."[3] By emphasizing on systematic examinations (vs. haphazard), teaching methods invited the pursuit of diverse knowledge genres holding both tangible and intangible linkages with design. Propositions collectively asserted deeper investigations even more at beginning levels to educate the future generations and with that expand design creation relevancies to society's pressing problems. Pedagogical explorations and innovations deem essential; prior studies are recognizing both an immaturity and ambiguities in definitions and methodologies of design research. Studies see them to be even more complicating by learners' prior misconceptions Uncertainties mainly subsist on what is meant by research for, into, and through architecture. Hence, the action project aimed at tackling misunderstandings to help demystify and streamline the perceived daunting process with operative teaching methods to enable and enhance research aptitudes during standard undergraduate studio procedures. The involved coursework recognized some desired learning-outcome attitudes and abilities: to 'investigate conditions as found', to 'suspend judgement for as long as possible', and to 'use findings to suggest new ways to (re)shape the environment'. These LOs were considered essential, with significant impacts for teaching research aptitudes and imperative for communicating underlying complexities of research procedures at beginner levels.

Commonly applied in architecture, problem-based learning requires that learners begin with ill-defined questions in the category of wicked problems.[4] With these types of problems, a reasonable aim and common procedural expectation is to conduct preliminary analysis, collect new information, evaluate the relevance of the information, propose a design solution, and assess quality of projected solutions. However, in reality such a comprehensive procedure may not fully materialize in a typical design studio setting, not finding needed time and space. Deficiencies may stem from a plethora of issues ranging from confusions about what research is, to clashes between the urge for self-promoted creativity and necessity to integrate an overwhelming pool of important factors including too many concrete realities. In addition, deficiencies may result from course design and pedagogical complexions caused by flawed workflows with regards to desirable synergies between processes of logical research and creative design. On top of these, deficiencies may be linked to learner pre-knowledge and skills, entering the process with insufficient preparation, narrow worldviews, and limited thinking capacities rooted, perhaps not even in higher education, but, in their prior K-12 education. Vis-à-vis the LOs pinpointed earlier and the need for dynamic problem-solving, reflective thinking and methodical reasoning are the more likely missing aptitudes playing parts in design conjunctions with good research. This action research had projected to detect and identify such gaps based on empirical evidence so it could create learning experiences that students and others can agree are truly significant. With the project

evolving in action, learning experiences were further defined and characterized, followed by a final effectiveness assessment.

The literature on the topic suggests existing ambiguities for the field of design research. Despite abundant theoretical studies, majority only stay at expert levels while research issues in contexts such as design studio and pedagogies remain under-discussed. Architectural education is the threshold where knowledge on significance and rigor of research forms and is also the place where it can feel more intimidating. Research requirements can quite simply get muddled with perceived confusions on processes and prolong beyond education. Becoming difficult to unlearn later on, such misunderstandings can carry on into the realm of practice. This action research project was able to link part of the confusions with one underlying clash-of-definitions dilemma. *Research* in general denotation is careful and systematic examination through in-depth testing, trying, and probing for determining facts and principles while *design* in general apprentice perceptions may resonate as loose-fit creative endeavor with lesser determined rulebooks and specifics. When the combinatory design-research is put together, more misunderstandings can arise. In actuality, however, we know that architectural design process itself requires as much rigor as research coupled with balanced measures of both divergent and convergent thinking and inductive and reductive reasoning. These are on top of demands for broad-mindedness, open-endedness, holistic thinking and global-local perspectives. Furthermore, responses to assignment problems in design studio originating *while* in research modes *while* designing complicates the dilemma. Perceived connotations may collide, generating time-related competitions and conflicts of interest impeding fruitful crossroads between design and research. Recognizing and planning for facing the dilemma is a key "threshold concept"[5] for all design learners. That; design as a multifaceted cognitive endeavor requires as much inventiveness as rationality applied for research thoroughness. Henceforth, pedagogies must synergistically draw and educate on all realms of critical, creative, and pragmatic thinking. Enhanced learning requires premeditated and unambiguous explications of design and research intersections and the transfer of customized sets of knowledge to cultivate non-binary worldviews and erudite abilities in learners.

If early learners perceive research only as linear and scientific based on full determinism, and design only as nebulous, subjective and unrestricted, pedagogies for cultivating reciprocities and interdependent knowledge connections between the two deem essential. Grounded in this, emergent questions developed on how more streamlined and regimented, yet, flexible progressions of research can be taught in studio explicitly based on each assignment's specific needs. An early goal was a broad search for best pedagogies to help eliminate learner confusions, demystify researching, and retune expectations learners carry into each studio with on what research means to them. The fellowship presented the time and space to explore pedagogies for articulating dissimilarities and overlaps between acts, intentions, and processes of design and research and problematizing separationist outlooks early on for learners. The project reflected on pedagogical effectiveness to discover, practice, and internalize some operative teaching tools and strategies. The study engaged the following overarching questions: how can course design and instructional activities enhance to perform better in coaching design as research, and create significant learning experiences for students? What pedagogical models are out there for teaching the underlying complexities and relevance of inquiry in design to enable and enhance design-research aptitudes?

BACKGROUND

General consensus exists amongst architecture academia for architecture as form of knowledge to urgently advance through research in order to generate new knowledge and strengthen its positions both in practice and university. Aligned with this is the notion that 'designing' as the core activity in the discipline must put more emphasis on research. Studies also acknowledge that research only producing packaged information for rationalized design is inadequate, and outcomes merely seen as scientific knowledge or fully systematized rubrics for direct design assimilation is problematic. These views of research lessen the vital designer reliance on intuition and deep-seated rules of thumb in response to design problems. In contrast, research must be viewed as a way to provide designers with stronger theoretical, operational and heuristic foundations based on which to speculate, rather than as information to regulate results.[6] Other studies, however, draw on a need for a more systematized research, criticizing how architecture mistakenly thinks of itself as already learnt and how there is a massive disconnect between design and research. Moreover, studies suggest that both academia and practice, despite being supportive of the need for research, seem to be confused about it. Unlike institutionalized research in natural and social sciences, and humanities, architecture is untaught, untrained, and oblivious about research.[7] In a canonical essay debating tenets of research in architecture, Till (2008) calls on the need for abandoning three major "myths" that have restrained the development of research in the field: "architecture is just architecture" (resulting in marginalization of architecture), "architecture is not architecture" (resulting in forgetfulness for architecture), and "building a building is research" (resulting in delusional confidence and renunciation of good research). This essay concludes with a counter-thesis to the three myths. That; architecture does have its particular knowledge fundamentals and processes, but this is not a justification that standard research procedures can/should be avoided. Normative measures of research originality, significance and rigor must still apply, while requiring additional efforts to visibly outline architecture-related specificities of contexts, scopes and modes of inquiries apt for the discipline.[8]

Broader discourses in the literature conceive design research as a multidisciplinary concept, in line with what Lunefeld (2003) calls out within the vast territory of "design clusters."[9] In this broad space, understanding and empathy for the people for whom the designers design becomes critical. Because designers are not creating their own vision without inputs from others, as Ireland (2003) puts, "if they desire to attract and delight customers or audiences for their work, they need to understand the people for whom they design (22)."[10] Akin to concrete demands of contexts and scopes in architecture, broader design-research prerequisites also demand meticulous investigations to comprehend the wants and wishes of diverse populations. Broader 'design thinking' attributes are determined and expanded upon through the well-known IDEO.org's framework and process. In human-centered design, designers consciously work to understand the experience of clients and customers as insights both informing and inspiring the design work.[11] In human-centered design's prescribed approach to design research, the concept of 'empathy' as both mental habit and knowledge gain is seen as important constituent.[12] In a comprehensive review of design research literatures, Bayazit's (2004) posits design research as a multifaceted attempt to answer obligations of design to humanities, achieved by studying, researching, and investigating human beings' artificial made things, while understanding how these activities have been directed in multidisciplinary academic studies or manufacturing organizations (16).[13]

Historically, design research was narrowly demarcated only as research that went into the process of design connected to design methodology. This idea was later extended to also include research that is embedded in the actual process of design. Prior to the promotion and popularization of the notion of design thinking, Archer (1981) defined design research as a "systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value, and meaning in man-made things and systems (31)."[14] This definition is specific, differing from, while partly overlapping with, a general description of social research as a systematic inquiry to describe, explain, predict, and control an observed phenomenon.[15] Prior to the indications, earlier writings had identified an emphasis on design methodology itself being vital, alive and living under the umbrella of design research. Archer (1979) had theorized the existence of a "designerly way of thinking and communicating that is both different from scientific and scholarly ways ...[but] as powerful, ...when applied to its own kinds of problems (17)."[16] Still today, Frayling's (1994) multilayer categorization remain central to design research knowledge. Alluding to triad paths of research 'into', 'for' and 'through' design, the descriptions address specific relationships between design and research. If interpreted particularly for architecture, in research 'into', the subject matter is architecture. This is often more common in architectural research (e.g. with interpretive-historical research, or descriptive building performance studies). In research 'for', a future application is the goal, which is more common in the types of research done in/for practice (e.g. on building

materials, or for typological, programmatic and technological investigations). In research 'through', architectural creations themselves become a part of the research methodology, which is prevalent both in academia and practice.[17] The research through or the design-as-research maxim has been both a popular and arguable theme. Designerly ways of producing knowing and knowledge are emphasized as the kind of research designers are engaged in when designing. Essential investigations formed in/by the design process are considered capable of developing into strong means and channels to discover new knowledge and insights for design.[18]

Mapping an existing landscape of design-research studies reveals a good stretch of productive history with wide-ranging thematic and compound cross-references to multidisciplinary design clusters, and design methodologies in architecture, arts and sciences. Current disciplinary sources recognize an all-time emerging field for investigation in architecture, while raising questions about ways of strengthening research process structures in bettering the types of insight and knowledge that architects create. Current pools likewise acknowledge the subsistence of quandaries in design-research definitions and methods, hence, demanding further explanations. A supportive working definition of architectural research offered is the "processes and outcomes of inquiries and investigations in which architects use the creation of projects, or broader contributions towards design thinking, as the central constituent in a process (Fraser 2013, 1)." Characterizations include the general research activities of "thinking, writing, verifying, debating, disseminating, performing, validating and so on (2)."[19] Furthermore, design research is seen by the literature as an area separate from systematic and method-based investigations constituting academic research, which can both be complicated and enriched by the role of practice.[20] A rather immature field compared to traditional research, design research misperceptions are partly linked to design itself being seriously misunderstood.[21] Particularly, the formality, rigor and validity of independent design-formed inquiries are opposed by important voices. Represented in Groat and Wang's (2002) volume on research methods in architecture, design investigations are visibly differentiated from good research methodologies. Further elucidations and differentiations between academic research and design research are needed in support of recouping the genuine diverse tenants of research for the field of architecture.[22] Despite broad awareness gained on the topic, partly referenced in this background section, the current pool seems not fully reflecting the nuanced complexities in connection to early design education, exposing a prerequisite for furthering explorations through applied and/or action-oriented research. Future thinking and theorizations must evaluate and boldly problematize some of the ingrained myths and fallacies in the context of education.[23]

RESEARCH DESIGN

The action research project was completed in two parts, using: [1] analytical approach for knowing [things] to change [a situation]; and [2] action research for changing [a situation] to know [things]. The analytical part built knowledge foundations and lines of action for extracting recurring patterns while the action part reflected on the efficacy of extracted components through application in pedagogies, integrated and naturalized as routine community design studio activities. Seventy undergraduate students (3rd + 4th year) participated in the study over the course of three consecutive semesters (spring 2020, fall 2020, and spring 2021). Ranging in scale, studio topics in all three included major community-based learning components and required participatory design processes. Information collection strategies included narrative-based questionnaires, observational vignettes, learner-generated artifacts, and faculty and community review comments. Gathered information was analyzed and synthesized in three stages of: pre-assessment, teaching interventions, and post-assessment. Prior-knowledge probes revealed prevalent learner knowledge traits, summary syntheses of which later on helping generate initiating-point premises for understanding the what/why behind learner misunderstandings. Lessons learned from the process of pedagogical experimentation were simultaneously applied throughout and (in)formed the study. The action research's information collection, analysis, and synthesis processes and outcomes are captured in subsequent images, diagrams and captions.

| PRE-ASSESS | TEACH | POST-ASSESS |

Evaluate what learners know and how learners think coming into the course to identify pre-knowledge gaps and misconceptions

Deliver content explaining key concepts and applying selected components

Evaluate final [design] outputs and assess [design-research] rigor

Research
systematic inquiry to describe, explain, predict, and control the observed phenomenon (Babbie, 2015)

Architectural Research
'systematic inquiry ... ' linked directly with architectural design research for, into, and through architecture (Frayling, 1994) rigorous investigation expanding into creation

Design Research
systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value, and meaning in man-made things/systems (Archer, 1981)

Strategies: Written Questionnaire, Observational Data (Field Notes and Photographs), and Learner-Generated Artifacts (Process Reflections, Concept Maps and Culminating Design Outputs).

Pre-Assessment Questions: [A] Define Architectural Research. Compare/Contrast Research and Architectural Research. [B] Compare/Contrast Design with Research. [C] Define Design-Research.

Timeline: Information Collected in Three Consecutive Semesters: Spring 2020, Fall 2020, and Spring 2021

Total Participants: 70 Students (24 [S20] + 13 [F20] + 33 [S21])
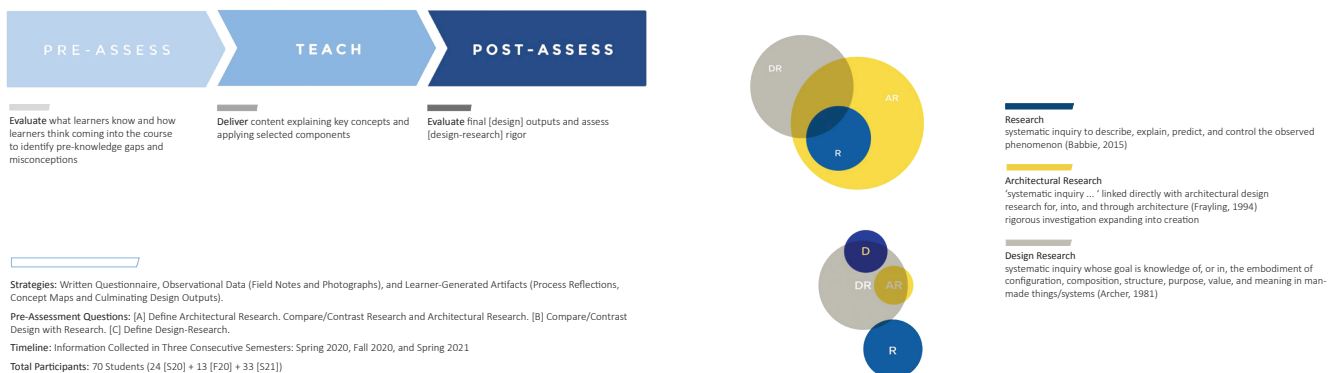
Figure 2. DEFINITIONS AND STAGES.

The action research categorized three stages of pre-assessment, content delivery, and post-assessment. Pre-knowledge probes identified learner (mis)understandings patterns on research expectations and perceptions in the field of architecture through a collection of pre-assessment surveys and evaluation of responses through decoding, memoing, and mapping. This step was followed by content delivery including teachable moments through planned instructional interventions and a resultant concept mapping exercise. The post-assessment stage next evaluated learner generated concept maps as well as specific research-related outcomes of studio projects for identifications of prevalent post design-research learning traits.
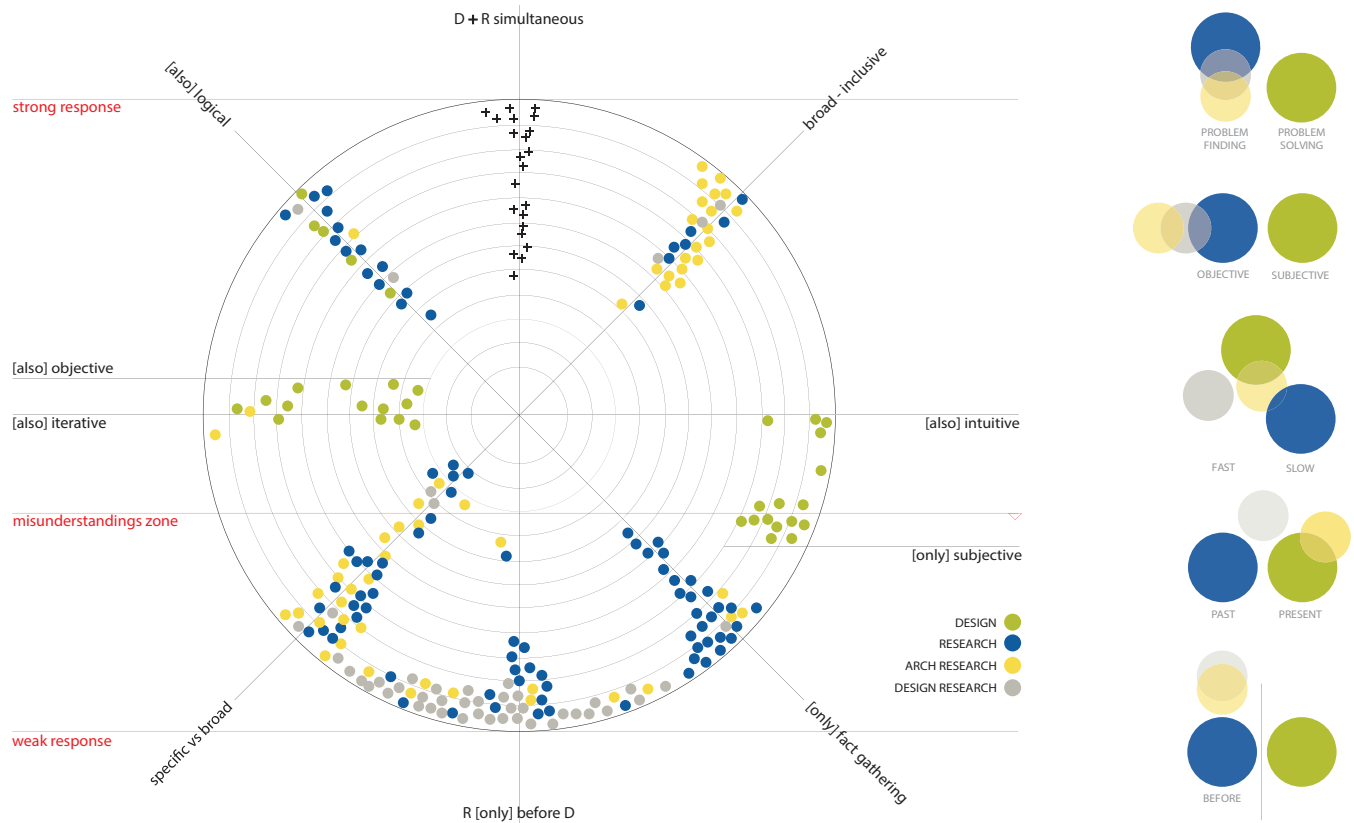
Figure 3. PATTERNS AND DOMINANT TRAITS OF PRIOR KNOWLEDGE.
Information coding and memo inscriptions completed manually revealed key characterizations of prior knowledge patterns.

ANALYSIS

On top of general misunderstandings detected, learners brought with them specific expectations and perceptions on what a design studio research process should look like in terms of timing and components. A major slip exposed was that research is either *always*, *only*, or *mostly* completed before design begins; that: design almost always begins after research is completed. This action research considered this as key indicator that could result in failure of studio exploration intents when pedagogy would fail to address this learner misconception. If the anticipation is good design grounding in rigorous research by internalizing attitudes and abilities to 'investigate conditions as found', to 'suspend judgement for as long as possible', and to 'use findings to suggest new ways to (re)shape the environment'; thus, the success of informed design will depend on unlearning and correcting any such early erroneous expectations and misperceptions. The design process pedagogy can early on catch perception problems and reinforce to correct learner misconceptions through premeditated instructive moments and activities.

Key for learners is to internalize that the investigative process is as much a part of the studio process as it is the act of design itself. That, it all needs to be completed continuously and simultaneously with the act of design, and in an ample back-and-forth with it throughout the entire process. Although initially expected as common-sense truth (presumably taught earlier), a more complex grasp and even acceptance of a simultaneity between design and research as prerequisite to success (as opposed to task-separations in silos) was assessed by this action research as rather foreign to novice learners. It appeared that this understanding cannot happen automatically and needed to be reinforced with pedagogy. In addition, it became evident that there was not much difference when learners saw the combined design-research term or referenced the words 'design' and 'research' together in the written questionnaires. The fusion of the two concepts by itself did not assist with any stronger connotations for the synchronized or back-and-forth process.
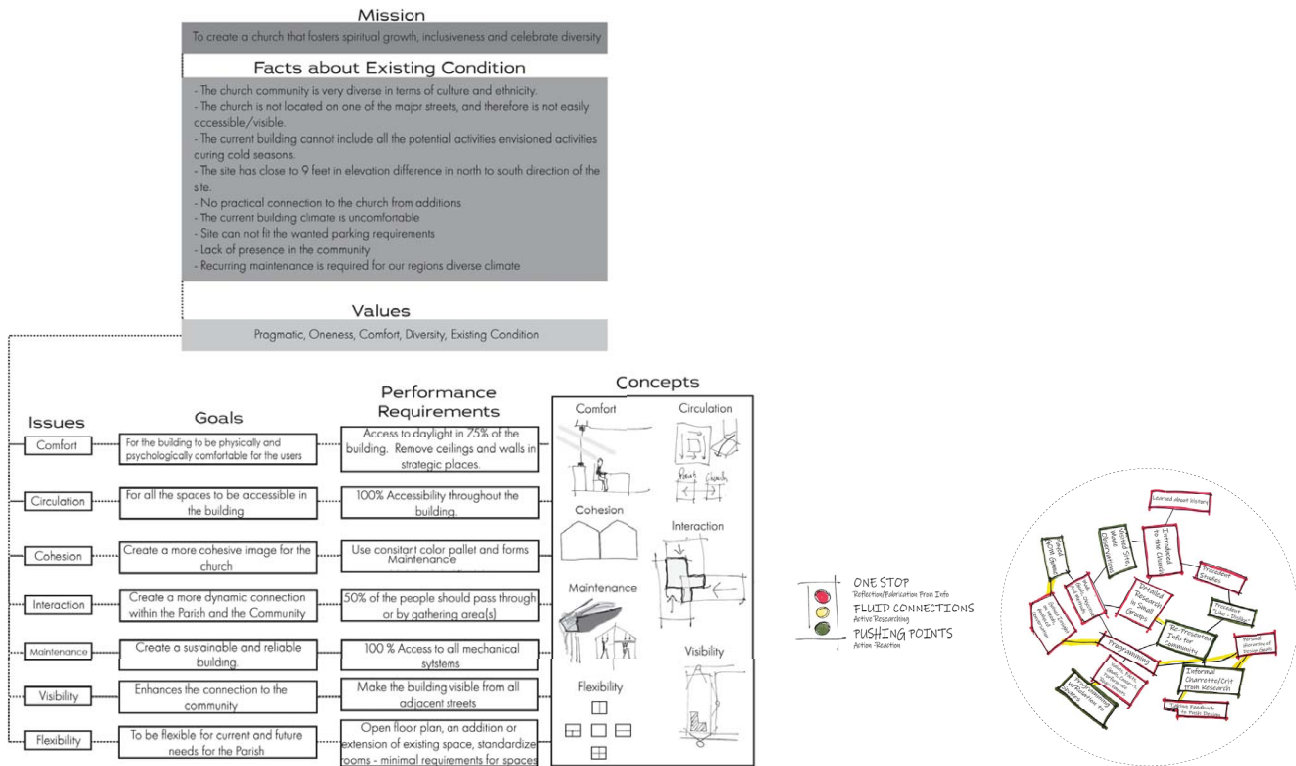
Figure 4. TEACHING CONTENT.

The Mind Map artifact [right] offers interpretations on semester-intended investigations with a focus on pre-design research. Conversant views are at display in a final project submission component [left]. The prompt below was used for the mind-map exercise as a sample from the teaching intervention stage in spring 2020. The activity began with a mini-lecture (20 minutes) on concepts in literature (Bayazit, 2004, 16): (A) physical embodiment of man-made things, how these things perform their jobs, and how they work. (B) construction as human activity, how designers work and think, and how they carry out design activity. (C) what is achieved at the end of purposeful design, how artificial things appear, and what they mean. (D) embodiment of configurations. (E) systematic search and acquisition of knowledge related to design and design activity. This was followed by a 20-minute "Mind Map" Exercise: (A) students back into pre-established research groups (4-5 students working together in studio). (B) find a comfortable place with large surface area. (C) create Mind Maps collectively in response to a prompt: brainstorm and break down how the studio that semester was organized in connection to design project assignment and expectations for research. Illustrate your collective understandings with words, icons, symbols, sketches, drawings, using any visual tool comfortable with. The instructor and two external guests from education department on campus arrived at student tables to observe the process and asked questions. The requested post-pedagogy mind map outcomes were able to show and assess overall effectiveness of how course research activities were chronologically set up in syllabus roadmap, showing being directly impacted and closely coincided with how learners understood the design-research process.
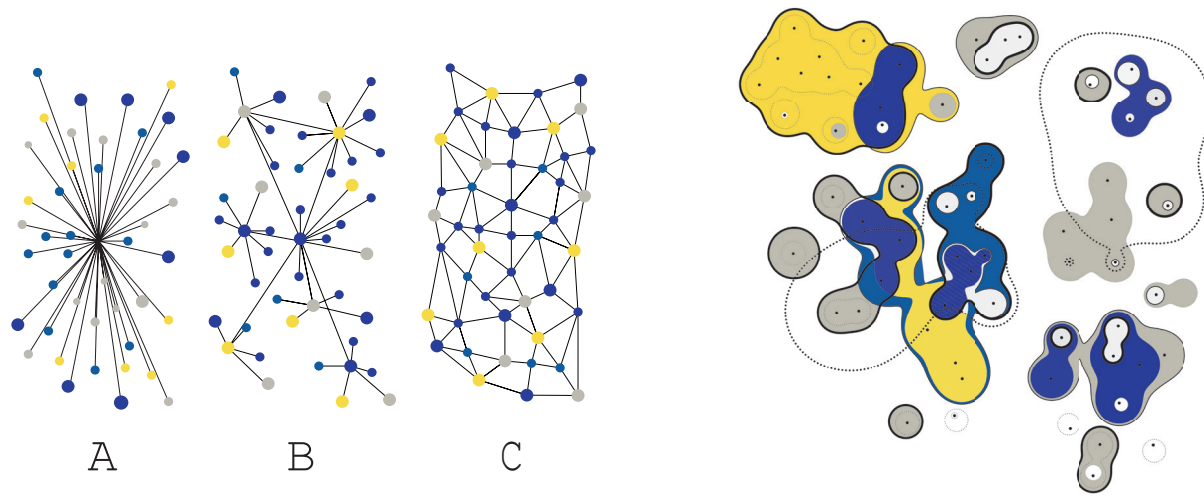
Figure 5. ALIGNING PEDAGOGY WITH RHIZOMATIC NATURE OF DESIGN-RESEARCH.
Pre and post assessment results collectively exhibited (A) noncentralized, or, at best, (B) partly-centralized knowledge possessions and acquisition patterns, suggesting pedagogical flexibility aligned with cyclical and multi-threshold, (C) rhizomatic 'how-to-research' learnings.

SYNTHESIS

Through extended clustering, comparing, and categorizing the assembled pre- and post-assessment results, the study arrived at a few interpretations. Depth and breadth of end-of-semester design applications concerning research rigor as were reflected in design outcomes correlated closely with how the three varied semester activities were scaffolded in different ways and how their specific process of research along the design activities was articulated within its particular syllabus and project descriptions. In other words, research expectations were comprehended by students only aligned with how the process had been explicitly mapped along with other components of course design. In addition to the need for clear research roadmaps, and despite learning profundity in some other aspects, research learnings fell short on cultural and diversity understandings from both analytical and empathetic points of views. If a desired statement for design(-research) be a means of acting in and transforming the world, bettering future pedagogical investigations is needed to examine and discover new ways to take research expectations beyond apathy and generic applications in design studio. Despite stronger achievements in the Fink's significant-learning taxonomy category of learning how-to-learn and how-to-design when syllabi are offering clear roadmaps, with regards to cultural and empathy shortcomings, future action research can explore bettering pedagogies for accomplishing more in line with Fink's attributes of Caring and Human Dimension.

The study emanated additional theoretical views seen as general ideas for furthering future discussions. Much of the prior learner misperceptions regarding research were linked with missing important threshold concepts in design learning, thus, an early-on addressing of which with effective and active pedagogies becoming necessary for achieving later-on positive impacts in design process. Incoming research commands and abilities though fluctuated across varied classes and semesters [considering all those three courses happened during COVID], where the whys and wherefores for knowledge deficits could resided beyond architecture curricula, possibly even linked to prior K-12 education gaps. Such disparities could have also been connected to learner character qualities stemming both from life-experience contexts [rural vs urban] or general inquisitiveness traits and/or comfort with navigating ambiguities. Expanding the interpretative outcomes divulged the benefit of the use of the rhizome concept in design-research didactics. Rhizome in botany (as plant structure growing underground with roots and shoots) offered a suitable metaphor for making sense of teaching-learning synergies and symbiotic connections between essential design and research aptitudes. Drawing on learnedness subsistence and growth not stemming from one single central point of origin, rhizomatic pedagogical structures (versus with constant seeking of centralized efficiency) can advantageously allow a more inclusive flexibility for diverse learners, creating learning rooms and space with multiple thresholds for entering and exiting research processes.

EPILOGUE

In the age of swelling inequalities, political mayhems and incessant crises provoking relentless traumatic effects from climate change, pandemic and disease, only to name a few, architectural design research cannot stay oblivious, generic or neutral, but must become a virtuous means for acting in and transforming the world. Today world's increasing complexities are leaving architectural design with more and more intricate wicked problems faced with by default as design challenges. Such intricacies are sufficient to compel essential needs for the broadening of design-research demands. It is, hence, imperative to grow not only more "empathy" with widely-diverse gamut of people-participants in design process, but also more "humility" with their existing circumstances, and even-if-imperfect contexts, situations, and exertions. It is within these nuanced interstices where architectural research should engage to become both producer of relevant knowledge and instigator of change. Exploring human life-environment documentaries in these grey areas can offer concrete possibilities to help open up better ways and more suitable approaches for architectural engagement in societal concerns. This is a way for the engagements to become part of a larger context in which the political and social issues are foregrounded and for design outputs to embrace the kind of research that is essential in transforming the world.

Past the arty, self-centered and abstract components of design process [that may come more naturally in architectural education], how might novice learners begin to understand and engage critical research in relation to concrete issues and timely ordeals of societies? What pedagogies and discussions, or approaches to project formulation are more effective in instigating and guiding the explorations of profounder research questions beyond normative scopes of design-research applications? Not answered considering a narrow scope of this action research, these important questions can be pursued in future studies. One issue became obvious; teachers and course designs play key roles mutually in either hindering or promoting good design research motivations. Courses requiring unsophisticated routes of research and mapping those naïvely in curriculum can not only result in weak design-research responses and blasé attitudes in outcomes for that particular semester, but also become the enemy of others based on which learners' long-term good research culture and virtuous design process can be compromised. Instead of assumed and implicit research paths, green learners benefit from being explicitly prescribed and made accountable to follow through with best/expert paths based on project particularities and needed knowledge components. Being asked to make connections between hypothetical studio design topics and their effects outside academic environments can help learners raise better questions for adopting additional social responsibility through architectural means. Teachers alike must broaden an empathy to meet learners where they are, identify with their ways of being, perspectives, and viewpoints.

Looking holistically at and plainly scaffolding better research mechanisms is essential throughout a course and instructional activities. In architectural education, if using the analogy of the popular Bloom's taxonomy of learning, the rush to the top of the pyramid happens rather hastily to quickly get to the "creating" part while overlooking the critical and necessary steps of and failing to educate on "remembering," "understanding," "applying," "analyzing," and "evaluating." This approach is no longer admissible in the age of continuous crises. The grave real issues to which the built environment must respond demand precision and rigor at those other levels of learning to be achieved through methodical ways. Numerous cross-disciplinary studies outside the field of architecture also highlight the importance of teaching separate research methods courses to undergraduate students as a successful endeavor, focusing on such pedagogies as active learning and flipped classroom. Not just that, but K-12 studies have also underscored the importance of teaching research skills as early as elementary school, for instance, focusing on educational uses of technology and online/digital research skills. Many of these are based on new frameworks on required 21st-century competencies for education and employability. Progressive learning models show clearer connections to Fink's (2013) taxonomy of significant learning. Instead of Bloom's, Fink's is a better fitting framework for 21st-century learning, looking more like the learners' lives.[25]

In efforts for matching learning theories and instructional approaches with existing societal conditions, a number of studies have begun investigating the value and methodology of using metaphors such as rhi-zome for teaching and learning. Rhizomatic design-research learning and making sense of its pedagogies can inspire future action research projects. Cultivating flexible non-linearity, rhizomatic learning might allow various points of entry to research and exit to design, and vice versa. Teaching-coaching the process, how-ever, could become challenging and chaotic, when everyone may come with different levels and intensity of understandings. What feasible pedagogies can personalize teaching of research aptitudes within the scope of a studio? Reflections on this action research outcomes have disclosed mixed degrees to which various learners grasp and perform architectural design research. As opposed to centralized efficiency in pedagogi-cal outlooks, rhizomatic instructions may offer insights into multi-threshold procedures in design-centered environments. Learning how to research may emerge from a different set of learner-teacher-content en-counters with/at multiple entry and exit points, opening new possibilities for the course and learners' intellec-tual engagements. How better or earlier might such rhizomatic processes communicate the required dyna-mism and simultaneity of back-and-forth progressions? What might their lesson plans look like, achieving better results without losing control of or falling behind a studio's main task of *designing*.

ENDNOTES

1. Donald A . Schön, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions* (Jossey-Bass, 1987).

2. Sources on research method: Peter Reason & Hilary Bradbury, *The SAGE Handbook of Action Research: Participative Inquiry and Practice* (Sage, 2008). Stephen Kemmis, Robin McTaggart, & Rhonda Nixon, *The Action Research Planner: Doing Critical Participatory Action Research* (Springer Science & Business Media, 2013).

3. L. Dee Fink, *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses* (John Wiley & Sons, 2013). Fink's (2013) Taxonomy of Significant Learning framing theory includes six categories of Foundational Knowledge, Application, Integration, Learning How to Learn, Caring, and Human Dimensions. "A significant learning experience has both a process and an outcome dimension (6)," the process always featuring engaged students and high energy classes, hence, the results, impacts or outcomes becoming significant with lasting change and added value in the life of the students (7). The taxonomy is progressive in taking learning beyond the understand, remember, and application (aspects predominantly highlighted in the former approach by Bloom's Taxonomy and more widely used in education). Instead, the Significant Learning taxonomy defines learning in terms of creating lasting change, likewise key aim for this action research with regards to boosting the acquisition of learners' investigative skills.

4. Problem-based learning recognized as innovative instructional method is also commonly used in architecture and referenced in other professional fields such as the medical. Diana F. Wood, "Problem Based Learning," *Bmj* 326, no. 7384 (2003): 328-330. With 'ill-defined' problems, given requirements do not include enough information "to enable the designer to arrive at a means of meeting those requirements simply by transforming, reducing, optimizing, or superimposing the given information alone (17)." Bruce Archer, "Design as a Discipline." *Design Studies* 1, no. 1 (1979): 17-20. 'Wicked problems' are complex and interconnected sets of social or cultural problems that are difficult or impossible to solve. Lacking clarity in objectives and solutions, they are subject to real-world constraints hindering risk-free attempts to find a solution. Horst WJ Rittel & M. Webber Melvin, "Dilemmas in a General Theory of Planning." *Policy Sciences* 4, no. 2 (1973): 155-169. Richard Buchanan, "Wicked Problems in Design Thinking." *Design Issues* 8, no. 2 (1992): 5-21.

5. Threshold concepts are learning components that must be understood in order for changing how learners think about a topic. As Meyer and Land explain, these can be considered as "akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress (1)." Threshold concepts are vital for becoming skilled at a subject and espousing the worldview of the graduate profession, or in the action research project case, for thinking like an architect. Meyer and Land outline five key characteristics: threshold concepts are transformative, irreversible, integrative, and conceptually bound, and involve troublesome knowledge that can appear counter-intuitive, alien, or incoherent (7). It is from this perspective that commonsense occurrences can obstruct threshold concepts' mastery, making it difficult to reverse learners' intuitive thoughts because such reversals can trigger uncomfortable and emotional repositioning. Jan Meyer & Ray Land. *Threshold Concepts and Troublesome Knowledge: Linkages to Ways of Thinking and Practising within the Disciplines* (Edinburgh: University of Edinburgh, 2003).

6. Bill Hillier, John Musgrove, & Pat O'Sullivan. *Knowledge and Design. Environmental Design: Research and Practice* (University of California Press: 1972).

7. Richard Buday, "The Confused and Impoverished State of Architectural Research." *Common Edge* (2017). Retrieved from: https://commonedge.org/the-confused-and-impoverished-state-of-architectural-research/, Date Accessed: January 15, 2020. Buday's essay argues that scholarly research eludes the profession and the problem is that architecture "thinks of itself as learned." Even with research seen as both vital for architectural design success and closely tied to design innovation, the confused and impoverished state of architectural research remains a longstanding problem. Citing Ruskin's 1848 introduction in *The Seven Lamps of Architecture*, Buday ties the failure in the pursuit of research rigor to the muddled understanding of what research in actuality is in architecture, the confusion being linked to approaches of research formulation as well as insufficiencies on types of questions or problems worth resolving, or actually knowing the problem in essence. In addition, the study raises the issue of a massive disconnect between design and research. That; unlike rigorously institutionalized research in natural and social sciences, and somewhat in humanities, architecture in both education and profession is basically untaught, untrained, and oblivious about research fundamentals. For architects, "research may be no more than background gathering of site data, a building code analysis, or photographing neighboring buildings for context. For some architects, critical investigation begins and ends with ephemeral form and material studies. For others, research is simply a post-occupancy evaluation to be filled out, filed, and forgotten." John Ruskin, *The Seven Lamps of Architecture*. Vol. 521. John B. Alden., 1885.

8. Jeremy Till, "Architecture and Contingency." *Field* 1, no. 1 (2008): 120-135. Good research must pass the triple test of originality, significance and rigor. Myth One to be abandoned: Architecture is just architecture draws on the discipline thinking of itself as being entirely different, unlike any other as discipline and knowledge domain where standard research classifications or procedures cannot be applied. Beliefs in this myth have resulted in using the myth as justification to avoid research principles through normative methodologies, and, instead, replacing good research with unspecified and self-referential impulses of heroic acts or autonomous genius. In due course, the end outcome would clearly be the marginalization of architecture. Myth Two to be abandoned: Architecture is not architecture goes against the first myth, asserting that, to gain rigor and credibility, architecture must consult other disciplines for authority, for example, bridging over to the methodologies used in scientific research or critical theory to legitimize itself, relying on their specific intellectual paradigms.

The end outcome in this myth would be a forgetfulness for architecture about what it might be in itself, ultimately obliterating it from its rightful complexities and turning it into what it is not. Myth Three to be abandoned: Building a building is research accepts as true that designing buildings is a form of research in its own right, which in turn is giving a permission to architects and architectural academics to deliberately avoid using correct norms of research. Backing opinions for the third myth are that: "architectural knowledge ultimately resides in the built object." That: "Every building is by definition unique and thus original." That: "The production of buildings can thus be defined as the production of original knowledge. This is a definition of research." These misbeliefs result in prompting for architects, designers and artists a delusional confidence that their very act of design is adequate in terms of conducting research, leading to a renunciation of the real benefits of good research.

9. Peter Lunenfeld, "The Design Cluster." *Design Research: Methods and Perspectives* (2003): 10-15.

10. Brenda Laurel, Design Research: Methods and Perspectives (MIT press, 2003).

11. Tim Brown & Barry Katz. "Change by Design." *Journal of Product Innovation Management* 28, no. 3 (2011): 381-383.

12. Brought to view as IDEO.org's backbone of practice, human-centered design is claimed as a creative approach to problem solving starting by designers building deep empathy with the people for whom design outcomes are meant for to suit their needs. The steps in the process are: empathizing, defining, ideating, prototyping, and testing. Defined broadly as the ability to be aware of, comprehend, and be sensitive to other people's states of mind and views without having had the same experience, empathy assist designers in the thinking processes to put to one side their own assumptions overall and particularly in association to the design problem and issues with the aim of acquiring insights into, and intuitions and awareness on the design creations' users and their needs.

13. Nigan Bayazit, "Investigating Design: A Review of Forty Years of Design Research." *Design Issues* 20, no. 1 (2004): 16-29. The review's definitions concern with: (A) "physical embodiment of man-made things, how these things perform their jobs, and how they work (B) ... construction as a human activity, how designers work, how they think, and how they carry out design activity, (C) ... what is achieved at the end of a purposeful design activity, how an artificial thing appears, and what it means, (D) ... embodiment of configurations, and (E) ... systematic search and acquisition of knowledge related to design and design activity (16)."

14. Bruce Archer, "A View of the Nature of Design Research." *Design: Science: Method* 1 (1981): 30-47.

15. Earl. Robert Babbie, *The Basics of Social Research* (Nelson Education, 2015).

16. Bruce Archer, "Design as a Discipline." *Design Studies* 1, no. 1 (1979): 17-20.

17. Christopher Frayling, *Research in Art and Design* (Royal College of Art Research Papers, vol 1, no 1, 1993/4).

18. Peter Downton, *Design Research* (RMIT Publishing, 2003). The central proposition of the book is that: "Design is a way of inquiring, a way of producing knowing and knowledge; this means it is a way of researching. (1)." Also see: Bryan Lawson, "Design as Research." *Architectural Research Quarterly* 6, no. 2 (2002): 109-114. Lawson argues that "not only is design research valid and respectable but that a form of research can also be seen to take place in the drawing offices of design practices as much as in the laboratories and studios of our schools of design (109)." Asserting that a present lack of evaluative methodology must not result in thwarting a recognition for how design itself can contribute to knowledge, the author invites the practice and the schools and their academia to debate what research should mean in architecture, taking responsibility for "demonstrating that the design work they submit is not simply local professional practice vulnerable to Yeomans' criticism, but that it has generic value that is part of a theoretical academic programme (114)." Otherwise, schools could be driven by governments and policies and be less relevant to the profession.

19. Murray Fraser, *Design Research in Architecture: An Overview* (Routledge, 2013).

20. Erkin Özay, Gregory Delaney, Nicholas Traverse, & Andrew Pries. "Making Bibelot: Casting Material Research within Cultural Frameworks," *Frontiers of Architectural Research* 8, no. 2 (2019): 121-135. "Architects either uncritically elevate particular aspects of practice as research endeavors, claiming broad disciplinary autonomy and singularity; or seek to break up research engagement into atomized undertakings, in order to substantially immerse them within the exploratory regimes of other disciplines (122)."

21. Bryan Lawson, "Design as Research." *Architectural Research Quarterly* 6, no. 2 (2002): 109-114. A problem associated with theorizing if design in architecture can be considered as a form of research is that design itself is badly misunderstood; "it is not surprising that we have some confusion. Some academics from other fields remain unconvinced that our work is indeed what they would call 'real research'. There are two concerns here. Firstly we need to defend this field intellectually and secondly we must defend it financially. (109)"

22. Linda N. Groat & David Wang. *Architectural Research Methods* (John Wiley & Sons, 2013).

23. Examples are the vigorously-represented three-myth abandonment by Till's (2007) essay, or a dismantling of a fallacy of scientism problematized by Moe (2016). Jeremy Till, "What is Architectural Research? Architectural Research: Three Myths and one Model." (2005). Kiel Moe, "Our Model of Models in the Anthropocene." *The Journal of Architecture* 21, no. 8 (2016): 1299-1311. The latter fallacy comes where more specifically the today modes of architectural reasoning and imagination should be questioned in the context of the Anthropocene and when architects routinely succumb to a technocratic and scientistic positions to authenticate design strategies and agendas, often through simulation techniques. The author argues where real data is scarce, the model of models must evolve.

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24.   For example: World Economic Forum, "New Vision for Education: Fostering Social and Emotional Learning through Technology." *Geneva: World Economic Forum*, 2016. According to World Economic Forum model, in addition to foundational literacies and competencies such as critical thinking/problem solving, creativity, communication, and collaboration, 21st century skills require the acquisition of character qualities. The latter is related to how students approach their changing environment through such traits as curiosity, initiative, persistence/grit, adaptability, leadership, and social and cultural awareness.

25.   Beyond understanding and remembering, and even next-level applying and integrating, Fink's is inclusive of life-space intangible gradations expanding to self-directed learning, cultivating caring encompassing feelings, interests, and values, and human dimensions of learning about oneself and others. Design-research learning models, likewise, necessitate similar real-ness and fluidity in essence and adaptability to fit societal conditions aligned with new generations of learners' styles of being and learning. Preoccupied with digital and dwelling in online spaces, current cohorts require enhanced pedagogies to foster their social and emotional learning. Striving for 21st-century relevancy, new models must promote shifts in individual values from self-centered and inwardly-directed to evidence-based and caring, seeing the built environment analytically from empathetic perspective.

26.   Although ideas are still raw and in infancy, rhizomatic learning is theorized as a metaphor for how we learn. See: Jenny Mackness, Frances Bell, and Mariana Funes "The Rhizome: A Problematic Metaphor for Teaching and Learning in a MOOC." *Australasian Journal of Educational Technology* 32, no. 1 (2016). C. Cronje Johannes, "Twenty-first-Century Learning, Rhizome Theory, and Integrating Opposing Paradigms in the Design of Personal Learning Systems," *Learning, Design, and Technology*, eds M. Spector, B. Lockee, & M. Childress, (Springer, 2016). https://jennymackness.wordpress.com/2014/06/22/the-rhizome-as-a-metaphor-for-learning-in-a-mooc/ "Many Rhizo14 participants valued the metaphor of the rhizome for teaching and learning. Quoting from survey responses, participants of the Rhizo14 course thought that teaching and learning based on this metaphor is 'subconscious', 'subterranean', 'subversive', 'a non-linear, multi-directional underground web of connections'. Learning is 'haphazard', 'messy', 'serendipitous', 'esoteric', 'dynamic', 'unbounded', 'unpredictable', 'adaptive', 'self-organising' and 'non-hierarchical'. This is what these survey respondents valued about it."