Theorem and practicum: order, value, result, interaction

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ABSTRACT: The Thesis is the last major step toward graduation with a first professional degree, or Bachelor of Architecture (B.Arch.), which traditionally prepares students for practice. As a threshold between directed studios and independent thought, the Thesis provides an opportunity for the student to systematically explore a coherent line of investigation of issues relevant to the field of architecture. The Thesis is an intellectual position laid down or to be advanced. It is the first stage of the dialectic–discussion, that is, discussion and reasoning by dialogue as a method of intellectual investigation. An architectural thesis demands that a student take a position and have something to say that is relevant to the discursive field that it inhabits and/or its wider cultural context. In the field of architecture such intellectual positions have implications that result from a critique and re-examination of the role of architecture as a critical participant in the conditioning of public and private space. Thus, while an undergraduate architectural thesis originates in a determinate intellectual position, it culminates in a designed artifact, but rarely the artifact itself. This paper takes a step in characterizing architectural research, where the interaction of Theorem and Practicum is used not only as a guiding principle in the critical thinking process, but also as a springboard for constructive practices in the built realm. This particular reading is an inquiry into the importance and influence of interaction between Theorem and Practicum, as well as, the importance of which is observed through different modes of cross-pollination occurring in various aspects of architectural discourse and practice. This investigation is explored in four perspectives, labeled 'order', 'values', 'results' and 'interaction' are categorized according to their relationship to the investigation of Theorem and Practicum. Furthermore, these four attributes permeate and connect the diverse areas of research explored, which in combination provides an argument that rather than questioning: "is doing architecture doing research" as articulated by Jeremy Till, instead asks: "is doing research doing architecture". Our aim is to expand the pedagogical field where the interaction of Theorem and Practicum is not an isolated act, but one of making.

KEYWORDS: undergraduate research, architecture thesis, design thinking, theorem, and practicum.

INTRODUCTION

Architectural research is a broad term with a long history. In the 1960s, architectural research referred to the study of design itself, its purpose and processes. This is still how the term is often used in academia today. This paper takes a step toward characterizing architectural research, where the interaction between *Theorem* and *Practicum* is used not only as a guiding principle in the critical thinking process, but also as a springboard for constructive practices in the built realm. It is an inquiry into the nature of this interaction and how it may be understood through differential modes of cross pollination occurring within various aspects of architectural discourse and practice. Specifically, the paper examines the potentialities of architectural research in the first professional degree, or Bachelor of Architecture (B.Arch) program, which traditionally is designed to prepare students for practice and licensure.

In *A Theory for Practice*: *Architecture in Three Discourses*, William Hubbard asserts that we must think about building (practice) in three distinct ways: order, values, and results. For Hubbard, these three modalities essentially frame the task of architectural practice. It can be argued that the academy does the first two very well. But the third '*to bring about results'* is limited by the constraints of academia, where the deliverable is not the thing-in-itself, but rather

a design articulated in a series of other distinct artifacts, digital media and/or interventions. Hubbard accordingly holds that a theory of practice should be defined in three modalities: 1.) as an instance of architectural **order**, 2.) as an embodment of **values** about living, and 3.) as the instrument for bringing about **results** (Hubbard 1995, 12-19). In other words, Hubbard's 'modalities' become the vehicle for an architecture of both product and process by suggesting that these three conditions define a particular mode in which an aspect or element of architecture is experienced. These modalities then in turn become the discourse of architecture as an all-inclusive approach or discourse. Reframed to consider the education of an architect, this paper questions how can the academy rethink pedagogy in a way that enhances the student's ability to think critically in this third modality?

1.0. WHERE ARE WE AND HOW DID WE GET HERE?

For just over a century, Modern architecture struggled to adapt to a changing world, one where society, politics, economy and technology shifted with each advancing decade. As a result, the nature of architectural practice fundamentally transformed with each subsequent generation.

Early Modernism, in the form of the Neue Sachlichkeit, formulated a specific paradigmatic response to this proposed third modality. Most commonly translated as "the new objectivity", the term refers to trends in architecture between the world wars that sought a 'rational aesthetic' or a 'rational appropriateness' in design. It was a reaction against both the romantic sentimentality and *lebensphilosophie* of the nineteenth century and the failures of the earlier avant-garde to address real world concerns following the first world war particularly the housing shortage. Emil Roh referred to this newly paradigm as 'Technophoria'[i] and it would last into the middle of the century. At its core were concepts of not only functionalism, technology and progress[ii], but also a non-ornamental aesthetic expression.

This paradigm would be challenged following World War II by Team X. The celebration of technology without consideration of the social and cultural aspects of the building's context was now seen as a hinderance to the development of concepts with significant architectural and urban meaning. It was now necessary to distinguish the specific conditions and needs of a particular culture and society in their evolved historic conditions as subjected to various influences over time. The Dorn Manifesto of 1954 emphasized the importance of 'human associations' and the concept of dwelling as 'habitat'.[iii]

Hubbard's third modality--*an instrument to bring about results*--was now reformulated along the lines of anthropology and more closely aligned with the second modality; as an embodiment of values about living. According to Aldo Van Eck architectural practice was represented by three great traditions; the Classical, the Modern and the Vernacular that should be reconciled. Together they held the formal and structural potential necessary to find answers to the variable and complex reality of human relationships.

Robert A.M. Stern would later update Van Eck's idea reformulating the traditions as Classical, Vernacular and Process, where the latter maintains a basis for form in the constituent facts of building productions and in an idealized condition of the possibilities of serial production. Thus, design is reframed as a process of cultural assimilation.

In our opinion, a relation with history, and all its social and cultural imprints, is essential for contemporary reflection and development of concept which can draw conclusions and find inspiration in it. Inspiration here is an interrogation about the state of being in the actual environment with its characteristic attributes to which innovative concepts should respond. This position is perhaps most explicit in Aldo Rossi's 1966 book *Architecture and the City*. It proved to be a seminal text for its critique of naïve functionalism, and for restructuring the traditional concept of type, in the process proposing yet again a new strategy for the third modality.

According to Rossi, the city is a constructed fact. It is a *Manufatto* that can be understood as the result of two processes the first the actual process of production; an object literally made

by the hands of men at a given moment in history. And second as a process of time which is ultimately responsible for the production of the city as an autonomous artifact. [iv] Thus architecture, and here we mean the rational analysis of the discourse, is only possible when it can be related to historically given elements or typologies, it is an architecture of collective memory.

The real significance of Rossi's theory of Type lies in its conception as process and object that transforms it into apparatus for analysis and invention. The 'Distributive Indifference' present in his theory serves as a catalyst to invention that allows for a new analogical process of design. The possibility of speculative invention is plausible with the type-form, because it is now both, process and object.

More recently we have seen emerge yet another take on the third modality, one that is projective, meaning it seeks meaning and validation in the actual project and the analysis of its own conditions. This paradigm is a return to tectonics, but one that in addition to the expressive aspects of the detail also places emphasis on its performative aspects. It is driven less so by theoretic explorations in the academy and more by the inherent design strategies of critical practices that engage in research.

We do not reject the earlier propositions for the third modality. It our opinion we may build upon and learn from them even if we find them limiting in the contemporary condition. They present different architectural concepts and thoughts about the characteristics of interactivity within architecture, as they explore different strategies of relations between entities such as; research and practice, constituents of architectural space and the understanding of them.

In his 1999 book *The Practitioner-Researcher: developing theory from practice,* Peter Jarvis noted that it was the very rapid pace of change in the nature of practice in the late 20th century that made it necessary for many practitioners to engage in their own practice-based research.

We have to be careful not to oversimplify the interaction between *Theorem* and *Practicum* particularly as it relates to the design fields. In *Practice-Based Design Research,* Laurene Vaughan uses Christopher Freyling's (1993) taxonomy to note the distinctions in design research and how it applies to the practitioner-researcher; 1) Into the practice – to understand what has been done, a form of historiography, 2) for the practice – to use in practice, 3) through the practice -to use the actions and sites of practice as a means of discovering something to be useful in articulating the intentions and outcomes of the practitioner-researcher's inquiry. [v] We are specifically addressing Freyling's third taxonomy 'through practice'. As Vaughan goes on to state; "The situated nature of practice-based enquiry ensures that research undertaken will produce knowledge that both deepens understanding and provides tangible applications for practice." [vi]

It is just this form of 'situated' knowledge that prompted Peter Downton to claim that design was a transformational process that; ". . . involves migration as well as transformation, for the knowledge crosses boundaries from that of the designer to the designed. Research through designing uses the knowing of doing to achieve productive outcomes which in turn indicate the knowing and knowledge used in their production." [vii] His argument echoes that of Marco Frascari in his *The Tell-the-Tale Detail* where he refers to the tectonic detail as the 'Logos of Techne and Techne of Logos'.

It was Cameron Tonkinwise who identify a fundamental shift in the nature of research; from one of mature expert practices deserving of a place in the university owing to the ways it engages a wide range of social challenges, to more pragmatic inclusion of a higher-performative approach to research in an era of competing knowledge economies. [viii] It was against this intellectual background that Vaughan asserted not only the necessity for a new kind of designer, but the migration of research out of the academy and the transformation of design pedagogy into one that could contribute to leadership in all areas of design. [ix]

The contemporary critical practice is one based on a foundation of research that explores the real-world conditions of the tectonic detail seeking to maximize performance, improve economic efficiencies, while developing a significant expressive detail that adds to the aesthetic, phenomenological and economic value of the building. The question then becomes how does this impact design pedagogy in a way that supports and reinforces this new reality? In considering educational models, we would argue that what is needed is a pedagogy that emphasizes the primacy of a *praxis* that is demonstrative, practical, experiential and in the end proves didactic. Based on this pedagogical foundation, how then, do we approach teaching an undergraduate thesis to serve as a useful threshold between faculty directed, skill-based studios and independent thought?

2.0. THE PRIMACY OF A *PRAXIS:* THE UNDERGRADUATE ARCHITECTECTURE THESIS

The ongoing debate of the relevancy of an undergraduate architecture thesis presents numerous and significant challenges, which explains why many architecture programs have opted out. Of the forty-four NAAB accredited B.Arch. programs, only sixteen offer undergraduate students an opportunity to produce a thesis as a way to speculate on a topic of their own invention, while demonstrating the capacity to apply basic research skills. Besides requiring faculty to actively collaborate as well as being a complicated coordination task, why do so many programs remove thesis—the idea of individual speculation--from their curriculums?

One argument in favor for the inclusion of a thesis is that by having to propose a Theorem, it encourages the student to contemplate the Practicum. As a result of this interaction, students are required within the curriculum itself to actively engage thinking about the role of the architects in society and their impact on theoretical and technological innovations, while in turn, gaining practical knowledge and critical thinking skills. Before entering praxis, students learn research methods, study architectural precedents, develop problem-solving skills, and complete exercises that empower them to communicate more effectively. According to Diana Agrest, Professor at The Cooper Union:

> "The Thesis project is of major importance to the education of an architect. Students have to define their interests and their questions about architecture through the definition of a theme, a site and eventually a program. These projects are not always or necessarily meant to be problem solving proposals, but rather the place where critical issues can be made explicit and tested. What unifies the Thesis projects is that they are all based on philosophical and conceptual values and beliefs, and in that respect, it is the hope of a teacher that this will be an experience that will inspire the students for a search that will last a lifetime."(1972)

At our University, the Thesis program represents the culmination of the undergraduate curriculum and it is the most significant test of the students' and school's ability to synthesize and produce critical and rigorous architecture. Undergraduate thesis fosters a broad culture of ideas, inquiry, and position-taking. Thus, the undergraduate thesis not only provides an opportunity for students to systematically explore a coherent line of investigation of issues relevant to the discipline, but to also build upon all of the skills they learned in the prior four years. Thus, while an undergraduate architectural thesis originates in a determinate intellectual position, it culminates in a designed artifact, but rarely the artifact itself.

Bringing back Hubbard's theory of practice as defined by his three modalities: 1.) as an instance of architectural **order**, 2.) as an embodiment of **values** about living, and 3.) as the instrument for bringing about **results** (Hubbard 1995, 12-19), he seems to speak to a primacy of praxis without addressing the notion of speculation. Furthermore, within Hubbard's mulit-modality criteria, the productive contributions of architectural theory seem to be quantitatively immeasurable. Therefore, we argue that there is a missing link in Hubbard's discourse by not considering practice for "what it ought to be" (Conrads 1964), as the speculative **interaction** of Theorem and Practicum. The question then becomes how does this impact design pedagogy in a way that supports and reinforces the speculative **interaction** of Theorem and Practicum?

2.0. INTERACTION OF THEOREM AND PRACTICUM: THE FOURTH MODALITY

The point of this investigation is not to take issue with Hubbard's three discourses, but rather to build upon his theory of practice by proposing a fourth modality in order to consider the interaction of theory in practice, and practice in theory. Along with Hubbard's: 1.) **order**, 2.) **values**, and 3.) **results**, we propose a fourth modality as defined as, 4.) **interaction**. By reframing the question to accommodate interaction, we then ask: how can the academy rethink pedagogy in a way that enhances the student's ability to think critically in this fourth modality while not losing sight of its order, values, and results?

Here the four modalities begin to address the primary aspects of creating a more holistic design pedagogy by bringing together the two hemispheres of design that of Theorem, and that of Practicum as shown in Figure 1. The challenge Hubbard addresses is to see how architects can work together within a common language. He suggests that architects have a blind spot where they do not work incorrectly, but that *they think incorrectly*. In academia, the Thesis is the place in the curriculum where students are asked to produce a personal and original contribution to the discipline of architecture, a contribution that advances the realm of architectural research and ideas rather than one that simply revisits existing paradigms. Which makes the fourth modality to pose the question 'what if' an important consideration in attempt to confront that blind spot. To throw light on these different points of view, Hubbard asks us to 'listen' to the process of design practice. He poses the question: 'How does it sound to produce a building?' and takes us through the process from the understanding of the architect, the user and the client, with and from the notion of results, values and order. By including 'interaction' as a fourth mode of experience, we are arguing for an all-inclusive architectural discourse that takes into account a wide range of assessments, such as, the personal and common values of users and clients, the marketplace, and the shared experience of the dialogue of design.

By creating a cyclical relationship within these two hemispheres—Theorem and Practicum-- as shown in figure 1, we can visualize relationships embedded within the process: 'Theorem as **order** | *why?*'; moving on to 'Practicum as **values** | *what?*'; and then, 'Practicum as **results** | *how?*'; and lastly, 'Theorem as **interaction** | *what if ?*'. Rather than a linear process with the aim to successfully create things or architecture, we are proposing that, once the architect has listened to and participated in the four modalities, design, or this case a creation of a Thesis, becomes a process of shaping "knowledge, practices and sensations" (Hubbard 1995, 155), with the built realm as the catalyst for discussion and ordering.

The quadrant model (figure 2) is similar to Herrmann's whole brain model that examines brain dominance in learning by challenging difference. Herrmann found that information is transferred from one hemisphere to the other, while each of the quadrants has its own specialized function (Herrmann-Nehdi 2008 and Tezcan 2017). As it is represented, this new fourth modality model also divides the primary relationships into four quadrants; however, unlike the Herrmann model, the x-and-y-axis are not merely divisions but play a more dominant role within the Theorem and Practicum relationship. The x-axis is concerned with 'value' and 'interaction' in terms of cognitive and intellectual operations; whereas, the y-axis is concerned with 'order' and 'results' in terms of logical and problem-solving operations. As a result, the beginning as indicated as 'step 1: *why?*' and the end of the cycle 'step 4: *what if ?*' fall within the Theorem hemisphere and act as bookends to the Practicum that questions '*what?*' and *'how?'.*

To reiterate, Hubbard's *Theory of Practice* embodies three discourses: 1.) as an instance of architectural **order**, 2.) as an embodiment of **values** about living, and 3.) as the instrument for bringing about **results** (Hubbard 1995, 12-19). Here, Hubbard presents a straightforward and clear message: good building design should have *order,* reflect communal *values,* and achieve *results*. We've now argued for an additional modality: 4.) as a speculative **interaction** of Theorem and Practicum.
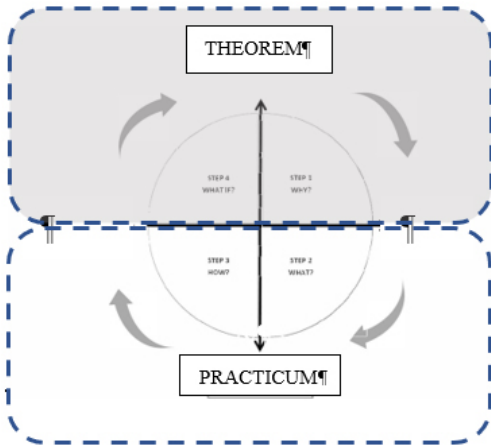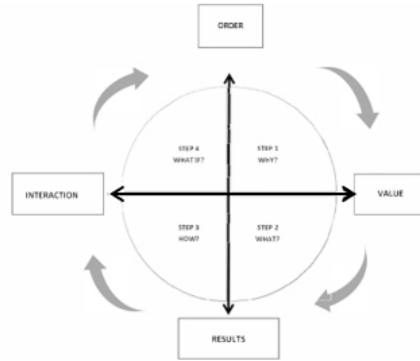
Figure 1: by author

Figure 2. Adapted from Hermann's Model

To unpack this fourth modality, the notion of **interaction** is further explored in four sub-frames, labeled A.) 'about', B.) 'within', C.) 'explore', and D.) 'expand' and are categorized according to their relationship to the speculative **interaction** of Theorem and Practicum. While recognizing the importance of *order, values* and *results*, the more speculative fourth modality 'interaction' does not see Practicum as an organized repertoire of units to be systematically practiced. Instead, 'interaction' asserts a more goal-oriented, meaningful activity and an important driver for education. Interaction serves as part of a system, and that system then becomes the force guiding the assimilation of all the modalities. To clarify the complexity of interaction as it relates specifically to an academic thesis, the concept is broken down into four qualities or traits to give a hand defining it. Interaction trait A.) *About*: surveys the environment both pedagogical and architectural that surrounds it. Trait B.) *Within*: is composed of student work produced within the walls of the academy, where a thesis student works in tandem with an advisor to develop a Theorem; Trait C.) *Explore*: investigative knowledge loops that suggests a palimpsest-like dynamism; and, Trait D.) *Expand*: pushing the frontier by examining the various fields that factor in the emergence of an architecture culture: education, practice, discourse and media (Figure 3).

A. About: surveys the environment both pedagogical and architectural that surrounds it.

B. Within: is composed of student work produced within the walls of the academy, where a thesis student works in tandem with an advisor to develop a Theorem.

C. Explore: investigative knowledge loops that suggests a palimpsest-like dynamism.

D. Expand: pushing the frontier by examining the various fields that factor in the emergence of an architecture culture: education, practice, discourse and media.
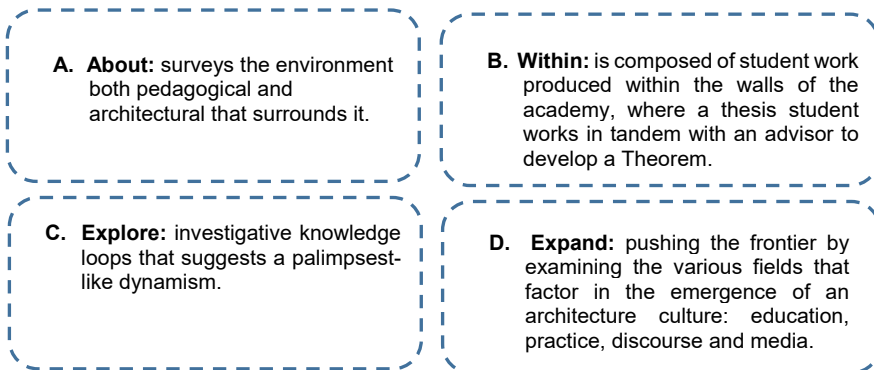
Figure 3: by author

The four qualities of interaction permeate and connect the diverse areas of research explored that in combination with Hubbard's 'order. 'value' and 'results' provides an argument that rather than questioning: "*is doing architecture doing research*" as articulated by Jeremy Till; instead asks: "*is doing research doing architecture*". Our aim is to expand the field where the interaction of Theorem and Practicum is not an isolated act, but one of speculation. This fourth position is that doing research through the act of speculation is a form of architecture in its own right, and should not be separated from the act of making. Thereby situating Theorem within

Practicum: knowledge + making are inseparable. It is for this reason that an investigation as Theorem is presented as ideas, but it is in the realization in built form, or Practicum, that convinces us (Smithson 1955, p.2).

CONCLUSION: EVERYTHING OLD IS NEW AGAIN

The interaction of theorem and practicum is perhaps not a new discourse, in fact it was first proposed by Vitruvius in his publication of *De Architectura Libri* in 30-20 B.C. In book I, Vitruvius begins with the education of the architect and then proceeds to a discussion of principles. These principles are intended to establish the *Arche*, or foundational principles of the discipline of architecture.[x] This is followed in book II with a discussion of the origins of society, buildings and materials that constitute the causes, or *Aitiai*, of the discipline.[xi] As such Books I & II serve to constitute a demonstration on the order of Aristotle's 'official' concept of techne through their elucidation of the basic principles of (*Arche*) and causes (A*aitiai*) of the discipline.

One should not think of Vitruvius' definition of *techne* solely as abstract *theoria* in its epistemological sense. He begins his treatise with the statement that the knowledge of the architect is born of theory (*rationcinatione*) and practice (*fabrica*). Practice, Vitruvius defines as "*the continuous and familiar practice, which is carried out by the hands in such material as is necessary for the purpose of a design*." It is the act of making or performing a given task, the bringing forward of the idea or design found, as he argues, in the drawing. Theory, Vitruvius defines as: "*The ability to demonstrate and explain the productions of dexterity on the principles of proportion*."[xii] This ability he claims is common to all scholars, not just architects. Theory is not just the explanation, but the demonstration as well, and this implies an experiential component to his understanding of theory. The word used here is *demonstrare.* In Latin, it means to bring forth or to show a hidden truth; that is to reveal, and it is linked to the concept of *inventio*, or invention.[xiii]

The theoretical and demonstrative characteristics of techne are stated up front by Vitruvius when he states that; "*both in general and especially in architecture are these two things found; that which signifies and that which is signified. That which is signified is the thing proposed about which we speak; that which signifies is the demonstration unfolded in systems of precepts*."[xiv] If we relate this directly to his idea of architectural invention, the columnar orders are the demonstrations that signify the harmonic ontology of the ancient world. Theory, as Vitruvius uses it, is inherently demonstrative; practical, didactic and experiential. It is achieved through the application of techne in the creation of inventions. He therefore follows Aristotle when he asserts that the techne of architecture consists of a teachable body of principles that are engaged in *praxis*. Moreover, its didactic character comes through an engagement within a process of invention.

Although the practice of architecture has evolved in the two millennia since Vitruvius' seminal book, his assertion *to the necessary education of the architect*, and *to the nature of critical practice* is perhaps even more meaningful today. Despite its strong qualities, this Vitruvian foundation of considering a relationship between practice-based and theoretical-based research takes neither learning styles nor brain dominance into account. There is a possibility that it is more appropriate for undergraduate thesis-based research to establish a positive and significant relationship within the academy by assimilating and accommodating learning style subdimensions and inquiry skills,[xv] resulting in a holistic approach. As with the practice of architect, this paper argues that our current undergraduate architectural thesis programs are also slowly losing their meaning and usefulness in the academy. In order to prop it back up, we propose in addition to Hubbard's three modalities: '*order', 'values', and 'results'*, the fourth modality: '*interaction'* consisting of 'about, within, explore and expand'; where cognitive and intellectual operations co-exist with logical and problem-solving operations creating a more all-inclusive approach, or holistic design method. For this reason, we believe that by developing a more inquiry-based research method as defined by four discourses will generate a new

understanding of an analysis and development of undergraduate architecture thesis programs by enhancing the student's ability to not only think but also build critically.

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ENDNOTES

[i] Roh, F. 1925 *Nach-Expressionismus: Probleme der neuesten europäischen Malerei* , Leipzig, Klinkhardt & Bierman, 1925 p. 108.

[ii] At its core was a functionalist doctrine that dominated both architecture and urbanism, specifically with regards to the propositions that served as the foundation of CIAM. The result was the concentration on topics like the 'Minimum Dwelling' and the 'Functional City'.

[iii] Team X, Aldo Van Eck, Jaap Bakema, George Candelis, Giancarlo de Carlo, Shadrach Woods and Alison and Peter Smithson, sought a more complex and sympathetic relationship between old urban tissue and new functions and to reintroduce into modern architecture the experience of 'community'. To achieve this they sought a more primal language in which form and meaning would be one. According to the

Smithsons; "Our Hierarchy of associations is woven into a modified continuum representing the true complexity of human association . . . we are of the opinion that a hierarchy of human association should replace the functional hierarchy of the Charte d'Athenes."

[iv] We can understand this through Rossi's concept of 'Permanence' that affects individual and collective artifacts within the city in different ways. The two main 'Permanences' in the city are housing and monuments. The individual house is likely to change over time and in that sense has no 'Permanence', but a housing district is likely to remain. It has 'Permanence'. With respect to monuments, the relationship is the opposite. The monument is a primary and persistent urban artifact it possesses 'Permanence'. Rossi's typology introduces the idea of memory into the object which now comes to embody both an idea of itself and the memory of its former self. Such forms occupy a material presence in the city and its history. The real and functional significance of them can remain indefinitely obscure with regard to the past that has produced them, but their mythical image remains so clear and present in our imagery today that they take on the value of a *forma mentis*. They persist through our collective memory as self-evident archetypal forms; the building blocks of the autonomous language of architecture. For the architect to not recognize this or to make use of it means condemning him or herself to incommunicability.

[v] Laurene Vaughan, *Practice-Based Design Research*, Bloomsbury Academic, London & New York, 2017, pg. 10. Christopher Freylings taxonomy is from his book *Research in Art and Design*, Royal College of Art, *Research Papers, Volume 1, Number 1, London,* 1993.

[vi] Laurene Vaughan, *Practice-Based Design Research*, Bloomsbury Academic, London & New York, 2017, pg. 10.

[vii] Peter Downton, *Design Research*, RMIT Publishing, Melbourne, 2003, pg. 108.

[viii] Cameron Tonkinwise, Post-Normal Design Research: The Role of Practice-Based research in the Era of Neoliberal Risk in *Practice-Based Design Research*, edit. Vaughan, Bloomsbury Academic, London & New York, 2017, pg. 35.

[ix] Laurene Vaughan, *Practice-Based Design Research*, Bloomsbury Academic, London & New York, 2017, pg. 1.

[x] Vitruvius asserts this himself, "But in respect to the meaning of my craft and the principles which it involves, I hope and undertake to expound them with assured authority, not only to persons engaged in building but also to the learned world." And then again; " When I wrote this comprehensive treatise on architecture, I thought in the first book to set forth with what trainings and disciplines architecture as equipped, and to determine by definition its species and to say from what things it sprang.:" Vitruvius, *De Architectura Libri*, Book I c. 1.8.

[xi] Vitruvius states this himself when he says; " For this book [book II] does not declare whence architecture arises, but whence the kinds of buildings have originated, and by what ways they have been fostered and, by degrees, advanced to their present finish. " Vitruvius, *De Architectura Libri*, Book II c. 1.8.

[xii] Vitruvius, *De Architectura Libri*, Book II c. 1.1.

[xiii] In *De Architectura Libri* Vitruvius gives numerous examples of such inventions including the Aeolus, a bronze ball filled with water that when heated reveals the exchange of energy that transforms water to steam. He used this to explain how wind currents are produced when heat and moisture combine. In the preface to book IX he includes Plato's use of geometry to determine the necessary length of the side of a square double the area of an existent one and Pythagoras' theory of the hypotenuse of a triangle. The most famous of the inventions discussed are of course, the columnar orders that serve to demonstrate the theory of right proportions. By relating their proportions to the human body he is able to relate them to the discovery of *symmetria* in the human body and his discussion of ideal proportions in book III c.1.

[xiv] Vitruvius, *De Architectura Libri*, Book II c. 1.3.

[xiv] To clarify, we believe a way to accomplish this is to establish a relationship between McCarthy's 4MAT teaching model and Hermann's whole brain model that will accommodate learning style subdimensions and inquiry skills.