

Taking Time to Develop Metacognition for Deeper Design Learning

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Introduction

This paper proposes ways that studio instructors can be intentional and opportunistic about when, where and how to develop metacognition—or thinking about one’s own thinking—as an essential learning goal for architecture students. Examples are from a beginning design studio where the instructors committed to making the implicit understandings of design inquiry more explicit in myriad ways and throughout the first semester of architecture school. The teaching strategies focus on the NCBDS theme of “Taking Time,” specifically advocating that studio instructors be taking time to step back from the flow of work or discussion to call attention to the work or discussion itself, and helping students to see it as part of a larger system of thought that we call design.

This paper also discusses the value of “giving time,” advocating for a greater shift from instructor-centered learning to student-centered learning and giving more studio time to students to think for themselves. Taking (and giving) time to focus attention in the studio on how immediate design-process moments are part of a larger, more sustained effort of learning design as a mode of inquiry, is a designerly form of metacognition which has great potential to give learners a deeper understanding of design inquiry longer term.

Studio Context

The introductory, first-year graduate design studio at University of Minnesota is for students in the three-year M.Arch degree program, i.e., for students without a domestic, pre-professional architecture degree. This means our first-year students, colloquially known as GD1, bring a range of undergraduate experiences into the studio. The strategies and examples in this paper are from three fall semesters (2015, 2016, 2017), when GD1 was co-taught by the author and Andrew P. Lucia, Cass Gilbert Visiting Assistant Professor. Rather than coordinating two smaller studios, Andrew and I chose to teach the 16-18 students as a single studio for the entire semester.

We had two overlapping teaching goals: 1. to unleash each student’s ability to interrogate the material world through multiple modes of representation, i.e., to develop the ability to ask productive questions in dialogue with architectural artifacts; and 2. to talk openly and explicitly about design inquiry as a disciplinary way of knowing, i.e., as a process that is open-ended, iterative, and predominantly nonverbal. From these studios, our students (through formal teaching evaluations and direct feedback) have helped us identify a set of best-teaching practices for developing metacognition about the design process for beginning architecture students.

Metacognition

In his 1979 seminal article in *American Psychologist*, John H. Flavell identified metacognition as an area of research ripe with potential to change the way learners learn. Flavell's model proposed the monitoring of "cognitive enterprises" through four, interrelated "classes of phenomena: (a) metacognitive knowledge, (b) metacognitive experiences, (c) goals (or tasks), and (d) actions (or strategies)" (Flavell, 1979, p 906). Since then, metacognition has been the subject of a growing body of research that validates Flavell's early work—deepening it, describing its nuances and/or developing related models of metacognition to support a range of student learning goals. The majority of this research, understandably, is focused on learning in children, on more traditional disciplines (math and science, especially) and on classroom teaching. The potential value of developing metacognition in the architecture design studio, especially as it relates to a student's experience of learning, is less well-known.

We know that learning architecture and the design process is distinct from most all other academic endeavors. In Flavell's terms, design inquiry in architecture might be considered an extremely unique "cognitive enterprise," operating somewhat like a set of matryoshka dolls, where learning and awareness-of-learning are nested experiences. That is to say, we expect architecture students to be designing a particular project, and simultaneously to be aware of a process for designing that project. We expect, for example, that architecture students are learning about a particular site, and simultaneously developing an awareness of when, how and why we interrogate site as the physical context for design work.

Many students do, over time and with repeated exposure (including professional practice), develop procedural knowledge of the design process. We want students, however, to develop a deeper conceptual knowledge of design as a mode of inquiry, to develop a greater understanding of which aspects of a design process are situational and which are transferable from project to project. In the GD1 studio, we take the position that helping students parse out those aspects of this wholly new learning experience is one of our primary responsibilities as architecture educators. In other words, it is our responsibility to help students develop metacognition about the design process for deeper design learning.

Considering Flavell's classification, we can identify several areas of opportunity in the design studio to improve design learning. Flavell (1979) describes **metacognitive knowledge** as an interaction of person, task and strategy knowledge. Person knowledge refers to how we think about who we (and others are) as "cognitive processors." An example might be when a learner is aware that she had a different understanding of the assignment when her drawings are radically different than her peers, or when a learner believes that he can draw using a computer "better" than he can by hand. Task knowledge refers to how a learner thinks about (or "knows") what needs to be done (e.g., "I need to make a physical model of the site"); task knowledge might also be at play when calculating the difficulty or ease of said task (e.g., "I know that making the model will take several hours"). Strategy knowledge refers to how a learner approaches, moves through and toward the next set of operations. Developing metacognition about strategies (e.g., asking "What might be the most productive way for me to advance the project?") can be especially difficult for beginning architecture students to understand, in part because this kind of knowledge typically builds over years of design learning.

Possibly the most effective teaching strategies, however, respond to Flavell's phenomena of **metacognitive experience**, i.e., to the interactions of person, task and strategy experiences. Simply put, students have feelings about their learning, and their feelings about their learning affect what and how they learn. The intimate nature of the studio experience—of spending considerable time with a small group of people in a smallish space—means that we see expressions of student experiences in the studio every day. We know students feel confused and frustrated especially when learning in their undergraduate major may have been relatively easy; when they have failures (before they learn the value of failures); when they suddenly feel that they “don't know anything” or are “the only one who doesn't understand”; or when they are at a loss about knowing what to do next or how to advance the work. The most frustrating conditions (metacognitive experiences) of design learning in a studio environment that we have observed are the iterative nature, nonverbal learning (making and drawing as a primary way of thinking), and public review of work. As instructors, we can help students develop awareness of when, where and how these feelings can be both positive and productive as an essential learning goal for beginning designers.

This paper identifies teaching practices that focus primarily on instilling habits of self-reflection and self-critique (metacognitive knowledge), and/or moving past the frustration of feeling stuck or not knowing what to do (metacognitive experience). For the purposes of this paper, the teaching practices for making implicit design-thinking operations more explicit—i.e., for developing metacognition of the design process—can be understood conceptually as Naming, Nudging and Negotiating.

Naming

As instructors, our willingness to name certain otherwise-unsaid things can go a long way toward demystifying the elusive and elliptical design process. In the GD1 studio, we spend considerable time discussing three important tenets for design learning early on, and are willing to remind and repeat throughout the semester as much as necessary until students begin demonstrating metacognitive awareness of these tenets on their own. The first two tenets are written into the syllabus, the third is from a straightforward reading. These discussions further set the tone for studio learning and establish the contract for what we should be expecting from one another. The three tenets are:

There is no “one” way —

There is no one way to define, to make or to consider architecture. There is no one, singular design process, mode of operating or of practice. This tenet can make for a profoundly frustrating learning experience for architecture students. As a means of tempering this truth, know that there are common ideas and processes, fundamentals and conventions that transcend the history and geography of architectural production. It is our responsibility as studio instructors to call attention to these shared, practical and conceptual frameworks whenever possible, so that students can find and define their individual ways of operating and their individual voice as architects. Conversely, it is your responsibility to be self-reflective about your learning, and to ask questions that further your understandings. (Lindt, Lucia, 2017)

An expectation of “all-in” —

An education in architecture takes time. Learning takes time. And thinking—the kind of deep thinking required of an architect—is hard work, even as it remains joyful. It is our responsibility as studio instructors to challenge and support you in ways that cause you to learn and think for yourself. Here, it is your responsibility to step up to challenges and (assuming you understand the basic intent of an assignment) to figure it out—literally and figuratively. When you feel overwhelmed, remember that this is your first year of a graduate-level studio, and you are only beginning your training for what will likely be a marathon of professional practice. (Lindt, Lucia, 2017)

Cultivating a Growth Mindset —

We also ask that students become familiar with the ideas of Carol S. Dweck, Ph.D., who identifies and describes two basic mindsets for learning: Fixed and Growth. In a Fixed Mindset, students see intelligence as static, which leads to a desire to look smart, and therefore a tendency to: avoid challenges, give up easily due to obstacles, see effort as fruitless, ignore useful feedback, and be threatened by others' success. In a Growth Mindset, students see intelligence as something that can be developed, which leads to a desire to learn and therefore a tendency to: embrace challenges, persist despite obstacles, see effort as a path to mastery, learn from criticism, be inspired by others' success. (Popova, 2014) cites (Dweck, 2006)

While these ideas are discussed early on and with the entire studio cohort, as instructors we pay attention to when students need supportive reminders of these fundamental truths. We explicitly tell our students that exercises, assignments and studio briefs are meant to challenge in healthy, productive and sometimes stressful ways. That it is okay—and quite normal—to be frustrated or feel up-ended at certain points of the process, and in certain points of the semester. We also repeat on a regular basis (especially when we see a student becoming frustrated with critique) that even when work is strong we are going to talk about how to make the work even stronger, in other words, everyone is asked to consistently learn, grow and advance the work.

Nudging

Nudging is a gentle way or small move that can have a big impact. Collectively, these nudging strategies are developing a studio culture of inquiry and critique, where everyone is working to question, understand and “read” the work, regardless of who authored it. The strategies shift the top-down, critic-as-authority teaching model to a student-centered model, and toward an expectation that students learn self-critique best through practice, and that practice begins on the first day of studio.

Here are three small (sometimes overlapping) moves with big impacts on learning:

Start with the Seemingly Obvious —

In this nudge, students are asked to pay attention to the work with the goal of identifying something “obvious,” something that we might otherwise tend to overlook. An example from a group pin up (or throw down) might be that most (or all) of the drawings are black and white media, that some artifacts are quite small and others quite large, or that all massing models are on a flat base, etc. Regardless, the studio instructor uses whatever students identify to call

attention to broader principles, for example, that we should be aware of the effects paper size could have on our drawings, or that how we start and the materials we use influence how we operate as we generate possibilities (allowing or limiting some possibilities over others), etc.

More broadly, the value of asking students to identify what seems obvious (i.e., to name it explicitly), means we are asking them to be paying attention differently, actively seeking patterns, and revealing the implicit biases, assumptions and preconceptions that are embedded in the work. Understanding these biases as implicit decisions (which we acknowledge) or as implicit assumptions (that should be challenged), and/or getting past the obvious are necessary for productive design inquiry.

Silent Reviews —

In “silent” reviews, the designer-student does not present intentions or attempt to explain the work, but instead listens to guest reviewers (and/or peers) read and question the artifacts the student-designer has constructed, coming to understand each artifact on its own terms and in the context of other artifacts.

The benefits of silent reviews are many, including, for example: productively reading and misreading artifacts; shifting away from verbal intentions as the basis of design inquiry; depersonalizing work (seeing work outside of one’s self and one’s intentions); and shifting from “defending” work toward understanding how artifacts relate to one another, and toward seeing patterns and relationships that words alone cannot reveal. Importantly, the silent review can, over time, also shift a Fixed Mindset toward a Growth Mindset.

Pass the Baton —

This nudge refers to the simple shift from peer- or instructor-led critique to self-critique. For us, this shift usually occurs for the final third of the students, whatever the group size for the reviews or pin-ups. If we are critiquing work around a table, for example, with six students and multiple models for each, we would ask the last two students to self-critique based on the conversations we’ve been having about the work of their peers. Students realize pretty quickly that they need to attend to the conversation and practice metacognition, questioning what is situational (i.e., about the work of a peer) and what is transferable (i.e., could be applied to their own project). [See, e.g., Fig. 1.]

Negotiating

We have consistently found that negotiating (rather than mandating) deliverables is one of the best ways to gauge and develop each student’s metacognition of the design process. Negotiating deliverables brings Flavell’s cognitive enterprise framework into full view, as knowledge/understanding, experience/feelings, goals/tasks and strategies/actions are all at play in the negotiation.

Like nudging, negotiating requires that we, as instructors, resist the temptation to direct students too much, drawing out a dialogue rather than pronouncing a monologue. Our teaching goal here is to help shape each student’s metacognition about design inquiry through a combination of modeling and

scaffolding, i.e., helping students to frame a question and then helping them to connect the question(s) with the modes of working and representational artifacts they pursue as a response. More often than not, these negotiations reveal previous ways of knowing and habits of mind that affect design learning (e.g., quantitative thinkers, verbal thinkers and/or students who crave certainty). Through negotiation we are in a better position to help students understand when their strengths in other arenas may be useful, and when those previously successful modes of operating may be hindering design learning.

The goal of each negotiation is to get to a place where students have a reasonably clear sense of how to move forward in a focused and productive way, i.e., they have framed a meaningful question, a mode of representation and a quantifiable deliverable (a specific quantity or a study limited by a certain amount of time). In short, we want students to understanding different modes of working and different media, but perhaps more importantly to develop a fundamental understanding of the role of representation in design inquiry. These negotiations may be one-on-one (usually later in studio, when students are each pursuing their own project/design proposition), or studio-wide.

Working in Open or Closed Mode —

We want beginning designers to appreciate the difference between working in “open” mode versus “closed” mode. In open mode the goal is to generate as many possibilities as time allows (rather than “overthinking” any single model or drawing), and we want to get past obvious understandings. By contrast, in a closed mode we are working to answer a more limited question, making design decisions, or refining our understanding of something. This may require a slower, more attentive way of working.

In open mode, we value of multiples (i.e., generating 10, or 20 or 40 models, or of testing six variables six ways). Rather than request everyone in studio construct “20 models for Monday,” which students inevitably resist, we engage students in their thinking process out loud, negotiating along the way key aspects of the inquiry, namely: the question being asked, whether that question implies an open or closed mode of working, and why the distinction between those modes is important to understand.

Representation Mode Reflects Inquiry —

We further want beginning designers to consistently work through multiple modes of representation in an iterative way. Negotiating next-day deliverables with this goal in mind allows us to gauge understanding of how one’s work might promote the next set of artifacts, of how one drawing might invite another, or of how a set of models might suggest testing a different set of variables. Negotiating deliverables also allows us to gauge student understanding of how being curious about something might solicit a particular mode of representation as a response. Negotiating helps move students who are, for example, comfortable with two-dimensional plan drawings to realize—for themselves—that they need to construct a series of sections or a three-dimensional model if they are wanting to better understand the topography of the site. [See, e.g., Fig. 2.]

Representation Reflects Project Specificity —

While we may have studio-wide, shared final deliverables (which we identify as group), we want students to begin seeing early on how the specifics of their emerging project come to bear on what might otherwise be conventional “required” architectural representations. Negotiating the particulars for final deliverables allows us to gauge the extent to which students understand how each representation (or each set of studies) has a role to play as part of a larger collection of representations, and how the representations in their entirety tell a very specific story about the project. A student may know they need a section drawing, for example, but negotiating with them the particulars of that section—its scale, framing and media type—helps students connect the specificity of the design inquiry with the particulars of the representation (and vice versa). [See, e.g., Fig. 3.]

Discussion

The purpose of this paper is to share teaching practices from the first-year graduate design studio at the University of Minnesota that focus on developing metacognition in beginning design students. Some of these teaching ideas are most certainly known and practiced by other architecture educators. Describing these practices in the context of metacognition for this conference, however, is a means to open a broader discussion about when, where and how architecture educators might be more intentional and opportunistic about helping students navigate the complex, nested-learning experience of design education.

Flavell (1979) identifies the role of metacognitive experience—the awareness of one’s feelings and the monitoring of those feelings—as a central component of student learning. This is especially of interest to the author of this paper, whose teaching practices have been informed by years as a final project “doula” for students in their last semester of the M.Arch program. Serving in the doula role exposed two conditions of learning that we could improve and infuse throughout our curriculum. The first was the need to **take** time to acknowledge and respond in productive ways to how students were not just thinking—but feeling—about their learning. The second was the need to **give** students much more practice and scaffolding for directing their own work earlier on and throughout the program.

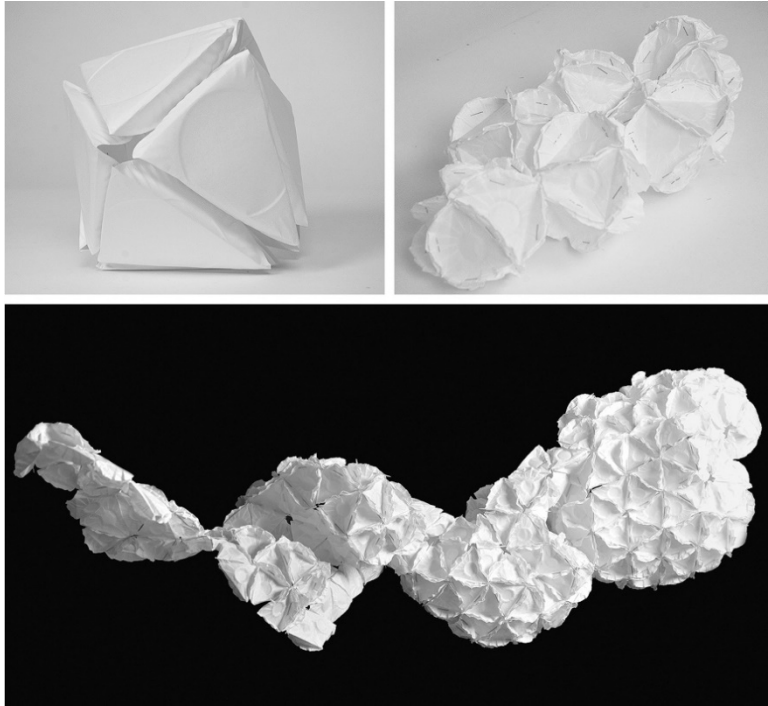
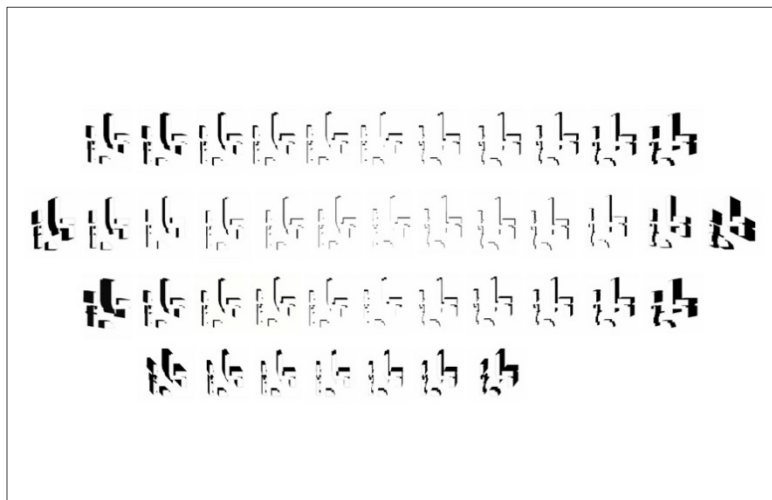


Figure 1: Erin Kindell (UMN GD1, Fall 2017) was prepared to self-critique a rule-based, material-assembly exercise when we “passed the baton” to her after several of her peers received instructor critique. She identified the “obvious” fact that her material investigations were forming closed systems, which limited its generative potential. She realized her rule set was self-limiting because it had certain symmetries; she adapted the rule set and the next set of models formed a more complex, open assembly system.

Figure 2: Ashleigh Grizzell (UMN GD1 student, Fall 2017) was curious about seasonality, including the dynamic nature of sun, shade and shadow on the project site. As we negotiated daily deliverables based on what she wanted to understand, she came to recognize the value of seeing how daylight and shadow conditions changed over time. Ashleigh, a marketing major, calculated the benefit of learning and using specific design software for this study, even though the task would take her longer in the short-term.



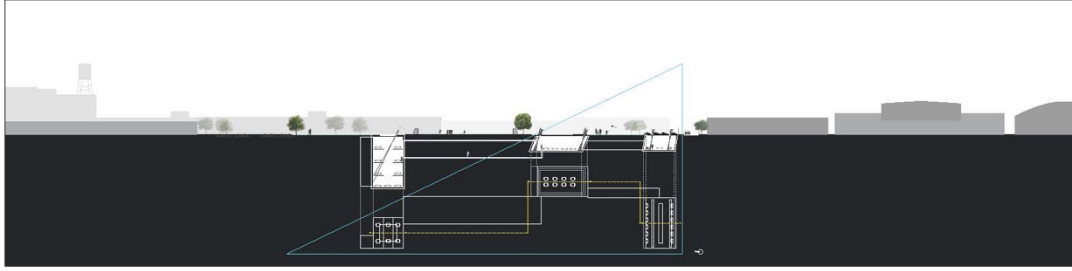


Figure 3: As her project developed, Ashleigh focused on an architecture comprising three distinct and seasonal underground rooms (spring/fall, summer and winter) with specific-season ways for daylight to enter at ground level. Negotiating her deliverables helped her see the importance of the drawings emphasizing the earth, horizon and sky. She continued working digitally and found precedent drawings that helped her realize a white-on-black, plan-section hybrid drawing for her final presentation.

References

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