

Reflective Design Practice: A Novel Assessment of the Impact of Design-based Courses on Students

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Abstract—This innovative practice work in progress paper responds to the question, how might we prepare design students to transfer their practice from academic contexts to applied contexts? This mixed methods study describes a new reflective assessment called Reflective Design Practice. This assessment prompts student to deliberately reflect on concrete artifacts created during the course. Twenty university students enrolled in design-based and project-based courses used Reflective Design Practice to more deeply understand both their design practice and the way environment impacts design. This assessment differs from existing assessments in that it can be applied to virtually any student work created during a course. Furthermore, it grounds abstract metacognition in tangible output.

Keywords—design, design-based courses, project-based learning, transfer, reflection, assessment.

I. INTRODUCTION

This paper outlines a novel methodology for illuminating student learning through reflections on artifact creation during a design course. Capturing and assessing student work in a project-based course, particular one with extremely open-ended outcomes, is challenging. If that course also has a goal of teaching a creative design process, the assessment becomes all the more difficult. To address this challenge we created a one credit supplemental course called Reflective Design Practice (RDP). The audience is students who are concurrently enrolled in project-based design courses—which we will refer to as design-based courses. RDP features a series of weekly reflections and a mid-term reflective interview. The output of these reflections provides the student and instructor with an assessment of that student’s conceptions of design rooted in concrete examples of actual work. What is new is that RDP can incorporate any type of work performed in any setting during the course. This opens up what is being assessed and when the assessment happens.

The primary goal of RDP is to help students think more deeply about their design practice, which in turn, prepares them to transfer and apply what they learn in their design courses to the real world. Although these two goals are related, the first is more introspective while the second focuses on the contribution of environments on supporting creative work.

Transfer happens when learning in one context influences

performance in another context [1]. The interactions between the learner, the environment, and the learning content (knowledge) determine how transfer happens [2]. It is well documented that transfer is much more likely to occur when the learning context is similar to the application context—near versus far transfer [3,4]. It is also easier to transfer well practiced routines—known as low road transfer—than it is to transfer learning that requires deliberate abstraction in order to connect with the application context, or high road transfer [1]. Most educational goals are aiming for the more difficult far and high road transfer.

When it comes to transferring learning that is creative in nature, the difference between academic contexts and applied contexts can be a big barrier. Many academic contexts, especially those that teach design, are constructed specifically to promote creative behaviors and creative work [5]. Students who leave design programs often wish to continue to utilize a strong creative process but have trouble doing so in work contexts built for efficiency and repeatability.

Fortunately there are ways to promote successful transfer. One of which is to teach a variety or a “bundle” of concepts that work together [6]. Another is to focus on the underlying concepts rather than just the procedures [7, 8]. Finally, dedicating time to metacognitive reflection can help students better identify and process underlying concepts and thus, increase transfer [9, 10].

Although transfer is difficult, there is reason to believe that design-based courses are up for the task. This is in part because design fits this notion of bundling. There is not a single concept underlying the subject, but rather a web of interconnected practices [11, 12]. We developed RDP as a reflective tool that fosters a focus on underlying concepts of design.

RDP concentrates on individual *design practice*, which we define as the way in which a given student uses the methods and mindsets taught in a design course. Design is a broad subject and even in a single course each student absorbs different aspects of it [5]. There are, however, aspects of design that virtually all students must incorporate into their design practice: the environment, collaboration, and personal creative behavior. The environment—which is separate from context—includes the physical space in which design work is done. Collaboration is how an individual works with others. And personal creative

behavior is the type of creative activities an individual takes on. Both the context and the individual influence all three aspects.

II. BACKGROUND

There are clear benefits of assessing students' creative processes and design-based curriculum. However, assessing this type of work is quite difficult. There are a number of challenges that instructors face.

One major challenge is that for most of the work in a design-based course there is no single correct answer. Furthermore, there is not necessarily even a right approach. If there were an answer that everyone was trying to find then we could assess how close they came to it or how quickly they found it. In design-based courses there often is a design process that students initially follow [12, 13]; however, the exact implementation of that design process is determined by the situation. That makes creating a one-size-fits all assessment of the design process infeasible.

A second challenge is that work in design-based courses is usually team based. And while there are methods for assessing teams and even individuals in teams, it is hard to parse out how a single student's creative process interacted with the creative processes of teammates.

Finally, and perhaps most importantly, the ultimate objective of many design-based courses is to establish a sense of creative confidence in students [14]. Design Practice is really about a new way of working—feeling comfortable applying a creative design process in a range of contexts. It also means that there is no single learning outcome. In fact, the outcomes depend on the person. Design practice can look like the creation of a new product at work or simply coming up with a novel way to rearrange the apartment [15]. Given these goals and challenges, it is critical that we use appropriate measurement methods.

There exist a number of assessments that measure design, creative problem solving, and project-based learning [16, 17, 18, 19, 20, 21]. However, none of these assessments by themselves are sufficient to address our goals of helping student understand their creative process and prepare for transferring learning from an academic context to an applied context. We need something that captures students' work in context and links that to their design practice. RDP is, in effect, an assessment of how well students prepare for transfer—or preparation for future learning [22]. This leads to our primary questions,

- *Are students able to explicitly connect the work they do in design-based courses to their own design practice?*
- *Furthermore, are they able to identify the contextual variables that promote or inhibit creative work?*

III. IMPLEMENTATION

To answer these questions, we created and taught RDP at the Hasso Plattner Institute of Design (d.school) situated in the Stanford School of Engineering. The Stanford d.school regularly offers courses and short programs on various aspects of design thinking—a prominent design-based curriculum—to students from across the university. These immersive and interactive experiences address a variety of questions and topics while employing strategies and techniques aimed at fostering strong design practice—a competency that is increasingly valued in engineering education as a necessary component of innovation and often entrepreneurship. The high level of student engagement in these experiences over the course of a ten-week quarter is often disruptive and memorable [15]; however, the broader impact, application, and generalizability of these curricula is not easily documented or assessed.

RDP consisted of weekly reflection exercises implemented with the goal of helping students deeply process the practice of design and highlight student learning that could not be captured on traditional assessments. Each student participated in an online interview with an instructor between weeks five and seven. Finally, all students were given a four-item pre/post survey: a creative agency scale, two short online design tasks, and a paper-based reflection prompt.

This approach was piloted with a small group in the fall. The course was taught again in the winter and spring quarters. By the end of the academic year, 20 subjects will have participated in the RDP course, contributing to a collection of approximately 180 artifacts and accompanying reflections. Figure 1 illustrates the timeline of the RDP Course.

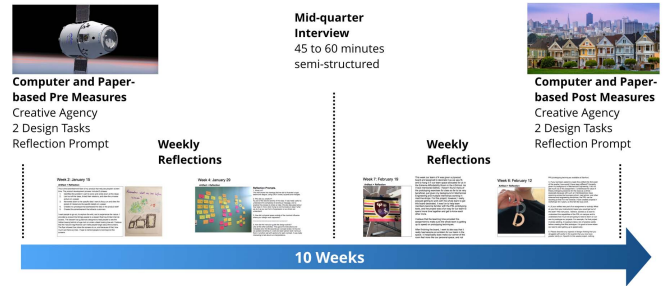


Table 1: Reflective Design Practice Timeline

IV. MATERIALS

The pre/post measures utilized a tool designed to measure the growth in creative agency in students before and after a design-based course [18]. The 11-item Likert scale captures students' comfort with dispositions needed to practice design beyond school. This measure was included as an independent variable so that we might compare the reflections of students with high and low creative agency.

Each of the two design tasks (generating unknowns and generating testing options) asked students to solve a challenge based on real life scenarios. The pre-course tasks featured a different challenge than the post-course tasks. For example,

before the course students were given a scenario asking them to generate a list of unknown issues that a space tourism company might encounter when sending two people on an eight-day trip around the moon. After the course students faced a different scenario asking them to generate a list of unknown issues that a home sharing company might face when catering to large families. Coming up with a list of unknown issues to a given problem is a common task in design-based courses.

Responses to the design tasks will be assessed using the number of responses (representing *fluency*), the number of distinct categories of responses (*flexibility*), and by the novelty of the individual responses (*originality*). These are three of the four primary measures in the Torrance Test of Divergent Thinking [21]. *Elaboration*—the fourth primary Torrance Test measure—will not be assessed because students were asked to focus on generating as many responses as possible and not on how detailed their responses were. As with the creative agency scale, the purpose of this assessment is to determine whether the type of reflections differs between students with high and low design task scores.

The final pre/post assessment is a paper worksheet asking students to respond to prompts about creativity and design. The questions included *in what ways are you creative?* and *what does innovation mean to you?* Here, we will be looking to see if students' post-course responses are thematically different from their pre-course responses.

The weekly reflections were the primary activity students engaged in. The format was a series of Google Slides—one for each week—collected in an online folder shared between the individual students and the instructors. Each week, students were told to take a photograph of an artifact they created while working on a project in their design-based course. The definition of the artifact was intentionally very open. Essentially anything they created was acceptable. This could range from a physical prototype to post-its from a brainstorming session. Once they posted the image in the Google Slide they responded to a series of prompts on the slide next to the photo. The first two questions were always the same: *what is the picture showing?* and *why did you create it?* The next set of questions varied depending on the week. Example follow up questions included: *what was the role of the environment in creating this artifact?* and *what was the role of your team in creating this artifact?*

Each student's collection of slides represented a growing narrative of their design practice over time. It not only included visual examples of the artifacts the students created but also their reflections on the act of creating each of those artifacts. The mid-quarter interview conducted with each student was intended to help students engage more deeply with their narrative by articulating and explaining their thinking and their growth over time. Each of these semi-structured interviews conducted by one of the instructors lasted between 40 and 60 minutes. The questions were organized around four categories.

- *Environment* – understanding how the surrounding environment and space, instructors, peers, and time constraints affect a creative process.
- *Contrast* – understanding how a creative practice differs from other working practices a student engages in prior to and after a design-based curricular experience.
- *Personal comfort/discomfort* – understanding what parts of the design-based curriculum feel personally comfortable or uncomfortable to a student and why.
- *Themes* – noticing how certain themes like responding to ambiguity or rapid prototyping show up in students' creative practice.

We chose environment and contrast as categories because we believe they help students think about context—an integral component of transfer. These categories prepare students to work creatively in contexts outside of a design institute context.

Personal comfort/discomfort identifies aspects of design-based courses that students excel at and struggle with which in turn, helps students be more mindful about working in any areas of design that they feel unsure about. Ultimately we believe this guides students to develop a stronger design practice.

Finally, we present these themes to students as a way to assess the stated learning goals of a particular course or program. We chose the two themes of ambiguity and rapid prototyping because they are both areas of the design-based curriculum that the Stanford d.school emphasizes. Asking students to identify and speak to those themes indicates how well their courses meet the learning goals.

After the spring cohort finishes we will code the interview responses so that we can look for patterns within these categories across participants. Specifically, we are looking for the number and range of responses to the weekly reflections and the interview questions.

V. CONCLUSION

We anticipate that the data collected using the RDP approach will illuminate how students link the academic context to their own design practice. This will allow them to understand the types of output that design-based work generates and how these deliverables differ from those created in other disciplines. This is especially important for students who wish to keep applying their design practice in the future within contexts that may not be as conducive to creative work.

Our hope moving forward is to refine the RDP approach such that it can be routinely taught alongside courses at the Stanford d.school and other engineering schools that teach all forms of design-based and project-based curriculum.

VI. REFERENCES

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