Never Mind the Prescriptions, Bring on the Descriptions: Students' Representations of Inquiry-Driven Design

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Abstract

Instead of designing by following prescriptive models, students may benefit by approaching design as a process of free inquiry. This paper considers the impact of this inquiry-based approach on students' thinking by considering the ways that students represented the design process at the end of an inquiry-based design course.

Introduction

When design is taught using prescriptive models (e.g., instructional systems design or computer integration into K-12 environment models), students come to understand what it means "to design" within the context of those models. That is, the model not only shapes the design process, but also models shape the designers' thinking. What happens when student designers do not have such a model on which to depend? How do students construct an understanding of the design process when design is approached as a form of theory exploration and reflection, and thus not guided by prescriptive models but by student designers' connections between scholarly literature and their own experiences, philosophies, and beliefs? This paper will explore these questions based on the author's experiences teaching a "Principles of Instructional Design and Learning Technologies" course that culminated in students creating representations of design after completing inquiry-based design projects. I begin this paper with an overview of the course and the course design project. Then, I present the ways that students represented their design processes. In the last section of this paper, implications and conclusions are presented.

Overview of the Course and the Design Project

The "Principles of Instructional Design and Learning Technologies" course covers the history of instructional technology (cf., Reiser, 2001a, 2001b), the appropriate role of computers and other media in the design process (cf., Clark 1983; Kozma, 1991), learning theory (e.g., behaviorism and cognitivism), and other seminal issues in the field. Historically, this course also provided an overview of prescriptive design, such as models of human-computer interaction design (e.g., Carroll, 1997) and instructional systems design (e.g., Morrison, Ross, & Kemp, 2004); but it was not a design course. Instead, this course was based on "typical" higher education pedagogy—lectures, group discussions of theoretical readings, exams, and research papers. Such an approach did allow students to learn *about* major principles and theories, but it did not provide students with a strong vision of how principles and theories influence the technology of designing instruction and/or facilitating learning—thus, the shift from "typical" pedagogy toward a learning through design (cf., Nelson, 2003) approach.

The design project for this course progressed in three stages. During the first three weeks of this course, students identified a design project and conceptualized their design approach. Since twenty-two of the twenty-three students in the course were full-time teachers, this initial approach was largely based on a "lesson planning" view of design.

In stage two, students began designing and developing their project, but they were required to adjust their design approach to include decisions that were relevant to course content. That is, as each new topic was addressed during the semester, students adjusted their own design plan (and thus their understanding of what it means "to design") to account for the topics. For example, when course readings dealt with extreme views in applications or theories for promoting learning (e.g., programmed instruction, on the one hand, and situated cognition, on the other hand), students had to either justify their previous decisions about their design in light of the readings, or they had to adjust their design decisions to create alignment with their understanding of the literature. Similarly, when students considered the Clark (1983) / Kozma (1991) debates about the role computers "play" in learning, students either had to adjust their previously-planned role of media within their design project or defend that role in light of interpretations of

the literature. The stated goal of the design project, then, was not to create "expert designers." Rather, as the assignment guidelines noted, the ultimate purpose was for students to report how the topics covered in this course shaped their "thinking about" and "understanding of" design.

In stage three, students had to report the ways that their thinking about design had evolved during the semester, and they had to offer a "representation" of what design "looked like" to them as a result of completing the course design project. Learning about design, then, resulted from personal descriptions of design, as opposed to resulting in students' understanding of model-based prescriptions. Notably, design prescriptions were not covered in this course until students had largely completed their design project. The design projects, then, were influenced by students' emerging understanding of theory, but not by formal prescriptive design. To the extent that design is problem solving, such a representation is useful in helping students concretely capture the problem space (cf., Jonassen, 2003) in which they had been operating. Furthermore, this representation provided students with a concrete artifact on which to reflect and through which they could consider how the course had shaped their thinking and understanding of design. The assignment guidelines noted that students' descriptions might be "formal" and "academic," but students were encouraged to take a more "creative" approach by, for instance, capturing the essence of design through an extended literary device (e.g., metaphor, analogy, or allegory), a mu ltimedia presentation, cartoon drawing, or even a sculpture. These "descriptive representations" will be the main focus of this paper, as they give the most insights into how students came to understand what it means "to design."

Students' Representations of Design

In this section of the paper, I summarize the various ways that students represented design and their design processes. Of the eighteen students who completed the course, four students represented their design process in the form of traditional-looking design models. One of these students offered a second representation of design (that was unrelated to the graphic) in the form of a metaphor. One student used a cartoon drawing that represented design metaphorically; the remaining thirteen students represented design through metaphors or analogies. In this section, I provide an overview of some of the representations. This overview of representations will serve as a basis for understanding an analysis presented in the next section of this paper.

Four students represented the design process in the form of a traditional-looking model. One of these models dealt not so much with the content of the design process (i.e., learner analysis, writing goals, designing activities, etc.) as it dealt with the flow of the design process itself. The model used solid lines for linear processes, dotted lines to represent cyclical revision, and "nodes" to represent "dead ends" or stopping points. This student described ideas as being "set in motion," "splitting," "morphing," and "branching" throughout the design process. Another student also used a traditional-looking model. This model was not "original" from the student; rather it was an adaptation of Morrison, Ross, and Kemp's (2000) model. This particular student had previously taken an instructional systems design course and had used this model. His adaptation of the model included annotations, which came in the form of numbers written within the original model (e.g., he wrote a "2" next to the "learner characteristics" event inherent to the Morrison, Ross, and Kemp model). The numbers within the model corresponded to explanations of how the course had changed and expanded his personal understanding of the Morrison, Ross, and Kemp model. A third student who also had taken instructional systems design as a course also used more of a traditional model to represent design. Her representation involved various elements that traditionally are used within design models (e.g., goals and objectives, task analysis, choosing media, etc.). Interestingly, though, her model was unique in that she placed herself in the center of the model. From this representation, it can be inferred that she viewed design as not something to be looked at but something in which she was situated. Another student also used a traditional model. (Interestingly she also used an unrelated metaphor of design as a symphony orchestra, which will be discussed below.) Her model included the events of comparing the idea to her own philosophy and understanding of theory. But, more importantly, her model used two-directional arrows to represent the iterative nature of "trying idea on learners" (i.e., implementation) and "revision."

One student combined the idea of a "graphic" representation with a metaphor and accompanying cartoon drawing of six panels. She represented design as a transition from a "pretty" day; to a storm scene; back to nice weather, but with evidence of the storm in the form of an uprooted tree. The uprooted tree, she noted, represented the destruction of some of her previously-held notions about design. The remaining students used metaphors or analogies without accompanying graphic representations. For one student, to design was to sail on open waters. Sometimes, the "storm of learning theories" seemed too much to

handle; for example, a "gust of cognitivism blew hard" as a precursor to the "hurricane of constructivism." When the storm wasn't upon her, she felt herself "rocked back and forth" between two opposing currents: "Clark, Kozma, Clark, Kozma." Interestingly, hers was not the only metaphor that involved water, as another student noted that "designing is . . . like jumping into deep, mucky, and swampy waters without knowing how to swim." Similarly, another student noted that designing results in a feeling that you must "reach the top of the water to breathe again, but you do not have the strength to get you to the top. You can see the top of the water, but [you] are unclear how to get your body up there." Another student also discussed design in relationship to water and tides:

Throughout the design process I have felt like a fish just flopping around on the beach, hoping to survive long enough to make it back into the water. Just as I get close to the water, the tide comes in and pushes me further onto the beach. While flopping around, I meet numerous creatures that offer to help me back to the water; however, they really do not have the means to do so. Only the crab had the ability to bite me on the nose and pull me back to the ocean.

Other students described design as a shopping trip, having ADHD, going through the stages of a butterfly's life, being in a never-ending maze, an amusement park ride, hearing a symphony, or building furniture from raw materials. Admittedly, some of these metaphors were quite vague, where students did not fully explicate the metaphor itself. In other cases, though, the specifics were a bit more clear. One example of this clarity came from a student who compared design to a journey:

Design is driving on a winding road. . . . [S]ome parts of the design journey are simple and refreshing, like driving on the straight, smooth section of road with the spring wind whirling in through the moon roof while sipping a fruit smoothie. Sometimes, though, you hit a pothole on the road. It throws you off-course. It may even cause you to pause and have to fix a flat tire. Or even worse, you may spill your smoothie and have to "clean" things up. And other times, the road ahead is curvy, so there are no surprises, and you see your course ahead of you. Design is like this path...sometimes smooth and easy, and yet other times it may be difficult and take more time as well as a break in action to contemplate or "fix" parts.

Another student compared designing to quilting where one must find "a specific place for each patch, so that it all fits together appropriately." This student notes that one occasionally "pricks her own finger," but that "grandma"—in this case, the course professor—is always there to provide gentle guidance.

Analysis of Representations

Some themes did seem to emerge throughout the semester, and I considered those themes in constructing this section of the paper. Largely, though, it was while summatively assessing (i.e., grading) the course design projects that themes emerged. As I graded, I used the constant comparative method (cf., Glaser & Strauss, 1967) as a basis for finding themes. I begin this section by considering the nature of the designs themselves. Then, I offer more of a pragmatic analysis in light of course and project goals.

Characteristic Analysis

While collectively considering the nature of the design representations, three questions of interest struck me as worthy of consideration as a basis of analysis. Each of these questions will be discussed in turn, and readers should see these questions as ones that brought forth a thematic interpretation of the various design elements.

The first question can best be stated thusly: How many were representations that came in the form of "natural" processes as opposed to processes that are more indicative of the artificially-contrived? Such a question is useful to the extent that design is a science of the artificial (cf., Simon, 1969). Addressing such a question might provide insights into the ways that students viewed design as something that they can construct and control. The students who created traditional looking models obviously were creating a representation that was artificially contrived. Table 1 divides the metaphorical representations into the categories of "natural" and artificial.

Natural Processes	Artificial Processes	Hybrid or ambiguous
• Having ADHD	• Shopping	• Amusement Park Ride
• Fish flopping on the beach	• Cooking	• The elements of an orchestra
• Stages in a	• Quilting	
	• Building furniture	

butterfly's life	• Sailing	• Driving on a winding road
• Drowning		• Jumping into murky water
• Transitions from peaceful to stormy day		• Being lost in a maze

Table 1. Design metaphors by nature of process.

To some extent the above categorization of these design representations suggests a view of design as either something the designer can control or that the designer is controlled by. For example, the notion of designer as a fish flopping on the beach is a metaphor of being controlled by "nature." The author of this particular metaphor even notes that tides pushed her further away from the water and towards the beach. Similarly the notion of trying to avoid drowning by aiming to "reach the top of the water to breathe again" suggests that design is a natural instinct of combating other natural occurrences. On the other hand, some metaphors suggest that students viewed designing as a process over which they had control. The metaphors of sailing, cooking, and quilting, for example, imply that designers can actively make decisions and control the process as an artificial science that can be well-executed.

A second question also arose for me during this course and, more specifically, during summative assessment of the course projects: To what extent did the students' representations indicate the non-linear nature of design? Some of the design representations are clearly linear. For example, the student who suggests that designing is like going through the stages of a butterfly's life provides a representation of design as a linear process. In fact, she implied a feeling of helplessness as certain stages took their natural course. Furthermore, comparing design to a ride at an amusement park offers a view of design with a starting point and direct movement toward an ending point without much control by the designer. It is only coincidence, it would seem, that this student found some resolution to her design dilemmas as the "floor [was] beneath [her] again, as the ride [came] to an end." That is, her resolution did not come as an act of going through a non-linear process; rather, the ride (i.e., design) had a natural end to it and that end was beyond her control.

On the other hand, some of the representations suggest a non-linearity to them. As I noted in describing the representations, one "traditional" model depicts the non-linearity of implementation and revision. The student who adapted the Morrison, Ross, and Kemp (2004) model also noted the non-linearity of that model and its manifestation within his course design project. Some of the metaphorical representations of design also suggest a non-linearity within design. For example, the student who used "drowning" as a metaphor for design discussed the process of trying to rise to the top but then being pulled under again. Furthermore, both cooking and building furniture are non-linear. In the process of cooking, for example, the chef is, in the student's words, "trying to perfect . . . recipes [through] a continuous process to achieve the ultimate masterpiece. . . . [I]t takes a lot of mistakes to get to a masterpiece."

A third question deals with considering the degree to which the student designers understood themselves as designers: How do the design representations portray the designers themselves? Do they situate themselves within the process? Or do their representations indicate that they are apart from the process? This particular question struck me as I looked at one of the more traditional models of design that a student created. Her model was circular much like the Morrison, Ross, and Kemp (2004) model of Instructional Design, but in the center of the circle, she included a representation of herself. She, then, was within the design looking outward. I found this compelling, and began wondering whether other representations of design mainly had the student on the "outside" looking in, thus design served as more of a cognitive plan; or did the representation include the learner as situated within the design processes? Admittedly, such a question may overlap with previous questions. Still, it seemed to me that such a consideration is worthy.

Several students did situate themselves within the design process. Consider as examples, the students who used analogies of boating, riding an amusement park ride, and driving on a winding road. All of them are in the "seat" that is seminally situated within the process. Interestingly, there are key differences, as the captain of the boat and driver of the car are in control, but the rider at the amusement park is not. So, two are situated in positions of power, while another is situated almost as a victim. Others situated themselves as "creators" within the process. Consider the students who used analogies of cook, quilt maker, and furniture maker. They situated themselves as creators of the design process.

Conversely, others situated themselves outside of their own design representation. Consider the student, for example, who used the cartoon drawing from a peaceful to a stormy day. She was not situated

within the cartoon. Rather, she was looking in at the cartoon. Similarly, the student who annotated the Morrison, Ross, and Kemp (2004) design model was not situated within the design model. The model was presented as something to be analytically viewed and considered—it presented a cognitive plan, not a situated learning representation (cf., Cobb & Bowers, 1999).

Functional Analysis
What was the "function" of these design representations? Were they successful in meeting that function? A full defense of the purposes of this design project is beyond the scope of this paper. Nevertheless, a functional analysis can only be discussed in light of the goals of this project. In short, I was trying to achieve some of the following:

- Enabling students to see design through a process of metaphorical synectics (cf., Joyce & Weil, 1992) as metaphorical thinking can help people see the familiar in a new light (Lakoff & Johnson, 1980).
- To promote a design environment where reflection is not "de-coupled from design activity (Shambaugh, 2004), but rather where iterative cycles of design and reflection inform each other.
- To promote a "learning by design" (cf., Edelson, 2002; Nelson, 2003; Nelson & Knowlton, in press) approach where the act of designing results in a new way of knowing.

Some students struggled to "break the habits" of the curriculum-development approach to design that is typical of their experiences as K-12 teachers. More broadly stated, students were shaded by previous design experiences. Those who had already taken more "formal" design classes—such as "Instructional Systems Design" or user-centered design—struggled to make design decisions without reference to the models with which they were already familiar. The most clear example of that is the design model that was an annotated representation of the Morrison, Ross, and Kemp (2004) design model that I described earlier in this paper. Other examples of this abound, as well, though. Earlier in this paper, I described a model in which the student situated herself in the middle of the design process. Still, her representation of design was similar to the Morrison, Ross, and Kemp model.

Even where students did successfully represent design in a way that was perhaps new to them—such as design as riding an amusement park ride or design as a fish flopping on the beach—most students struggled to integrate their novel representation throughout the remainder of the paper. Typically a student would introduce the metaphor in a paragraph, but then they would leave the metaphor altogether to discuss their understanding and view of design. So, while some metaphorical activity was present; that metaphor did not "shape" their explanation of design throughout the rest of the paper. In fact, as I have already noted one student offered a metaphor of a symphony but then offered an unrelated "traditional" model. Another student created an extended metaphor in her paper, but then when discussing her new understanding of design brought in numerous additional metaphors in the form of one liners (e.g., you can lead a horse to water, but you can't make it drink). To some extent, these variations defeat the entire point of metaphorical thinking and undermine the bulleted list of goals that I present at the opening of this section of the paper.

Implications, Conclusions, and Forward Progress
In spite of a few of the shortcomings of this project, I do think that using an open-ended inquiry-approach to design has merit as suggested both through the literature (cf., Edelson, 2002) and through an analysis of the design representations in this course. Particularly in light of the fact that the program in which I teach attracts k-12 teachers, using an inquiry-approach to design serves as a nice transition from their "teacher education" way of thinking to a more systematic design approach. Decision makers in other graduate programs might sequence courses such that students learn about design in general prior to taking prescriptive design courses.

Furthermore, focusing solely on this course and its future, I will "stay with" the general design project described here. Based on some of the results from this initial implementation of the project, I find myself wondering how I could more strongly scaffold students' efforts on two levels. One level would be to better scaffold students' understanding of the design project itself. How can an instructor of such a class help students see the benefits—largely metacognitive benefits—of engaging in metaphorical and representational thinking? One way would be to add a literature base to the course that raises the notion of situated cognition as a perspective from which we learn. Perhaps sources, for example, that deal with "learning by design" (e.g., Davis, 1998; Hoadley, 1997, Rittel, 1984) would be useful in promoting such a perspective.

A second level would be to better scaffold their production of a "representation" and discussion of that representation. This might involve shaping other elements of the course to directly support the design project. For example, currently in this course, there are three captions of grades: the course design project, in-class participation, and summary/reaction journals. (See Knowlton, Eschmann, Fish, Heffren, and Voss, 2004, for a discussion of summary/reaction journals within this particular course.) Shaping course activities to more directly include processes that would help students make decisions about their design representations might be useful in scaffolding students' thinking about design and how to represent it. For example, during small group discussions about course readings, I might more directly prompt students to bring their design projects into the discussion as a basis for understanding a reading's implications on practice. Furthermore, my comments within their summary/reaction journals might provide a forum for me to urge further thinking about their design representation. Using other areas of the course would also better help students see the ways that the course could be synthesized into a useful experience.

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