



Design thinking: A creative approach to educational problems of practice



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ARTICLE INFO

Keywords:

Creativity
Teachers
Teaching
Problems of practice
Design thinking
Design

ABSTRACT

The problems educators face in professional practice are complex, varied, and difficult to address. These issues range across teaching and learning topics, to social or community issues, classroom climate issues and countless others. Such problems are multifaceted, cross-disciplinary, human-centered, and rarely solved through simple or linear solutions. Grappling with them requires educators to think creatively about educational problems of practice. But given the challenges and expectations facing teachers, creativity is often seen as leisure in teaching practice. While creativity is considered a core 21st century thinking skill, many people are hesitant to self-identify as “creative,” or are uncomfortable with intellectual risk-taking and open-endedness. We suggest that design thinking may provide an accessible structure for teachers and teacher educators to think creatively in dealing with educational problems of practice. We examine a qualitative study of a graduate teaching course framed around using design thinking to creatively approach educational problems of practice. We discuss thematic takeaways that teachers experienced in learning about and using design thinking skills to approach educational problems of practice. Implications suggest that design thinking skills may provide habits of mind that benefit teachers in creative problem navigating.

1. Introduction

The problems educators face in practice are complex, diverse, and often difficult to address. These issues range across teaching and learning topics—such as lesson and curriculum development, student motivation and engagement or disciplinary issues—to concerns around school climate, relationships with parents or community, and others. Such problems of practice are multifaceted, cross-disciplinary, human-centered, and rarely solved through simple, linear solutions (Bullough, 2012). Grappling with them requires that educators think creatively about educational problems of practice.

Creativity is a core 21st century thinking skill for students (Mishra & Mehta, 2017). We suggest that it is also vital for educators; yet given the challenges and expectations facing teachers, creativity is often seen as classroom leisure (Berliner & Glass, 2014; Root-Bernstein & Root-Bernstein, 2017). For many, creativity remains a sought-after, yet daunting and intimidating skill (Williams, 2002). In the face of creative thinking or problem solving, many people are reluctant to self-identify as “creative,” or are uncomfortable with intellectual risk-taking and open-endedness (Weisberg, 1986). Because the open-endedness of creative work is challenging, people need a flexible structure to guide creativity, as a way to “intentionally work through getting stuck” (Watson, 2015, p. 16).

It has been argued that design thinking provides a flexible, accessible structure to guide educators (Rauth, Köppen,

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Jobst, & Meinel, 2010) and scaffold their creativity in dealing with problems of practice. Just as creativity is a key 21st century skill (Robinson, 2011), Pendleton-Jullian and Brown (2015) assert that design thinking skills are core literacies for 21st century creativity. While design thinking has most often been used in business or product/service design, it has increasingly received attention in education. However, the relative newness of design thinking in teaching and education means there is much that we do not know. While there is much discourse, there is still a dearth of educational research on the subject. To begin to address and consider these ideas, we share a qualitative study of a graduate teaching course, about using design thinking to creatively approach educational problems of practice, along with process and creativity themes about educators' experiences in using design thinking for problems of practice.

2. Dissolving creativity myths

Creative thinking is often mythologized as an inherent trait, rather than a developed habit of mind or approach (Cromptley, 2016). Stretching back to Plato's belief in the muse, there has been a mysterious element to creativity and a common assumption that only rare or exceptional people have creative insights (Starko, 2005). Sternberg and Lubart (1991) note that people today continue to presume that creativity is spiritual, or simply inherent in nature, and cannot be developed or enhanced. Despite educational discourse around the need for creative teachers, these myths continue through practice (Henriksen & Mishra, 2015). Many teachers do not receive avenues or opportunities to engage or develop their creativity (Henriksen, 2011). Current educational policy is often constricting and unsupportive to teacher creativity; and teachers often feel uncertainty about their own individual creative potential—making it difficult to identify and enact creative solutions to problems of teaching practice.

While challenges and myths propagate around creativity, scholars have discussed possible approaches toward creative thinking via design thinking. Design is an interdisciplinary domain that employs approaches, tools, and thinking skills that help designers devise more and better ideas toward creative solutions (Kelley & Kelley, 2013). The term “design thinking” refers to cognitive processes of design work (Cross, 2011; Simon, 1969)—or the thinking skills and practices designers use to create new artifacts or ideas, and solve problems in practice.

We begin this article with a discussion of design in relation to creativity, to consider how it may inform teacher education by helping teachers create solutions to problems of practice. We describe a graduate design thinking course for educators, aimed at engaging design creativity to address educational problems of practice. Finally, we share a qualitative study, examining how in-service teachers experience and learn from design thinking skills for creative professional problem solving. Our findings explore a trajectory of themes, from teacher participants who worked through five core design thinking skills: Empathizing, Defining Problems, Ideating, Prototyping, and Testing. Implications suggest that design offers thinking skills and practices that can support teachers in creatively addressing problems of practice, by deepening their capacity to address such issues.

3. Everyone designs: design thinking, creativity, and education

A basic, often-cited definition of creativity describes it as the process of creating ideas, artifacts, processes, and solutions, that are novel and effective (Cromptley, 2003; Fox & Fox, 2000; Oldham & Cummings, 1996; Zhou & George, 2001). Design is the creative process of intentionally developing something that does not yet exist. Thus, both analytical thinking and divergent creative thinking are key to design processes (Kelley & Kelley, 2013). Design lies at the intersection of art and science, and applies to a wide range of human-centered disciplines through creative work (Cross, 2011; Weisman, 2012). A designer's work is iterative and often idiosyncratic, but designers' creativity and design choices are scaffolded and informed by common processes (Buchanan, 2001). These design thinking skills give flexible support and grounding to the open-ended arena of creative practice (Hoadley & Cox, 2009; Watson, 2015).

Herbert Simon (the Nobel Laureate who founded design as a professional field) stated a definition of design that reflects its applicability to human-centered problem solving:

Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artifacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state (Simon, 1969 p. 130).

In this, design crosses many fields of human endeavor around complex problems and creative solutions. Buchanan (2001) notes that design involves using human ability for creative problem solving around ideas, processes or systems that serve needs. Design involves directing creativity towards goals, actions, and purpose around real world issues (Collins, Joseph & Bielaczyc, 2004; Hoadley & Cox, 2009). This situates design as a creative problem solving and thinking approach for human-centered professions, such as doctors, nurses, engineers, and others—most notably, educators.

3.1. Teachers as designers: design thinking and education

Scholars have discussed design as a theoretical lens for education (Mishra & Koehler, 2006; Kirschner, 2015; Norton & Hathaway, 2015). Schön described how human-centered professions call for “an epistemology of practice implicit in the artistic, intuitive processes which [design and other] practitioners bring to situations of uncertainty, instability, uniqueness and value conflict” (1984, p. 49). This underscores design as a creative and reflective process—an ongoing dialogue between processes, people, and materials in practitioners' work.

Existing research draws implicit and explicit connections between teaching and design. Mishra and Koehler (2006) developed their theory of technological pedagogical content knowledge around the concept of teachers as designers. They emphasize the role of educators in working with tools, content, and ideas to design experiences for learners. Koehler and Mishra (2005) suggest teachers need experiences that place them overtly in designer roles, to develop their knowledge for solving problems and creating learning experiences.

Norton and Hathaway (2015) describe the importance of teacher education based on design, because teachers are increasingly challenged to be creative in novel practices for 21st century educational contexts. Kirschner (2015) describes how the demands of 21st century schooling and the creative design aspect of what teachers do, is distinct from traditional views of teaching as doing or implementing what already exists. The professional and creative capacity of teachers is one of the most essential factors in determining the experiences of students in school (Darling-Hammond, 2001; Kalantzis & Cope, 2010). But teacher education and professional development have struggled to give educators tools and ways of thinking that help them confront complex and diverse educational problems of practice.

3.2. Design thinking to address problems of practice

The term “problem of practice” is common in education, but it has no single, common scholarly definition (City, Elmore, Fiorman, & Teitel, 2009). We suggest that problem of practice is: *a complex and sizeable, yet still actionable, problem which exists within a professional’s sphere of work*. Such problems connect with broad or common educational issues, but are also personal and uniquely tied to an educational context and its variables; thus, they must be navigated by knowledgeable practitioners (Lampert, 1985).

Such problems of practice are intricate, purposeful, user-centered, and contextual in nature. Therefore, they rarely have a single right or wrong solution. If there were a simple right-or-wrong answer, all teachers would apply the one correct approach and all students would thrive. In the face of this creative challenge, design thinking offers teachers needed support and skills. Kelley and Kelley (2013) note that design is a process of “making” solutions, and a well-recognized by-product of this “making” is a sense of creative confidence and self-efficacy. This gives teachers a belief in their own ability to affect change and have positive impact on their world. As such, creativity and design are central to educational problems of practice. However, there is relatively little educational research exploring how such tools might be integrated into teacher education or professional development.

Design knowledge is developed implicitly and intuitively through experience and participating in practice (Schön, 1984). But designerly habits of mind can be difficult for educators in a demanding climate to intuit and internalize, without information, instruction, support, resources and scaffolding. Norton and Hathaway (2015) suggest that teaching experience itself cannot scaffold teachers’ capacity to innovate in practice, or to create solutions around problems of practice. Teachers need education and professional development that engages them in design thinking authentic to practice.

Given this, there is a need to understand design thinking skills in teacher education through specific tools, approaches, applications, examples, theory and frameworks that can be applied to educational problems (Norton & Hathaway, 2015). Here, we examine such an application of design thinking for teacher education and professional development, exemplified in a graduate-level course in which teachers learned about and applied design thinking to self-selected problems of practice. We engaged qualitative methods to explore and explain how they navigate the creative area of design thinking, for their own professional practices.

As course designers and instructors, we used a specific design thinking framework—the Stanford design thinking model. We do not suggest that the Stanford model is the only or best design approach. Watson (2015) notes there are dozens or more variations of design thinking models. But having a model is valuable as it provides educators a guiding approach and tools -to move past creative blocks, to spur creative insights, and to promote more and better ideas (Watson, 2015). Before describing the course structure and our themes/findings, we provide an overview of the Stanford design thinking model.

4. The Stanford design thinking model and the course design

The Stanford model has five phases or stages of design thinking, also referred to as modes, which are worked through towards problem solutions or resolutions. These five modes are: empathize, define, ideate, prototype, and test. While we describe them in linear fashion, design thinking is actually an iterative process. Designers, teachers, and others can cycle through the process or re-enter modes as needed, to understand or explore problems and solutions.

The first mode is **Empathize**. Empathy is at the foundation of human-centered design as an essential starting point for any design work. In this mode designers observe users and their behaviors, interact with and interview them, and immerse themselves in understanding the experience and perspective of the user. These insights allow designers to approach the rest of the process with a stronger understanding of the context and problem.

In the second mode, the **Define** mode, designers use insights gathered from empathizing to focus on the problem. They aim to go beyond a simple definition as they describe the complexities of the user, the problem, and the context. In this mode designers articulate a problem statement based on details and understandings they gained previously. They focus in and frame the problem, to guide design efforts moving forward.

The third mode, **Ideate**, explores a wide variety of solutions and ideas. The goal is to go beyond the obvious to brainstorm, incubate and generate far-ranging ideas, solutions, and approaches connected to the problem. Designers must go wide with ideas, keeping the problem in mind, but also letting flights of fancy bring up novel, creative ideas. Deferring judgment on evaluating ideas allows the unconstrained development of ideas.

After designers have generated ideas, they put those ideas into action in the fourth mode of **Prototype**, by creating a possible prototype or a model of a solution(s) to the problem (which can later be tested). It is not an attempt to arrive at a final solution, but an opportunity to try making ideas concrete.

In the fifth mode of **Test**, designers test the prototype with actual or representative users/stakeholders. Designers may interview users, observe them interacting with the prototype, or use other methods to gather feedback for refinement of the solution(s). Testing may show that a designer must refine the prototype, or redefine and re-examine the original point of view. They may revisit the empathize mode to understand users, or return to the ideate mode to explore alternative solutions. Design is iterative, and at any point a designer might repeat or reconsider a phase.

In the next section, we briefly describe the course itself and how the model was applied to the structure of the course and assignments.

4.1. Overview of the course: design thinking for teacher education

The course, Learning by Design, is an online course offered as part of the Masters of Educational Technology program in a nationally top-ranked U.S. College of Education at a large university. We, the authors of this study, served as both course designers and instructors. The syllabus description states, “this is a course about design. Design as practice and a process. Design as it relates to education and the world around us.”

The course was divided into seven modules of two weeks each, with an introduction module to cover basic ideas about design, followed by a module for each of the five phases of the Stanford module, then a concluding module to summarize. Each module consisted of several common parts, which we briefly describe:

- Readings and Discussion – This involved ongoing participatory discourse (whole class and small group) around design themes, in which individual readings suited to each phase or design topic were assigned, with discussion questions tying these ideas to educational practice and themes.
- Problem of Practice Design Project – This was the major semester-long project, in which each student selected a problem of practice in their context, working on the issue throughout the semester, through each of the phases of the Stanford design model. Each specific mode included associated deliverables (e.g. an empathy report for the Empathize phase; a record of a brainstorm session with stakeholders for Ideation; or a basic model/mock-up of a possible solution for the Prototype phase, etc.)
- Module Labs – These were shorter, more informal, and creative activities done in each module. Labs were designed to allow students to engage deeply with the theme of the module as an idea, with a focus on creative thinking, while engaging with big ideas. Labs were not connected to the larger design project, but simply smaller guided, fun activities. For example, during the Empathize phase students did “A Twice-Told Tale,” in which they told a real-short story from their own life (or someone they knew), then reimagined and retold it from another different perspective of someone else involved in the original event/story. Or for the Ideate phase, students kept an “Incubation/Idea Journal” with them for the week, in which they informally noted or sketched any interesting or creative ideas from their thoughts.
- Reflection Paper – This was a final paper in which students reflected back, and looked ahead to their learning and goals around design thinking, with an eye to future practice.

The Stanford model’s modes structured core activities that students (who were also educators in practice) applied as a lens for their educational problems of practice. In the next section, we discuss our methods for approaching this study as an illustrative case with themes of design and teacher education.

5. Methods

This study explored design thinking as a framework for teacher education, through an in-depth qualitative analysis of an illustrative example of a teacher education course framed by the Stanford design thinking model. We sought to understand the following questions:

1. How do teachers and other educational professionals experience the process of design thinking and how does it impact their teaching and thinking practices?
2. What do they take away from design thinking, for approaching their teaching practice, problems of practice, and creative learning?

5.1. Research approach

Given the contemporary nature of the topic, there is not a great deal known from research about the use of design thinking in teacher education and professional development. Based on rising interest and calls for design thinking in teacher education (Kirschner, 2015) we aim to fill the need for rich, illustrative examples, as qualitative inquiry allows (Lincoln & Guba, 1985). Therefore, an emergent qualitative research design was used, with thematic coding of the discussions, projects, and writings of course participants (all educational professionals), to understand their experience of learning about and using design thinking as part of their practice.

5.2. Participants

Our participants were students from a semester of a Masters level teacher education course, called “Learning by Design,” in the graduate education program of a large Midwestern university. This online course is offered to a wide range of graduate Masters level education students across different graduate education programs. There were 22 student participants in this semester-long instance of the course—included and quoted in this study. Most students in the course were K12 teachers (from a range of classroom/school contexts, age/grade levels, and subject matters). However, there were also some educational professionals from other contexts. This included: school counselors, professional development coordinators, district-level technology coordinators, school administrators, higher education contexts, and other areas of education (see [Appendix A](#) for more information).

5.3. Data collection and analysis

We used multiple types of student-centered qualitative data, to share participants own voices through rich, thick description (Creswell, 1998, 2007). Our data were comprised of course products, writings, and student-generated discussions. As an additional IRB-approved measure of privacy, we use pseudonyms for all student comments, ideas and work shared here. To draw upon these different data sources, we archived the course website, along with all written student online discussions, reflection papers, and their design project reports. Our focus on the sharing of student experiences and ideas in the words of participants.

Since qualitative coding is interpretative, we initially calibrated our understanding of common themes and patterns (Moustakas, 1994). Yin (2013) suggests playing with data to become familiar and develop an organizational schema. As instructors and researchers, we had practical familiarity with the data, but took another step to read and reread it for familiarity. As Bazeley and Jackson (2013) recommends, we engaged a first round of coding to saturate our thoughts with data and look for patterns, then sought themes between student ideas and stories. In early/exploratory coding we engaged a hand coding process to identify important ideas that occurred and recurred in student comments and work.

The first code set included emergent themes that were interesting and pertinent in our individual data reviews. The second iteration eliminated superfluous codes and summarized ideas into patterns (Anfara, Brown, & Mangione, 2002). Third iteration themes were tightened to ideas that arose most frequently through the work and comments of course participants. The final round of coding included the most significant and concise themes, as discussed in the findings and conclusions.

Our goal was to methodically highlight core themes of these educators’ experiences in learning about and working with design thinking processes to scaffold creative work around problems of practice. Since qualitative foundations suggest that rich examples have a “story” to tell, a well-crafted structure can inform the field in ways that offer transferability, albeit not conventional generalizability. Transferability speaks to the degree to which these ideas might transfer (not generalize) to other contexts or settings. Since qualitative work places the responsibility for transferability upon the consumer of research (Lincoln & Guba, 1985)—we have tried to support this transfer through thoroughness in describing the context and theoretical foundations central to this work. Transferability notes that there are not any absolute solutions to most situations; rather, every person may interpret the work to determine their best practices; and in transferring results or ideas from such research, there are opportunities to combine ideas, and refine, develop and alter these practices (Lincoln & Guba, 1985).

As Miles, Huberman, and Saldaña (2014) suggest, “the events and processes in one setting are not wholly idiosyncratic. At a deeper level, the purpose is to see processes and outcomes—to understand how local conditions qualify them, and thus to develop more sophisticated descriptions and powerful explanations” (p.101).

5.4. Reliability and validity

We engaged three qualitative verification techniques (Creswell, 1998, [nullchapter](#)) including: prolonged engagement, peer-review or debriefing, and rich, thick description. *Prolonged engagement* was done through examination of data that spanned students’ work and experiences with design thinking over a full semester (four and a half months of their work and discussion). We did *peer-review or debriefing* via regular check-ins with each other as collaborative researchers, but more importantly with several outside scholars not involved in the data or analysis (these included faculty members and doctoral students). We also include *rich thick description* in our results and discussion, through descriptive detail and extensive direct quoting of participants, to allow readers to consider students’ words alongside our own themes.

To strengthen the findings, we engaged multiple kinds of course data to determine findings that were consistent across the context. Data included discussion comments and postings, design project reports, comments from lab activity writings, and reflection writings. Data spanned the course of a four-month semester, and provides participants’ direct comments and themes. The thematic findings are culled from multiple participants (educators), over a period of time, across different instances of their voices, from different types of data. Methodologists have noted the power in such uses of data, through its complementarity and consistency—meaning that data, across multiple sources, point to the same outcomes and themes (Greene & McClintock, 1985; Greene, 1994; Greene, Kreider, & Mayer, 2005)

5.5. Limitations

There are several core limitations in this work. In being involved in a course directly about design thinking, the participants may have felt compelled to discuss notions of design in more affirmative ways. We attempted to control for this to some extent, by asking

students to do work that contextualized design in their own specific practice, so that they shared real-world impact on their work as practitioners, via examples and details about these approaches in their work. We directly quote students, for rich thick description (Creswell, 1998, 2007; Moustakas, 1994) so that readers may judge their responses, alongside our interpretations and themes.

A key delimitation of this study is that we confined the sample to a small group of educational professionals, who were enrolled in this graduate teacher education course. There is no guarantee they are representative of an overall population of teachers. While this small specific sample inhibits generalizability, statistical generalizability is not a focus of this work. Our intent is to understand and describe the experience and takeaways of a design thinking example in teacher education, and consider its potential in practice. By focusing in we aim to provide a thoughtful view of design in education that has value to consider across contexts. A smaller sample is a function of this focused look where participants, as educational professionals speak to their experiences—and common themes transfer across a range of contexts.

6. Results and findings: experience of teachers using design thinking

Given our focus on process themes and students' voices, we could not fully describe the range of teachers' contexts and problems of practice. While these data points show up through the themes and comments, we also provide an overall depiction of the participants' work in Appendix A. For more about each participant's teaching, work context, and problem of practice topic, see the Appendix A table. Below we explore and exemplify themes within each mode of design thinking via direct quotes and interpretations. Emergent themes within each design thinking mode of empathize, define, ideate, prototype, and test, are italicized at the beginning of each section's mode, and then explored in more detail. At the end of each mode-section, we describe how these findings relate to creativity and existing thinking in the field.

6.1. Empathize

Empathy is where a designer begins to understand a situation or problem from the perspective of others involved. Root-Bernstein and Root-Bernstein (1999) note it as a key thinking skill central to most creative work as well. In the experiences of teachers in this course, there were common aspects of this theme. Many of the teachers experienced empathy as a *powerful new strategy for understanding students*. Empathy was something they had assumed they understood, yet realized they sometimes failed to apply in teaching situations. These teachers found that the power of this strategy *led them to question, recognize, and challenge their own assumptions*—with surprising realizations. Given all this, empathy was a broadly *applicable skill across different educational problems of practice* for understanding problems' underlying nature, causes, and possible solutions.

6.1.1. A powerful new strategy for understanding students

Students experienced this mode by realizing that they had not previously fully understood empathy, and seeing how it could be used effectively in teaching situations. While these educators cared about their students, they were also surprised to realize they had not always brought a student perspective into their practices. As Allison, put it:

I resonated with the quote, “Unsuccessful design often comes from the assumption that users like what we like.” I make this mistake sometimes still, but especially when I first started teaching. In school I was a good student and enjoyed learning, so all of my knowledge was drawn from my own positive experience, but not necessarily reflective of all my students.

McAllister and Irvine (2002) suggested the value of empathy in teacher training for promoting better teacher-student interactions and understandings. Many of our teachers began to recognize how easy it is to overlook empathy in practice. Another student, Kathleen, stated, “This has me thinking...do I continually make assumptions that my students enjoy the lessons I teach? This is how we develop as teachers, by constantly questioning, designing, and improving our practices and delivery. Understanding what students know and how they feel is essential.”

6.1.2. Sense of surprise in questioning and confronting assumptions

Many students found it affecting to recognize how, in using empathy, they became more aware of their own assumptions. Brandon described how empathy altered his approach to developing teacher trainings. He noted that it caused him to recognize and question beliefs that impeded the design of his trainings:

Empathy was the key this semester in my understanding my staff/students, and in how I approach professional development. For those that have begrudged PD attendance I've always assumed they didn't value ongoing education or the benefits of the subject. Now it seems simple, why didn't we simply ask our teachers why they didn't like or embrace our professional development? Why had we never attempted to empathize with our audience?

Joan identified her problem of practice as trying to improve student skills at engaging more productively and deeply in conversations. She described the experience, along with the surprise and new realizations that delving into empathy brought:

I interviewed and observed my students—asking questions and finding patterns to uncover root causes of their lack of conversation skills. I was so surprised! I thought I understood, but I had no idea! It wasn't that my students were not having conversations, but that they didn't really understand what a conversation was. I learned that my students gravitated toward interactions with friends and topics they connected to. I realized that our current setup was not conducive to conversations.

Kelley and Kelley (2013) have noted how empathy has this effect when designers apply it in professional practice—it becomes a “gateway” to better insights and surprising realizations. Here, Nina, described how it can lead to simple and clear realizations:

I gave my students a chance to share their experiences and stories. This gave me insight on why students don’t take full advantage of the tutorial/reference resources I offer. They forget about the supplemental materials because they are not linked within the main lesson. Students prioritized other things and didn’t realize resources were useful.

6.1.3. Applicability across contexts and problems of practice

When design is woven into teaching it helps identify insights at the students’ level. For the teachers here, in a group who had a diverse range of problems of practice and topics, starting with empathy provided an approach that applied across different contexts and problems.

For instance, one student, Candace, was a high school English teacher who loved Shakespeare. Her problem of practice aimed to improve student interest and understanding of Shakespeare—a unit in which they were typically “bored and confused.” Through empathetic role-play and putting herself in the students’ mindset, she came to a better understanding:

I needed to make myself bored and have the text be difficult. I found one of Shakespeare’s plays I had never heard of, in my least favorite genre. Just two pages into reading it, I realized what was proving challenging to students... In reading, I was struggling to create a rhythm and couldn’t pay attention to the meaning. I was just vocalizing the words in my head. This gave me the perspective I needed to define my problem. Had I not done this, I would have gone in a different direction.

There was a wide spectrum of teaching contexts/problems among the students in this course, from incorporating more effective project-based learning to increasing motivation on varied topics. In using empathy, students stepped out of their own perspective and into another’s. One student, Laura (a technology professional development coordinator), discussed her realization that she needed to understand her teacher audience:

The empathy phase opened my eyes on approaching my problem of practice (improving technology professional development, or PD, for teachers). In the past, I’ve tried to hope that I know what teachers experience, but I never actually watched closely or asked how users feel, when they’re placed in a PD setting that is stressful or unhelpful.

6.1.4. Creativity connections

In design, empathy speaks to the user, attempting to understand what matters to them (Kolko, 2014). This also speaks to foundational ideas in educational philosophy, such as Dewey (1916, 1934/2005), who emphasized the need to make learning relate to the experiences of the student. But beyond this, empathy has been consistently noted as a core part of both exceptional and everyday creative practice. Psychological studies have found clear positive relationships and correlation between empathy and creativity (Carlozzi, Bull, Eells & Hurlburt, 1995). Root-Bernstein and Root-Bernstein (1999) describe empathy as a meta-level creative skill. They note that, without empathy we are limited to our own experiences and cannot create artifacts or ideas that connect with others or capture the richness of experience in our world. Empathy is the first phase of design work, and for our participants, it began a trajectory of understanding how to approach and create solutions for their students or users.

6.2. Define

Defining a problem requires examination of its complexities and variables. It helps us understand the problem by framing it clearly from many viewpoints. The teachers entered the define mode with a general sense of their problem of practice, but left with a better definition of the problem along multiple lines. They found it essential to *view their problem from multiple perspectives*. Students also noted that it was helpful to take time to thoroughly define their problems because it led to a *deep understanding of the context and a vision for moving forward*.

6.2.1. Viewing the problem from multiple perspectives

Educational problems are often complex and require nuanced understanding. A key part of this mode was encouraging students to examine the issue from different perspectives before deciding on a path to approaching the problem.

Brandon realized this as he began to look at his problem of practice from different perspectives. He began to see that it was when he was willing to be uncomfortable that he was able to look critically at his own role in the problem, commenting, “Many times as you truly define the problem, you realize that at some level you may be part of the problem, and that will require change. And change is uncomfortable.”

Blair reflected on the challenge of trying to understand her problem definition in a multifaceted but focused way, noting the tensions that arise:

This was the hardest step for me. How do you define the problem of student engagement? We thought about our users, and found a problem through multiple perspectives. But how to narrow it down without being too broad or too constrained? Some of the tools of the process were so helpful. Asking why, in a root-cause analysis helped me the most. Why am I thinking about this problem? Why is this problem important? Why do the users care? You need to explore the whys.

Designers consider their problems from perspectives outside of their own, and then practice framing and reframing because of what they learn (Schön, 1984). For Kelly, this proved to be the key to defining the parameters of a problem she could solve:

You can reframe the problem by questioning yourself and looking at it from different angles. You suddenly find there might be another completely different cause to the problem you are trying to fix. Maybe the problem is student engagement. Or it might be the difficulty of the presentation and/or differentiation as a teaching strategy. Continually asking yourself why something is causes you to look beyond the surface of the problem and to dig deeper into the heart of the cause.

This deep exploration essential to the Define mode can be challenging. Existing beliefs, emotions, and prejudices can prevent looking beyond what is immediately seen (Michalko, 2001). For many students, the deep exploration of their problem resulted in new learning and the realization of essential components that had not been apparent before.

6.2.2. Deep understanding of the problem

For these teachers, the define mode resulted in a more in-depth way to know their problem and a vision for moving forward. Moving forward for Candace became possible after the define mode because she could articulate a more thorough understanding of her problem:

I could see from my research that students found Shakespeare to be (a) irrelevant to their lives, (b) boring, and (c) difficult. I needed to get kids to see how the plays are the same stories of conflict, love, relationships, and humor that they deal with... I had to find a way to present the material that made the language easier to follow while addressing the structure of the written version. I came away with a clear visual for how to proceed.

Designers across multiple contexts often tend to jump to ideas for solutions or partial solutions before attempting to thoroughly understand the problem (Cross, 2011). The teachers in this class agreed that a thorough understanding and ability to articulate the complexities of their problem was critical for moving forward. For Jordan, a change in his problem definition gave him a clear picture of what his project might look like moving forward:

The define phase allowed me to get to the root of the problem and develop a problem statement. It moved me from “Teachers don’t have enough time” to “teachers don’t have enough time because of ____.” Once you’ve identified the “blank” and some other variables, you can work towards solving the problem at a more fundamental level.

6.2.3. Creativity connections

The purpose of the define mode was a thorough exploration of the problem—to look from multiple perspectives and understand it deeply so that a descriptive problem statement and vision for moving forward could be designed. When designers investigate root causes they must be open to moving forward in a way that can unlock creative solutions. These themes provide a design and teaching connection to existing creativity scholarship, which suggests that creative thinkers exercise a capacity to perceive an issue along multiple dimensions (Simonton, 1988). This often means breaking or reframing existing patterns, to develop new knowledge by examining multiple, different or new angles (West, 1991).

6.3. Ideate

After previously developing a problem definition, the Ideate mode focuses on generating a range of ideas and approaches to a problem. Designers must hold judgment and jump into an open-minded idea exploration. Here, the teachers were ready to “go wide,” with varied strategies to generate ideas. They realized the *power of idea incubation* as a purposeful way of pushing themselves to generate ideas. This provided an opportunity to *brainstorm without boundaries* or think widely and deeply about solutions to problems.

6.3.1. The power of idea incubation

A purposeful incubation period leads to an ability to step away from a problem for a while, so that one can return to it with a “fresh set of eyes.” Many teachers realized that the kinds of idea incubation they had done previously were not purposeful. Jordan began to see driving and walking as opportunities for incubation:

I feel like it has been a cycle of “work, work, work, incubate.” Because of this I have had several occasions where I’ll be driving or walking and ideas or further questions will pop into my head...Students and teachers (and just people in general) need to understand the importance of taking a step back and letting your subconscious work on a problem.

Incubation can be a powerful creativity tool for our minds, often leading to moments of creative insight or breakthrough (Pérez-Fabello and Campos, 2011). Allowing ourselves to incubate subconsciously through daydreaming can be challenging. One teacher, Patty, commented:

I “incubated” by taking a break from my Problem of Practice, to relax my mind a bit. I found this step of ideation challenging because I am *not* the type of person to turn off my mind in the middle of an activity. I am constantly thinking and digitally connected to the world around me. I decided to let my mind wander while I relaxed for about 30 minutes. I really felt I was able to think clearer after the incubation phase, and I’m thinking more about how to work incubation into the process of an effective design.

It is a natural habit of the mind, to focus on a problem to the exclusion of all other matters. But creativity experts have noted how to tight a grip on a problem can block new ideas and prevent the mind from making creative connections (Michalko, 2001).

6.3.2. Brainstorming without boundaries

Hand in hand with idea incubation is the important practice of generating and encouraging ideas, without judging or disposing of them quickly. Michael found that this type of unbounded ideation was essential:

What I loved about this stage was that there were no wrong answers, no worries of failure. Only a time period of brain freeze where new ideas may be slower to originate. I was free to connect the unrelated dots and imagine what could be done to resolve this issue. It was a freeing experience to let the mind ideate and innovate.

There are often constraints, imposed by our own beliefs or by others' expectations, that limit our thinking. In addition to pushing against any constraints, we urged the teachers to push beyond their initial ideas. Designers have been shown to have an attachment or fixation with early solution ideas (Cross, 2001), so it was important for teachers to recognize this and work to gather a multitude of ideas, without limits. As Kelly noted:

I realized colleagues were having similar problems with curriculum. This process not only helped me think of new ideas to integrate into my classroom, but it also made others share their own ideas with me. An important part of teaching is sharing ideas and learning from others. This phase opened up dialogue about particular problems within the school and various solutions. When you are just gathering ideas—all ideas are good ideas.

6.3.3. Creativity connections

The ideation experience required the teachers to develop ideas widely. Ideation is an essential element of design thinking processes, but it also reflects the divergent thinking aspect of creativity (Nusbaum & Silvia, 2011). Creative work is, in practice, both a process of divergent and convergent thinking (Runco, 1993), where people think divergently to generate a range of possibilities, but also phase back into convergent thinking to focus and develop an idea with attention and craft. Ideation took our educators toward divergent creativity in developing many ideas, and they came away with directions to consider as they looked toward the next mode, Prototype, in which they switched back into a convergent mode to build out an idea.

6.4. Prototype

Having generated many ideas or solutions, a designer chooses one to develop. In the Prototype mode, the designer creates something tangible, as a potential solution to a problem. Students discussed prototyping related to creating or crafting. They noted an *excitement in bringing ideas to life* and building something real out of an idea. In this excitement, students recognized the *connection between thinking and doing* that happens in prototyping—ideas become more clear through decision and action. Through this, prototyping promotes creativity, as it involves *taking a risk and being willing to fail*.

6.4.1. Excitement in bringing ideas to life

A key idea that was fore-fronted as students discussed their prototyping, was the satisfaction of building something real from their ideas. There was a sense of fun and energy to creating that came through in comments. As one student, Noreen, put it:

The process of creating something was so much fun! Finally, the inner designer in me came alive, and I could really see that education and design are uniquely intertwined...my prototype propelled me to do even more with my ideas.

The initial phases of design in the Stanford model are active and energized, yet they are characterized by ideas rather than products. Once one begins to prototype, ideas take shape in clearer form, which spurs excitement in doing. Jordan, also spoke to the excitement of giving substance to ideas:

This was an exciting phase because in the early phases I was trying to decide which direction to take for my solution(s). Here I was actually able to put together a “product” and put my ideas into reality, prototyping like a ninja. It feels good to get ideas out of your head and into reality...I worry we don't give students this experience enough.

Jordan's comment may reflect the way that education systems often do not give teachers or students the opportunity to create and build. Kelley and Kelley (2013) have described design as a process of making, which brings a by-product of creative confidence—and this sense of creative self-efficacy emerged in the ideas of teacher participants.

6.4.2. Connection between thinking and doing

In addition to this excitement in prototyping, students brought up the link between thinking and doing. Often, education practice separates thinking about things, from doing things. Yet creative thinking happens through the action or process of doing. As Schön (1984) describes, design often occurs in a “dialogue” between the designer and his or her work, materials and other contextual variables. Designs “talk back” to the designer as they think and evolve their designs as they develop. As Mary noted:

I see a connection between knowledge and physical experience; between thinking and acting in design. In my prototype, I incorporated an aesthetically pleasing mock-up of a course, and added the functionality aspect in the organization. This brought my ideas to a form and helped further the evolution of my work.

Laura created an infographic (not as an assignment but simply to share in discussion), to show her view of design thinking. She depicted the Prototype mode simply by the phrase of “thinking = doing.” As she described it:

The most important part of prototyping is that this stage of “doing” is actually about “thinking.” You have to suddenly become clear on all of the ideas that have been swirling, and make them something real. You stop questioning, and think by doing.

6.4.3. Risk-taking and willingness to fail

Students felt creative freedom as they worked with ideas in a tactile form. They frequently noted that this sense of creativity brings an element of risk-taking, which requires a willingness to fail. As Tanya commented in a reflection:

My biggest takeaway here is about risk taking...What I'm seeing as I look at design experiences is that risk taking is necessary to learning, making progress, and doing something better. Teachers need to be trusted...They need to be able to try new ideas that might require taking risks. We might learn as much from a failed idea or prototype as what we'll learn from a successful one.

Tanya's comment echoed other student's experiences about taking risks in building ideas. [Smith and Henriksen \(2016\)](#) discuss the importance of failure, for creative thinking and teaching, and note that failure is not generally given enough space in teaching and learning.

6.4.4. Creativity connections

Design and teaching are inherently creative and sometimes messy, without single right answers. [Schön \(1984\)](#) suggests that creative design work requires respect and trust for practitioners. In prototyping, these educators were given space and support to build on their ideas—to take action toward creating something that could address their educational problems of practice. Prototypes varied across students' contexts and problems (everything from a lesson/unit plan designed to engage motivation in a subject, to a phone app created for school counselors, to a strategic plan for improving teacher retention in urban districts – see [Appendix A](#) for the range). Prototypes take many shapes and forms. But they always move ideas into actions, in the creative process of building and developing something from an idea ([Papert & Harel, 1991](#)).

Whatever a designer creates must be tested for users. So, prototyping is inextricably linked to the phase that follows—Test. The Stanford Design School philosophy states, “prototype as if you know you're right, but test as if you know you're wrong” ([Plattner, 2015](#)).

6.5. Test

In the Test mode, a prototype is shared with an audience of stakeholders or users. A designer might implement their prototype with users, and observe, interview, survey, or ask them for feedback. The teachers reflected on how design testing benefited their work, and contrasted with other views of testing. As learners and teachers, they reacted to “testing” based on past and current associations. They suggested that *design testing can be more productive and learning-oriented than testing in the field of education*. They described how in design, *testing requires a willingness to fail, then learn and improve through it*. Finally, in being able to fail, learn, regroup, and improve, students noted how the *Test phase reveals how design cycles are iterative and non-linear*.

6.5.1. Design testing vs. educational testing

A powerful theme that arose quickly involved how our educators reacted to the idea of “testing,” and contrasted between design and education testing. The teachers found design testing to be a more productive and learning-oriented model than traditional educational tests. Nina highlighted this contrast, and critiqued standard approaches to tests in the field of education. She noted that in design, testing is a value-neutral activity that happens “early and often.” In education, it carries a judgment:

A design test showing unexpected insights or failure is not a problem, but a way to a better solution...In education it should be used in the same way. Most students don't like tests because they are just a grade—not a way to improve or learn.

Along these lines, Chloe also noted how the word “test” in education is instinctively viewed as a judgment-based end product, even an object of fear. She commented that, “tests cause anxiety for teachers and students in high stakes situations. But in design thinking I see the Test phase as learning. I am testing my work to modify, change, or improve.”

As Chloe suggests, educators often recognize how anxiety and determinativeness can be associated with the idea of testing in schools ([Von Der Embse, Barterian, & Segool, 2013](#)). For instance, Patrick noted that he had to rethink his prior personal experiences with testing in order to engage in design:

The idea of testing my own work was daunting. Historically, testing has meant how “smart” or how “dumb” I am. Now, I'm seeing it as a way to determine how I can make things better. As I create the template for my test focus group and begin prototype testing, I'm reminding myself that even a “failed” user test is good, if you learn from it.

Design testing is an opportunity to fail, learn and improve (Seidel & Fixson, 2013), which differs from valuations in educational tests, particularly for high-stakes contexts (Embse & Hasson, 2012). Patricia emphasized the design view of testing as more than just a grade:

In education, we get hung up on the tests (frequency, type, etc.) and then get lost on the point. If the focus of a test or assessment isn't to get and give feedback, then we've missed the point. If we aren't using assessment to make adjustments to pacing or pedagogy (as happens frequently in my school) then we need to rethink our purpose.

6.5.2. Value of failure for learning and improvement

Students discussed how traditionally, tests punish failure, rather than seeing it as a way to learn; but design testing emphasizes the value of failure for learning and improvement. There is no shame in a failed user-test, in the way that “shame” or “judgment” are often associated with failure in classroom tests (Bacon & Ferri, 2013; Dworkin & Tobe, 2014). For instance, Claire related this recognition of the power of failure and her struggle with it in her own design processes:

It was so difficult to fail in my first prototype. But I bounced back with a better one and was proud because it made me and my design stronger. It's ironic when I think of all I've learned in this course, one of the major things that stands out is failure. I learned to fail through design. And to take that failure and turn it into success.

Scholars have noted failure as an essential part of learning (Dweck, 2006; Lewis 2015). When we do something easily, we may move on without reflection. But in failing, we must stop, evaluate and reconsider. When viewed productively failure becomes essential to creativity and design processes (Smith & Henriksen, 2016).

Joan commented on how failure brought her to a better solution in her problem of practice. She had created and tested tools for building her students' conversation skills. Some of it worked, and some did not, as she described this process, “I learned it is *okay* to be wrong! I talked to my students, listened to their concerns and opinions, and used what I had gathered to change my original ideas. The solutions that emerged were greater than I thought they could be!”

This is succinctly summarized by another student, Brad, who noted that, “The final, most profound lesson of this process came at the very end in testing: In the whole design process, cut to the chase and fail fast. Then, iterate. Iterate. Iterate.”

6.5.3. Design as iterative and non-linear

Out of failure and improvement, a theme that emerged was how design is an iterative and non-linear process. Depending on what a designer learns in a user test, they may cycle back to another phase, to redefine the problem, brainstorm more, or revisit a prototype. Many students noted the iterative nature of design thinking.

For example, Michael discussed how feedback in testing is a stepping stone, giving information that may direct you back to another step. He noted how feedback allows a return to prior design modes, to refine the prototype or redefine the issue. He reflected that, “a key point I've taken away from the designer perspective in the testing phase is to never assume you're done once you've tested. Use the testing phase as a stepping stone for improvement.”

Overall, the nature of testing in design freed up students to learn, as opposed to educational tests, which are often summative. Design testing requires an openness to learn and improve. This is summed up in a comment from Chloe:

Testing in design is not the end product. It is the user (student) giving feedback to your prototype (lesson, unit, product, solution). This allows you to modify, adjust, or try something else. The process is amazing, and beneficial to both the teacher and student!

6.5.4. Creativity connections

It is appropriate that the testing process brought students full circle back to earlier phases. There is a cyclicity in the process that continually brings the designer (the teacher) back to the user (the student). In this, design is an interconnected process aimed at using creativity to meet practical needs (Schön, 1984; Pahl & Beitz, 2013). Creative work is both novel and effective (Oldham & Cummings, 1996), and in order to make something new to one's practice be effective for users, a designer must test it out to learn what works and what does not, to refine or redefine their solutions. Testing is how designers facilitate this creative goal. Design testing is not an end in itself, but a part of the creative cycle.

7. Conclusions

7.1. Summary of findings

Our research examined a group of educators' experiences in working with design thinking processes—to understand the creative takeaways that emerged. There were themes that occurred in each of the five modes of the process to characterize their experiences.

For the Empathize phase, many found empathy to be a *powerful new strategy for understanding students*. As a strategy for problem solving, it *led them to question, recognize, and challenge their own assumptions*—often with surprises. Moreover, it was an *applicable skill across different educational problems of practice*.

For the Define stage, it became important to *view their problem from multiple perspectives*. Taking the time to reconsider and thoroughly frame a problem led to a *deep understanding of the context and a vision for moving forward*.

Ideate was a phase in which educators recognized the *power of idea incubation* as a purposeful way of generating new ideas. Ideation became an opportunity to accept multiple ideas, to *brainstorm without boundaries* in an effort to think widely and deeply about solutions to problems of practice.

In the Prototype mode, educators reflected on the *excitement in bringing ideas to life* to build something real out of an idea. In this excitement, students recognized the *connection between thinking and doing*; and through this, found that prototyping promotes creativity, as it involves *taking a risk and being willing to fail*.

In the Test mode, educators found that *design testing can be more productive and learning-oriented than testing in the field of education*. They noticed in design, *testing requires a willingness to fail, then learn and improve through it*. Finally, this phase reveals *how design cycles are iterative and non-linear*.

All of these themes have connections to creativity—a skill that teachers rarely receive the support for or the scaffolding needed to address problems of practice. Having an in-service course that actively approached teaching through design thinking led these educators to view teaching as a creative design thinking practice. They began to see design as a path to problem solving in teaching practices and in the field. As one student, Beth, summarized it:

Schools are facing challenges across the board, from designing lessons for content mastery, to finding funding for professional development, to creating 21st century learning experiences, or differentiating instruction for diverse populations. Often these issues cannot be easily solved and need a creative perspective such as design thinking.

At the beginning of the course, the educators did not initially view themselves as designers. But they came to see themselves this way, through exposure and experience with design thinking practices.

7.2. Implications for scholarship and practice

Our findings reflect the potential of design thinking in teacher education. There is power in providing educators with a framework, tools, and support from design practices. Prominent scholars have noted the value of a design lens for teaching and learning (Mishra & Koehler, 2006; Norton & Hathaway, 2015). But it is incumbent upon educational research to go beyond this assertion, to support educators with design thinking tools and approaches. This study is an initial step toward a rich picture of the creative learning that unfolds in giving educational practitioners design thinking skills and opportunities. Here, we used the Stanford design thinking model. But there are a range of tools and models that have emerged in recent years for design thinking (Watson, 2015), which may be considered and explored.

Teacher education might examine ways to incorporate these ideas to help teachers work through problems of practice and apply a creative design lens. From the work of Dewey (1916, 1934) to Schön (1984), into recent scholars (Carlgen, 1999; Koehler & Mishra, 2005; Norton & Hathaway, 2015) there are solid foundations for viewing teaching as design. But teacher education and educational research must delve deeper into what design thinking looks like for teacher training, to explore concrete examples with creative connections for practice.

Teacher preparation curricula does not often focus on creativity or design themes. Here, our teacher participants saw that they had the ability to approach problems systematically and creatively, with techniques, skills, and a path forward. This gave them permission to take creative risks, and to learn and fail. They felt empowered to formulate solutions to problems they had previously struggled with.

While we have attempted to share themes and takeaways, the value of design in teaching might best be summarized in the trajectory of Joan—a teacher who described herself at the start of this course as such:

We've seen it before—the overworked, overwhelmed, and frustrated teacher. The one who jumps through hoops while meeting the needs of twenty-five plus students. This was me five months ago. So I began this course design process on a low note. Little did I know the impact it would have on me and on my students.

By the end of the process, she finished on a sense of efficacy and creative confidence:

I get a little choked up because I am in a completely different place than I was in December. After only a few months my classroom and my attitude have shifted. This design process allowed me the opportunity to get to know my students, not only as conversation participants, but as individuals. It is encouraging and exciting to see my creative impact. My goal now is to utilize this process with both personal and professional problems. I want to share it with colleagues. If classrooms, schools, and districts ran with design as the foundation, students, and education in general, would succeed at greater rates. Tackling classroom problems doesn't have to be so anxiety filled and overwhelming. It can be a positive and insightful experience. Going through this process and semester taught me how to be a better creative problem solver and a better teacher. I am no longer feeling defeated...I am feeling empowered!

This brings us back to a central idea, of how problems educators' face in practice are complex and challenging, and teachers often do not believe they have the creativity capacity or tools to address them well. But creativity and design are not magic—they are messy and iterative (design modes do not proceed or feel as linear as they may appear), but they also offer thinking tools, skills, and practices that support and scaffold such work. Giving educators the support of such skills opens design pathways toward creative thinking around problems faced in practice.

Appendix A

Student Name	Role	Problem of Practice
Allison	High School English Teacher	Improving Teacher Feedback and Student Reflection to Positively Impact Performance
Kathleen	Elementary School Teacher	Developing a Project-Based Learning Unit to Make Learning Engaging and Relevant
Brandon	EMS/Paramedic Educator	Designing Opportunities and Resources to Support Learners' Natural Curiosity
Joan	Second Grade Teacher	Supporting Effective and Meaningful Conversations that Lead to Deeper Thinking
Nina	Online High School Science Teacher	Supporting Students in the Use of Online Resources
Candace	Educational Technologist	Making Shakespeare More Appealing to High Schoolers
Laura	Middle School Math Teacher	Designing and Implementing Technology Integration Professional Development
Kelly	Fourth Grade Teacher	Making Scripted Curriculum More Engaging for Students
Jordan	High School Math Teacher	Helping Teacher Colleagues Manage their Time
Patty	K-8 Technology and Digital Writing Teacher	Developing a Technology Curriculum
Michael	Associate Registrar	Improving the Help Ticket Process in the Registrar's Technical System
Noreen	Middle School Language Arts Teacher	Retaining High Quality Teachers in Urban School Districts
Mary	Online High School Teacher	Designing and Implementing Engaging Online Class Discussions
Tanya	Technical Product Manager	Designing a Process for Sharing Materials and Resources
Chloe	High School Teacher	Re-Defining the Role of a School Counselor
Patrick	Educational Nurse Coordinator	Developing a Flight Nurse Curriculum
Claire	Second Grade Teacher	Designing a New Math Curriculum
Brad	Director for Virtual Campus Ministry	Helping Staff Become Comfortable in Using Digital Spaces
Morgan	High School Science Teacher	Implementing Student Centered Learning by Promoting Student Responsibility and Leadership
Janet	K-2 Special Education Teacher	Developing a Process for Successful Co-Teaching and Differentiated Instruction in Math
Beth	Middle School Science Teacher	Helping Teachers Enhance Student Engagement with Technology
Patricia	Pre-School Teacher Supervisor	Supporting Teacher Classroom Management

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