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ARTICLE



Design thinking and the practicing teacher: addressing problems of practice in teacher education

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ABSTRACT

Design thinking has been receiving increased scholarly and popular interest in education; yet, teachers are often uncertain about what it means to implement this in their educational settings. Design thinking, nonetheless, offers a framework to address the challenging problems of practice educators face. In this article, we examine a graduate-level teacher education course, at a Midwestern US university, which uses the Stanford Design Thinking Model. Educators in the course found that exposure to and practice of the design thinking model allowed them to creatively solve problems of practice relevant to their context. In particular, educators reported three main takeaways from the experience: (1) valuing empathy, (2) becoming open to uncertainty, and (3) seeing teaching as design. We discuss implications and challenges for scholarship and practice.

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Introduction

The field of education has increasingly heard the term design thinking, referring to applications of the field of design to teaching and learning. Scholars have described the value of design thinking for teachers and suggested that teachers are designers (Carlgren, 1999; Norton & Hathaway, 2015). Furthermore, popular discourse suggests that design has become a buzzword in education; yet, teachers are often uncertain about what it means or how to apply it (Lahey, 2017). Design thinking refers to the cognitive skills and that approaches designers use to address problems (Cross, 2001); and the term has been popularized by institutions such as the Stanford Design School or widely-known design firms like IDEO. Despite this growing interest in connecting design to teaching and learning, it is not always clear what this means in practice. There is a need to understand how design thinking might be applied in teacher education. We suggest that design thinking offers a framework for teachers to engage with problems of practice – and when teachers view themselves as designers, it can empower their ability to address problems, at a time in which challenges abound in educational systems.

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The types of problems educational professionals encounter in practice are complex and varied – from designing curriculum, to motivating students in content areas, to communicating effectively with parents, and to countless other issues. Such problems of practice are open-ended and challenging, with many possibilities but no single solution (Bullough, 2012). By thinking like a designer – for example by examining how students experience aspects of school, much as a professional designer might consider how people use products, physical spaces, or other artifacts – teachers might better understand challenges and identify ways to move forward.

In this article, we examine a graduate-level teacher education course structured around a design thinking model. We discuss results of a qualitative investigation of the impact of design thinking on educators' approaches to problems of practice. Our purpose is to share research insights through teachers' voices, about design processes for navigating professional challenges.

We begin by considering theoretical foundations for design thinking in education, then describe the design thinking model used in this context with an overview of the course. We present our methods for this inquiry and share our findings in a thematic examination of the teachers' ideas and takeaways – including *valuing empathy*, *becoming open to uncertainty*, and *seeing teaching as design*. Finally, we examine implications and critical challenges in applying design models to teacher education.

Theoretical foundations of design in education: 'everyone designs...'

Scholars have noted the significance of design as a theoretical lens for the field of education with connections to teaching and learning (Kirschner, 2015; Razzouk & Shute, 2012). Beyond recent discourse around design thinking in education (Lahey, 2017), we can consider the roots of design as a discipline to see a rationale for applying it to educational issues.

For example, Herbert Simon, a 1978 Nobel Laureate in sociology and economic design making, suggested a definition about the purpose of design, connecting it to varied disciplines and complex problems of practice. Simon defined the field of design as such:

Everyone designs who devise 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)

The broad applicability of design is evident in the contention that *everyone designs* if their goals include *changing existing situations into preferred ones*. Thus, design is integral to the work of those who aim to devise solutions that improve situations for people and society. Buchanan (2001) notes that design lies in a place where human ability for planning, problem solving, and creating is applied toward building objects, ideas, processes, or systems that serve needs – this includes those of students and learners. Collins, Joseph, and Bielaczyc (2004) suggest that design involves directing goals, actions, and purpose toward the challenges and solutions of real world issues. Others have argued that design bridges theory and practice to fashion solutions to challenging, open-ended problems, spanning scientific and creative activity (Hoadley & Cox, 2009).

Kimbell and Julier (2012) have described the applicability of design across professions, noting that most people engage in some kind of design work every day and that people working in all sorts of contexts – as managers, activists, receptionists, volunteers, and others – are involved in creating new solutions in their organizations. They suggest that becoming conscious of this use of design and paying more attention to the development process is critical, because ‘to move from silent design to conscious design requires tools and guidance’ (p. 5). Jonassen (2000) specifically suggests that design offers a metatheory for thinking about problems in education, noting that learning to solve problems is seldom required in formal educational settings, because our understanding of its design processes is limited.

Locating design within professional practice, Donald Schön’s (1983) work described how design is part of human centered professions that require ‘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’ (1983, p. 49). This situates design as a kind of creative approach to problems. Design is at the core of human-centered professions, including doctors, nurses, engineers, and notably, educators. Yet, design has unique disciplinary approaches (Cross, 2001); and these approaches may be difficult for teachers, in demanding educational settings, to intuit and internalize without information, instruction, support, resources, and scaffolding. Teachers need support for the problems of practice they encounter daily, which may range across issues of curriculum planning, instruction, student engagement, school culture, classroom management, and more.

Amongst the voices suggesting that design is applicable in education, some have suggested the role of the teacher as akin to a designer (Norton & Hathaway, 2015). There is a need for specific applications of design thinking that educators can apply to the contextual and often messy problems of practice that abound in education (City, Elmore, Fiarman, & Teitel, 2009). The problems that educators face are often situated at the intersection of multiple disciplines, issues, and stakeholders and require thoughtful tools for problem solving.

We suggest the term problems of practice to refer to complex and actionable issues that emerge in a professional’s sphere of work. Such problems are unlikely to have one right or wrong solution. For example, a teacher might wish to increase student efficacy in certain mathematics content. If there were a single clear answer, all math teachers would apply the correct approach, and all students would thrive in math. Because there is no simple, one-size-fits-all solution, such challenges are well suited to design thinking processes (Buchanan, 2001). Yet, we must also recognize that design processes are eclectic and have varied applications or meanings in education.

Threads and meanings of design in education

The approach we focus on draws from one specific scholarly strand of design in education – the role of teacher as designer – and in our case, we specifically focus on using a design thinking model as a tool for teachers to use in managing problems of practice.

There are many subtle variations in how ‘design’ is connected to educational research and practice, making it difficult to fully represent the range of connections. But in the interest of situating our work in the field, we denote a few major areas in which design plays

a role in education. These categories include: design-based research (DBR), learning by design, and (in this case) the role of teachers as designers. These different connections are distinct areas; yet, they may overlap or relate to each other in thematic similarities.

DBR

One area where design has been increasingly discussed in education is a form of research inquiry, DBR (Anderson & Shattuck, 2012). DBR is a significant space in education, and it is distinct from 'learning by design,' or the 'teachers as designers' role that we focus on. DBR is a research methodology – an approach to empirical research in education based on principles drawn from design and engineering (Zaritsky, Kelly, Flowers, Rogers, & O'Neill, 2003). Sometimes used by researchers in the learning sciences, DBR involves the development of educational/classroom interventions, which are then implemented iteratively in real-world situations alongside cycles of empirical inquiry. What makes it unique in educational research is its goal of testing the validity of existing theory and developing new theory and frameworks to inform the field (The Design-Based Research Collective, 2003). Bannon-Ritland (2003) notes that such studies are informed by design and engineering processes, and proposes how DBR studies can 'construct propositions about teaching and learning as well as engineer and construct effective learning environments ... that allow teachers and learners to make these propositions actionable' (p. 21).

Cobb, Confrey, DiSessa, Lehrer, and Schauble (2003) note that while educational designs have often informed theory building, DBR experiments purposefully work to 'engineer' aspects of learning and then systematically study them in natural contexts. Design principles allow DBR to be both purpose- and user-driven – devising innovations, then applying and testing them with a real world audience *in situ* of teachers, students, or stakeholders (Anderson & Shattuck, 2012). The empirical, theory development-testing focus distinguishes it from other aspects of educational design discourse – but clearly there are similarities. Other conceptions of design in education, such as 'learning by design' or 'teachers as designers,' also employ design for education, toward their own practice-centered purposes.

Learning by design

The idea of 'learning by design' is another conception of design in education, but the focus is on how students learn or construct knowledge through the active process of design. The focus is on engaging in design processes as an important way to construct learner understandings of a topic (Kolodner, Crismond, Gray, Holbrook, & Puntambekar, 1998). The premise is that learning happens best when students are engaged in doing – in designing or creating something and using and developing subject matter knowledge to do so (Bereiter & Scardamalia, 2003). There is an emphasis on how students can encounter design processes, be involved in project-based learning, and experience and apply concepts in ways that become personally meaningful (Papert & Harel, 1991). Kafai (2012) has also connected the work of design to learning, often with a focus on games and programming. Students are exposed to the requisite application of knowledge that designers must build and enact in order to create something (Gee, 2005). The role of the teacher is still central in facilitating and guiding learning (Kalantzis & Cope, 2005), but learning by design is aimed at building learner knowledge, skills, and creativity through more active, collaborative design situations.

Teachers as designers

Another critical area of design in education is in the work that teachers do, and the kinds of problem solving and management tools that may support their work – which is where this study is situated.

Scholars have drawn implicit and explicit connections between education and design thinking. Mishra and Koehler (2006) developed their theory of technological pedagogical content knowledge (knowledge that twenty-first century teachers need for teaching with technology) based around the conception of teachers as designers. They emphasize the role that educators play in working with tools and content or ideas, in order to design experiences for learners, making a case for teachers to view themselves as designers of knowledge, classrooms, learning, experiences, and more. Koehler and Mishra (2005) note that teachers must have learning experiences that place them overtly in the role of designer. The conception of teaching as design is more intuitive when you understand ways that these disciplines relate to each other. Wiggins and McTighe's (2005) work around Understanding by Design (also called backward design) is a critical application that empowers teachers as designers of learning and encourages the intentionality of design during the process of crafting learning. In this sense, educators must establish the purpose of doing something before implementing it into the curriculum; so, this form of backward design provides specific guidance in the work teachers do to create learning experiences, plans, or units (Wiggins & McTigue, 2005).

The scholarly link between teaching and design is not new (Dewey, 1934; Schon, 1983), though it has been observed more explicitly in recent years (Boling, 2010). Norton and Hathaway (2015) have described the growing search for a teacher education framework based on design. They suggest that because teachers are challenged to create novel practices that address twenty-first century educational purposes, they are in a position to be active and creative designers of experience. As they state:

Teaching calls for a kind of practice different from but complementary to the traditional view of teaching as a doing practice. Notions of teaching practice must acknowledge a second form of practice – the work of teachers as designers. (p. 5)

Kirschner (2015) has asserted that given the tremendous range of demands in twenty-first century teaching and schooling, an expert teacher is both a practitioner and a designer. The design aspect of what teachers do is distinct from the traditional view of teaching as merely doing or implementing something that already exists. Instead, the teacher becomes viewed as someone who 'actively constructs, invents, develops and designs the practice of schooling' (Carlgren, 1999, p. 50).

A framework for teacher education

We have teased apart several connections to design in education, including DBR, learning by design, and teachers as designers. Our context in this article is situated in the category of 'teachers as designers,' albeit a more specific application of a framework (in the Stanford Design Thinking Model). We chose to apply the Stanford Design Thinking Model based on several considerations which we will discuss. There are dozens of design thinking models which might be employed by teacher educators. Having and using a model may provide teachers, as novice designers, with a guiding approach.

The Stanford Design Thinking Model embedded in teaching coursework

The Stanford model has five phases of design thinking, referred to as modes, which are worked through toward a problem solution/resolution. These five modes are Empathize, Define, Ideate, Prototype, and Test. These modes are intended to be flexible and iterative so that at any point a designer might need to repeat or reconsider a phase. Designers, teachers and others can cycle through the process or reenter modes to understand or explore problems and solutions, by engaging any of the five modes:

- *Empathizing* with stakeholders to understand the problem (such as by conducting interviews or observations of students, or trying to put oneself in their shoes);
- *Defining* the problem (describing it comprehensively, including all of its facets and perspectives);
- *Ideation* (brainstorming, to gather as many solution ideas as possible, from the commonplace to the wild and everything in between);
- *Prototyping* (choosing a solution to create and build a concrete model from); and
- *Testing* (trying out the prototyped solution with students, to gain perspective on what works, what does not, and what needs to be done, or redone).

In the next section, we discuss our rationale for this model and describe the course.

Rationale for adopting the Stanford design model

Prior to the development of the course featured in this article, a preexisting version of the course had existed for years in the College of Education at Michigan State University. It is specifically housed within a Masters of Educational Technology Program, nested within the Department of Counseling, Educational Psychology, and Special Education in the college. In the earlier course version, this design course had been built around the topic of website-portfolio design for teachers. However, in recent years, web design has become more automatic and intuitive (via user friendly tools like WordPress, Weebly, Wix, etc.), and the need for teachers to learn a web design/portfolio focus has faded (Shaltry, Henriksen, Wu, & Dickson, 2013). At the same time, there has been more discourse and interest in creating teacher education curricula framed around issues of design – particularly through emergent tools and frameworks for design (Scheer, Noweski, & Meinel, 2012). Given this, it was programmatically decided, as a point of curriculum updating, that the course should be redesigned with a broader focus on design thinking for education.

The course is core content within the Masters of Educational Technology program and is required for students to take within their second year of that program. Graduate students in the program take this course after they complete the first year of core program content, which focuses on foundational issues of teaching and or technology. This course was designed for the second year of masters coursework, when students begin to move beyond straightforward educational psychology and educational technology content, into courses that build around creativity, design, and more diverse but compatible content. Thus, it both complements but also extends the program content. And while this course on design is housed within the Masters of Educational Technology program, it is also open to other graduate students in the College of Education. Given its

broader, interdisciplinary focus on design thinking and education, the course often draws not only in-service teachers interested in educational technology but also teachers in master's programs having other educational focuses (e.g. curriculum and instruction, special education, or others).

The faculty redesigning the course, specifically the lead author of this article, had noted that the professional capacity of teachers is essential in determining the experiences of students (Darling-Hammond, 2003) and that teachers often confront professional challenges that require them to design the solutions in practice. Yet, teacher education has not always been able to offer teachers opportunities, models, or tools for using design principles (Norton & Hathaway, 2015). In an initial step toward integrating design thinking in a course, we sought to adopt a model that would be relatively clear, straightforward, and accessible to novice designers. In fact, as we will describe, many of our teachers came in with absolutely no sense of themselves as being capable of design – so, it was important to structure and scaffold these processes in manageable and supported ways. We sought a model that offered available tools and resources and could be adapted for use in an educational setting.

Along these lines, we choose the Stanford model because the Stanford d.School encourages others to use their model by making adaptable resources freely available. It has also seen a fair amount of translation to educational settings – both of which were important reasons behind the decision to apply and examine this model for teacher education. But perhaps most important to our rationale was the fact that the Stanford model explicitly starts with the idea of *empathy*. While other design models do often integrate empathy via the idea of user experience, this model is perhaps most explicit and concrete in making it the first phase of design. The fact that it purposefully starts with empathy toward understanding the problem was important. Teachers often approach issues with the assumption that they understand a phenomenon based on their personal experience (Skott, 2015). But while personal practitioner experience is invaluable, such personal viewpoints can also cause one to miss factors and components of a problem that are grounded in the experiences of others. So, having a model that started the process with explicit 'empathetic' consideration of other stakeholders' perspectives was a critical point.

There are broad commonalities that span design thinking models, as well as contextual differences or varying details between them. We do not assert that the Stanford model is the only approach to design thinking in teacher education. As Watson (2015) notes, there are dozens or more variations of useful design thinking models. Teacher educators may consider their own context, needs, or preferences in a course or teaching context and then review the range of approaches or options for design thinking to determine what serves their needs. The point of having a model is valuable in that it provides teaches with a guiding approach and tools as 'a way to intentionally work through getting stuck' (Watson, 2015, p. 16). In our case, we found the Stanford model to be a constructive structuring point, which led to insightful takeaways for teacher education, as discussed in our results.

Overview of the course: design thinking for teacher education

The authors of this article were course designers and instructors. This course was taught fully online, and students were educational professionals from a range of settings and

contexts (mostly classroom teachers, with a small mix of administrators, instructional designers, counselors, and others). As stated in the syllabus description: 'at its core, this is a course about design. Design as practice and a process. Design as it relates to education and the world around us.'

Each educator in the course selected a problem from their own professional practice to work on over the semester. It could involve anything from increasing student motivation in science, to improving school culture or teacher retention, to helping students develop better conversation skills, or any other issue that seemed relevant to their work.

The course was divided into seven modules of 2 weeks each, with an introduction about design, followed by a module for each of the modes of the Stanford model (for Empathize, Define, Ideate, Prototype, and Test), and then a concluding module. Each module consisted of several key parts – including readings and discussion, a semester-long problem of practice project, module lab activities, and a final reflection paper. We briefly describe and elaborate on each of these aspects of coursework, to give an overview of the course and what the students did.

Readings and discussion

As in any graduate course, readings and discussion were central to the module learning activities. There was no single textbook used, although the Stanford d.School's Bootcamp Bootleg document was a frequent reference point for resources and tools. Varied scholarly readings for each week focused on ideas relevant to each mode/phase (e.g. readings on the topic of design empathy for the Empathy mode, or about brainstorming and idea generation for the Ideate mode). These scholarly readings were also accompanied each week by one or two lighter 'side-dish' readings that complemented the design thinking theme and contextualized the ideas in practice (e.g. a reading from Fast Company about rapid prototyping for the Prototype mode, or relevant pieces from Edutopia, the Atlantic, or other sources of intelligent popular discourse to situate the ideas in the larger conversation of education). Multiple weekly discussion threads promoted ongoing participatory discourse – both whole class and small group – around each design phase/theme with discussion questions that aimed to tie the ideas at hand to educational practice.

Problem of practice design project

This major semester-long project required each student to select a problem of practice, which they worked on over the semester using each of the modes/phases of the Stanford design model. This involved weekly mini-project work leading up to a final complete project. Each specific design thinking mode included associated deliverables which the students then assembled or synthesized at the end into a complete overview of their problem of practice design work.

The problems of practice were chosen by the teachers to address a topic or issue that each person wanted to work derived from their professional practice. Some were broad (e.g. a plan to improve student motivation); others were a bit more concrete (e.g. revising an area of curriculum to improve student engagement, or designing a professional development unit for their peers). While we cannot describe all individually selected problems of practice here, the Appendix includes brief descriptions of these, to give a sense of the scope of our teachers' problem contexts.

In each mode, students did work that produced deliverable relevant to their problem of practice. For example, for the Empathize mode, students had to conduct empathy research (using at least two techniques from the Stanford resources, such as interviews, observations, journey mapping, putting themselves in user position, etc.) and then write up a short empathy report of their findings about their users' perspectives. For the Define mode, students did several problem defining activities noted in the Stanford resources – such as a why-how? ladder, a root-cause analysis, and several others – and then considered these takeaways along with their empathy findings to write up a detailed problem definition. In the Ideation mode, students each conducted a brainstorming session with their relevant stakeholders and then produced a record of it (e.g. photos of the sessions with participants, sticky notes, whiteboards, etc. or a video recording). They were asked to ideate as widely as possible and solicit as many possibilities and ideas as they could. For the Prototype mode, students selected an idea to follow and then developed a prototype or representation of a solution to their problem. Given the brief frame of the module, we did not expect prototypes to be complete, comprehensive or final problem solutions. Rather, we sought to have students make their thinking concrete and create something that took their ideas and made them 'real.' Finally, in the Test mode, students conducted a user test of their prototype, choosing any of the user test strategies offered in the Stanford model or simply taking their prototype to try it out with their actual stakeholders and users – then writing up a brief report on results and points of learning and iteration.

Module labs

For each module, there was also an activity/assignment designed to help people connect with the core idea(s) of the module. The main goal was to engage the teachers with the theme of each module, in ways that allowed them to explore and play with themes. These labs were not connected to the larger problem of practice project but were shorter, informal, creative activities to explore the ideas of each design thinking mode.

For example, during the Empathize mode, students did a lab activity called 'A Twice-Told Tale,' in which they wrote a real short story from their own life (or someone they knew), then reimagined and rewrote another (flipside) version of it from an entirely different perspective of someone else involved in the original event/story – as a means of building empathy by stepping out of their own perspective and into another's. Or in the lab from the Ideate phase, students kept and recorded in an idea incubation journal throughout the module (submitted later as a digital file), where they informally noted or sketched any interesting ideas that came to them through each day. In the Prototype mode, students used household objects to put together some sort of physical creation or 'prototype' that represented a bigger idea (such as their view of learning).

Each of the module labs thereby allowed students to explore the meaning of each design thinking mode with some creative abstraction alongside the more instrumental design uses they applied to their problems of practice. Thus, our goal was to balance the more specific and instrumental nature of their problem work, with a broader thematic view done in more eclectic or playful ways.

Reflection paper

Finally, this being a graduate teaching course, there was also a final reflection paper to allow the teachers to reflect on what they learned, consider how they might go forward

in practice. The simple goal here was for teachers to reflect back and look ahead about their learning and goals with design thinking.

In the ways that we have described here, these design thinking modes were part of the activities and structure of the course as a scaffold for our teachers' coursework embedded in their practice. In the next section, we transition into our methods for inquiring into how teachers experience and learn through design thinking and what they take away for their practice.

Methods

Through qualitative investigation, this study explored design thinking as a framework for teacher education seeking to answer the following research question:

- How and in what ways did teachers using design thinking experience an impact on their thinking, and what did they take away for their approaches to educational problems of practice?

Participants

There were 22 student participants in this semester-long course. The majority of the students were K-12 teachers (from a range of classroom/school contexts, age/grade levels, and subject matters), as well as some educational professionals from other contexts. These other contexts included: school counselors, professional development coordinators, district-level technology coordinators, school administrators, higher education professionals, and other unique areas of education (see Appendix for a list of roles and problems of practice).

Data collection and analysis

Our data were comprised of course products, writings, and discussions generated by the students in this course. For privacy, we use pseudonyms for student comments, ideas, and work. We archived the course website and all written student online discussions, reflection papers, and design project reports, for coding purposes, to organize and identify salient themes.

As qualitative coding is interpretative, we first calibrated our understanding of common themes and patterns (Moustakas, 1994). We engaged a first round of coding to seek patterns (Bazeley, 2013). The first set of codes included emergent themes that seemed interesting and relevant in our initial data reviews. The second iteration of coding honed in on core ideas by eliminating superfluous codes and summarizing ideas as key themes of design thinking in teachers' experiences. In the third iteration, the themes were tightened to the ideas that prevailed most strongly through the work of the students in the course. The final round of coding offered our most significant, concise themes, which are discussed in the findings and conclusions.

Qualitative foundations suggest that rich exemplars have a 'story' to tell, so a well-crafted structure can inform the field in ways that offer transferability, if not conventional generalizability. 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 they are qualified by local conditions, and thus to develop more sophisticated descriptions and more powerful explanations. (p.101)

Reliability and validity

We engaged three qualitative verification techniques (Creswell, 1998), including prolonged engagement, peer-review or debriefing, and rich, thick description. *Prolonged engagement* involved examination of data that spanned students' work over a full semester (four and a half months of their work and discussion). We did *peer-review or debriefing* via regular check-ins as co-researchers, but equally importantly, with several outside scholars (these included faculty members and doctoral students). Within our analysis, we also include *rich thick description*, through use of descriptive detail and extensive direct quoting of participants, to allow readers to consider participants' own words alongside our own ideas.

Finally, we engaged multiple kinds of course data to determine that the findings were consistent across the context. Methodologists note the power in data, which across multiple sources point to the same outcomes and themes (Greene, Kreider, & Mayer, 2005).

Limitations

In being involved in a course about design thinking, the participants may have felt compelled to discuss design in more affirmative ways. We attempted to control for this by asking students to do work that contextualized design in their own practice, sharing examples and specific details. We directly quote students so that their responses can be judged by readers.

A 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. This small specific sample inhibits generalizability, and there is no guarantee that our sample is representative of all teachers. But statistical generalizability was not our focus – we sought to provide a view of this illustrative case with thematic resonance, offering considerations for teacher education.

Findings

Given our thematic focus, it was impossible to capture a description of all teachers' problems of practice. So as context, we summarize participants' roles and problems of practice in the Appendix. We identified three key concepts that suggest what our teachers took away from learning about and using design thinking. These include: *valuing empathy*, *becoming open to uncertainty*, and *seeing teaching as design*.

We frame and phrase these with active words, because students talked about changes that they saw in themselves, both personally and as educators, via the experience of design thinking. Wong (2007) notes that genuine educative experiences occur on a trajectory, such that

The experience becomes educative as we grasp the relationship between doing and undergoing. The experience is transformative as we have new thoughts, feelings, and actions, and also as the world reveals itself and acts upon us in new ways. (p. 203)

The nature of these themes indicates the action of 'becoming' something – a trajectory of change through experience and learning. These ideas demonstrate how the practices of design helped educators on a trajectory of growth and change.

Valuing empathy

Singling out empathy as a core theme of this study may seem unusual, in that empathy is already one of the phases of design thinking itself. All of the phases are essential to the process. Yet within the whole process, empathy made a distinctive impression upon these educators, as a transformative action upon their personal thinking and upon the other phases in design.

Many scholars have pointed to empathy as a core construct that is especially and uniquely central to design, as a principle cognitive tool of designers (Kouprie & Visser, 2009). Here, it allowed these teachers to understand their users/audience more authentically and approach their problems more fluently. Kathleen commented, 'Without that first mode, *Empathy*, my problem of practice never would have reached its true potential.' This was echoed by many of the educators.

Kelly articulated the importance of beginning with empathy and drew a clear connection to design for teaching contexts:

Understanding the people impacted by the design helps a teacher understand how to create a solution. As I interviewed my class, my students waved their hands, enthusiastically wanting their voice to be heard. In the past, I would turn to my mentor teacher for advice. In the empathize phase I learned the importance of the student or user voice... What I thought my class was thinking was not necessarily what they were actually thinking.

Educators care deeply about their students, so it can be easy to assume that empathy is already part of their practice. But as Morgan put it, it is not always easy or natural to get into the mindsets of students, and it requires active questioning:

I try to help my students in any way possible, to create activities and lessons that they would enjoy and learn from. But now I also ask, had I ever viewed my classroom and my teaching from their perspective? Where on the spectrum of horribly frustrating to simplistically wonderful were my lesson designs? I had no idea until I began this process.

That is not to say that educators must simply empathize with students and then do whatever their students want. Teaching occurs in a complex space with competing considerations and demands. Design thinking starts with empathy. From there, teachers can balance student needs with other objectives, as a tension to navigate. As Nina stated:

It is easy to assume that students share the same passions that we do ... but I'm realizing that the first step of empathy is important to understanding your users with an open mind. Later, there are opportunities to make decisions and to balance needs and wants. But first, making a sincere effort to hear what your users think or feel starts to open up new possibilities to balance student needs with other objectives.

The educator participants in this course singled out empathy as a transformative phase that connected other aspects of their design work. In education, there is often rhetoric that suggests the presence of classroom empathy. Educators aim to develop classrooms and lessons that are student-centered (Jonassen & Land, 2012). Yet, even when teachers care a great deal for their students, they may be instinctively building their teaching practices from their own view of the world.

Jordan reflected on how empathy has caused a shift in his approach across different contexts and teaching arenas:

I've often sat in the lunch room and heard teachers discuss 'unmotivated' students. I'm now wondering what insights would we gain from looking at the student perspective and how might it change what we do as teachers? ... I think about this a lot now. When I sit in meetings or PD I try to empathize with the people our decisions will affect. Without empathy we end up thinking things like more testing and more 'accountability' will result in better student outcomes.

Empathy is a challenging cognitive skill to apply, and designers become more fluent through practice (Nilsson, 2003). Psychologists note that empathy requires us to step away from our own experiences and explore the world from the viewpoint of other people (Wispé, 1986). These teachers consistently identified empathy as what transformed and informed their design work around their problem of practice as well as their practice as teachers.

Becoming open to uncertainty

Another theme involved becoming comfortable with uncertainty, through a willingness to try new things and take thoughtful risks. The US educational system has historically revolved around conformity and rules (Meyer, Rowan, & Meyer, 1978). In traditional learning settings, mistakes are penalized, and trying new things or being willing to fail is not encouraged among teachers or students (Levin, 1991). Yet creativity, new construction, and new growth often come through trying new things and engaging in intellectual risk taking (Smith & Henriksen, 2016).

Most of the teachers in our design thinking class were products of conventional pedagogy, and they understandably perpetuated this in their teaching. An essential part of the design thinking process is to ideate widely, then try out a potential solution, and test its effectiveness toward the problem, to find mistakes (Razzouk & Shute, 2012). A designer must consider whether they need to throw out the initial definition of the problem and reframe it, or prototype something, then dispense with it or start over if it does not work. This approach runs contrary to the one-correct-answer method commonplace in school structures (Struyven & Devesa, 2016). The teachers in this study described how having the permission to be wrong, then reflect, try again, and explore possibilities, was essential to their learning.

Claire noted that in the face of strict school accountability systems, many teachers have become obsessed with finding quick ways to improve student performance, which makes it difficult to explore the problem and address the root causes of poor achievement. She noted,

We think we know why problems occur. We think we have the answers. So often we skip empathizing and understanding and defining, and jump right into a solution. Fortunately, I see it now ... how crucial it is to focus and refocus.

Jordan had similar thoughts and articulated a belief that this must change, in his own practices and in education overall. His comments reflect the need to give teachers the creative freedom of an environment where the uncertainty of mistakes and ongoing iteration are an expectation.

This process helped me develop ideas for my problem without anxiousness about the uncertainty of how they might be received. We might learn as much from a failed idea or prototype as we'd learn from a successful one. Teachers need such a culture of trust and risk taking.

Tanya noted the importance of creating a culture that supports uncertainty and trying new things. As she commented, 'I'm seeing the importance of thoughtful risk-taking as necessary to learn, make progress, and get better, and that failure is something to be embraced, not excoriated.'

Michael discussed how the process of exploring or trying unique ideas can ultimately lead to a solution that might otherwise never have come about:

It's important to let the teacher-designer connect unrelated dots and link concepts. The learning is as much about us as designers as it is about the design. If we can get comfortable with generating ideas and the uncertainty of 'coloring outside the lines,' then the possibilities are endless.

Human psychology tends to be naturally risk averse (Nicholson, 1998); thus, conformity and rigidity have been designed, to a fault, into most educational systems. Scholars note that the structure of US schooling more closely resembles the strict, scripted behaviorist principles of Edward Thorndike, rather than the broader, creative, constructivist principles of John Dewey (Lagemann, 1989; Levin, 1991).

Human ingenuity, innovation, and discovery require willingness to try new ideas – to design, create solutions, and be open to uncertainty or failure. When circumstances are safe enough, this is what people often do (Konner, 2010). Having a model for design thinking helped these teachers become more comfortable with uncertainty and risk taking in their own practices.

Seeing teaching as design

While scholars that have suggested the role of the teacher as akin to a designer (Mishra & Koehler, 2006; Schön, 1983), our teachers did not enter this course seeing themselves this way. Their views changed and evolved through exposure to design processes for their problems of practice. Teachers entered the course unsure about the connection between design and education. This may be surprising because teaching requires the design of curriculum and instruction. Yet, the teachers discussed how at the start of the course they did not view themselves as designers. They were 'doers' and 'implementers,' of content. As Nina commented:

The term 'design' can bring with it many associations. When I initially thought of design, I thought of car styling or of architecture. I had not thought to apply the term 'design' to the complex problems I work with in the classroom.

There were multiple examples of students describing their initial uncertainty about whether a course centered on design could be relevant to their work. As Joan put it:

Had you asked me on entering the course to describe design, I would have said it is an art achieved by artists, car designers, or architects. I definitely would not have said that I, myself fit into this category. I hold many roles – mom, wife, teacher, colleague, leader. But not designer. Boy was I wrong.

As teachers began to participate in activities and go through the process of design thinking as relevant to their work, they began to see themselves as designers. This helped to strengthen their view of teaching and how they approached it as designers. Many spoke of how they started to see themselves as creative individuals who now had the tools to solve complex problems in their context. For example, Morgan reflected on her growth as she began to see how connected her work was to design, commenting:

I took a problem that I have tried solving through various other means, but also previously thought, ‘well teachers are always trying to make students more involved,’ or ‘this is just something that teachers are always trying to do, and working on it may be as close to a solution as I can come.’ But here I found I was actually making progress toward designing a solution! I could also tell at this point that my mindset had shifted and I had begun to see teaching and lesson creation from a designer’s point of view.

Beginning to view oneself as a teacher-designer was a transformative act of self-definition for many of the teachers in the class. As the teachers began to view themselves as designers, they became more confident in their abilities to engage in the process of design thinking. As Janet noted:

I no longer see myself only as a teacher, but as a designer. I’m realizing misconceptions I had. I had always thought a design was based on an idea that popped into your head. I thought people that came up with excellent design ideas were the people that just naturally had great ideas. This has taught me that everyone can be a designer and that there is a process. Teaching is design.

Something that had previously seemed out of reach or only for those with natural creative talent was now something attainable. This was an empowering realization for many, as Noreen stated in her comments, ‘The challenge of identifying the inner designer in me was exciting. Navigating the design modes of thinking, and working on my problem of practice through each, I gained more skills to develop into the designer I am.’

This initial lack of belief in themselves as designers may also explain the comments of gratitude they described at each step (in reflection papers, class activities, in final anonymous course evaluations, and some personal thank you emails to instructors after the course ended) for learning a systematic way to approach the myriad problems of practice that happen in educational contexts. As Patrick said:

Earlier, I would have raised an eyebrow to design and education being related. Now I cannot imagine one without the other. Education is entirely about understanding students’ needs, defining problems, goal setting, generating ideas, fostering self-direction, creating engagement and evaluating performance. It is the essence of design.

The intentionality of having a process makes the messiness of problem solving more manageable (Zande, 2011). Watson (2015) found that those who use design thinking

produce more and better ideas and have a path forward when they get stuck or are flummoxed by open-endedness. Pink (2005) states the connection well when he notes, 'The future belongs to a different kind of person. Designers, inventors, teachers, storytellers – creative and empathetic thinkers whose abilities mark the fault line between who gets ahead and who doesn't' (p. 1).

Discussion

Our themes reflect what these educators learned from working with design thinking, and how their approaches to solving problems of practice changed.

Valuing empathy was highly present in these educators' takeaways from design thinking. While 'empathize' is already a phase in design thinking in itself, it arose strongly as a meta-takeaway. As Norman (2014) has pointed out:

Designers bring multiple talents to complex issues, but first and foremost is empathy, of incorporating the needs of the people... Most existing professions who approach these complex, messy problems do so from an organizational or efficiency perspective. (p. 3)

Creating solutions for others begins with being able to understand their perspective and needs. The educators here noted that they assumed they were empathetic but realized there was space to improve. Psychologists have noted that empathy requires us to step away from the most natural point of view we have, our own, and engage other ones to deepen our understanding (Nilsson, 2003; Wispé, 1986). Empathetic listening and discovery can be improved through conscious design practices (Battarbee & Koskinen, 2005). For the teachers in our course, this was key to understanding their problems of practice, from which they could step forward into creating better designs.

Becoming open to uncertainty was also important. There is no avoidance of the complex and uncertain nature of educational problems of practice (Bullough, 2012), and design processes offer ways to embrace and productively grapple with uncertainty. As reflected in these educators' experiences, design thinking helped them to become more comfortable with the discomfort of uncertainty. This may offer preparation for the complex, shifting, and challenging contexts that most teachers work with in twenty-first century education.

Seeing teaching as design was transformative for these educators. While scholars have increasingly suggested the role of teachers as designers (Kirschner; 2015; Norton & Hathaway, 2015), teachers need support for this. Seeing teaching as design characterized a transformation which enabled these teachers to act as designers, with tools to face the challenges of education today. They began to see design as a path to addressing problems. As one student, Beth, summarized it, 'Schools are facing challenges across the board... Often these issues cannot be easily solved and need a new perspective, such as design.'

Evaluative tensions in using the model

While these findings are promising for implementing design thinking and practices in teacher education, there are challenges and tensions. Our results and the feedback from teachers were overall positive, both in qualitative data demonstrated here, and in student evaluations. Yet, we also experienced tensions as instructors in using design thinking in

teacher professional development. Because each student works on their own specific real-world problem of practice, there is a need for individualized attention. While this is the case in most graduate work, it is felt strongly in using design thinking, because the problems vary widely and uniquely across contexts. For teacher educators, this can require increased time and mental switches or shifts to interact with student work. Beyond this practical issue, we note two critical considerations for future applications or research.

One is a problem we experienced in trying to allow for the kinds of iteration that are authentic to design. Design is fundamentally messy and iterative and does not occur in linear, lockstep phrases (Cross, 2001). While using such a model ensures that we have process strategies to support novice designers, in the real world, designers often work in nonlinear or idiosyncratic ways. However, teachers new to this could mistakenly assume the process model to be (deceptively) linear.

Further, teachers need time to engage with each design phase and learn the fundamentals – yet in a semester-bounded timeframe, the need for order and instructional continuity means that the design phases are often organized into linear modules, which did not necessarily feel representative of ‘authentic’ design or its nonlinearity. While many students commented on awareness that the process was iterative, as instructors we did not necessarily see them experience such iteration. Given more research and practice in this area – perhaps by investigating educational practices used with novice design students – this issue may be better informed. In this local context, and in teacher education broadly, more work from an instructional perspective may help us understand how to support this kind of iteration.

Another tension in this model is that while design thinking aims at innovative solutions, there is nothing inherent in the Stanford model (or any design thinking model) that absolutely guarantees creativity or innovation. Therefore, the present study cannot speak to whether the project solutions that teachers developed were legitimately innovative. The results of this study do suggest that teachers came away feeling supported by design thinking and empowered in feeling more innovative to improve their own practice and problem approaches. We believe there is significant value in this as an initial step. But more work is needed to understand if and how this model can support teachers in consistently developing innovative and creative approaches or solutions, and whether it is a sustainable model with real-world application beyond the boundaries of in-class results.

Implications

The field of teacher education might examine ways to incorporate design ideas into both pre- and in-service work for educators. There is scholarly rhetoric for a view of teachers as designers (Norton & Hathaway, 2015), but little evidence that teachers consistently receive opportunities for sustained design thinking in teacher education or professional development. It is perhaps unsurprising that the teachers in this study initially struggled to view themselves as creative, or as designers. As they progressed, they felt empowered to formulate solutions to issues they had previously struggled with. This suggests that educational research, practice, and teacher education may be informed by applying and studying design thinking approaches for teacher education and professional development. More work is needed to explore the benefits and address the challenges, but our work shows that there is promise.

While we have attempted to share themes and takeaways from this course, the overall experience might well be summarized in the trajectory of Joan – a teacher who described herself at the very start of the semester of this course as such:

We have seen it before – the overworked, overwhelmed, and frustrated teacher, who jumps through hoops – addressing the needs of twenty-five plus students. This was me five months ago. I have been teaching for ten years, but felt like a rookie in front of this class. I consulted my colleagues, but always got the same answer, ‘That group of kids is tough, good luck!’ ... So I began this process on a low note.

At the end of the process, Joan shared:

I get a little choked up writing this because I am in a completely different place than I was before. After only a few months my classroom has shifted and I have too. This design process allowed me to get to know my students, not only as conversation participants, but as individuals. ... If classrooms, schools, and districts ran with design as a foundation, I think students, and education in general, would succeed at greater rates. ... Going through this process and semester taught me how to be a better problem solver and a better teacher. I am no longer feeling defeated ... I am feeling empowered!

Conclusions

We suggest that design thinking can be an effective structure for teacher education to use in supporting teachers to address problems, which opens up new directions and challenges for educational research and practice. Our thematic findings in this study show that through learning and engaging with design thinking, teachers found resonance in the ideas of valuing empathy, becoming open to uncertainty, and seeing teaching as design, as takeaways that transform their thinking and practice.

Much educational literature has suggested that teachers are designers (Carlgren, 1999; Mishra & Koehler, 2006; Norton & Hathaway, 2015). So, it is important that the field of teacher education aims to offer teachers beneficial skills to engage with design in their own professional practices and in addressing problems of practice. As a process, design thinking can be iterative, nonlinear, and complex, but it is not magic. It is a way of thinking and working, with tools and skills that are available to everyone – perhaps first and foremost, to the teachers that engage with complexity and challenges on numerous fronts and across varied contexts.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

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	Redefining 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	Preschool teacher supervisor	Supporting teacher classroom management