

Beyond TPACK: Expanding Technology and Teacher Education to Systems and Culture

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Abstract: Despite copious amounts of research on technology in education, many teachers still struggle to use technology effectively. Much research on technology integration focuses on teacher education and design. For example, the TPACK framework describes the type of knowledge teachers need to design effective uses of technologies in their classrooms. However, despite its prevalence, TPACK has not led to wide-spread change in educational technology use. We argue this is because we have not paid enough attention to how educational technology works at a systems and culture level. In this article, we present a new framework, the Five Discourses of Design, that can help us consider how educational technology impacts and is impacted by systems and culture. We provide examples of how the framework applies to teacher education.

In 2014, *The Atlantic* carried an article titled, "Why Tech Still Hasn't Solved Education's Problems?" (Meyer, 2014). The article specifically referenced e-learning and the failed promise of MOOCs. This question (and its variants) have been asked of educational technology for decades. In fact, we could argue that the history of educational technology is littered with stories of how the advent of a new technology (and its potential for learning) leads to a significant level of hype about how it would transform education. Then, when these extravagant promises are not met, we despair that all technology is useless.

For instance, consider this statement about a new technology:

The modern school is forced to meet the demands of a rapidly changing civilization. Today the world of the learner is almost unbounded. He must acquire facts relating to a bewildering variety of places and things; he must acquire appreciations of far-reaching interrelationships. The curriculum and methods of teaching must undergo a continuous appraisal. New subject matter and new devices for instruction are being scrutinized for their potential contributions to the learning process.

What is interesting about this quote is not *what* it says but rather *when* it was written. This statement is not referring to the "net generation" or even to the first "computer generation." This statement was written in 1933 about the use of moving pictures (film) in the classroom (see Devereux, Engelhardt, Mort, & Stoddard, 1933)! It is interesting to note just how well this statement resonates even today. They go on to write:

The introduction of the use of the talking picture into education may prove to be an event as epochal as the application of the principle of the wheel to transportation or the application of steam power to the industrial age. No development in education since the coming of the textbook as held such tremendous possibilities for increasing the effectiveness of teaching as the educational talking pictures. (Devereux, Engelhardt, Mort, & Stoddard, 1933)

Even though technologies have changed drastically since 1933 (imagine 'educational talking pictures' vs. YouTube), the discourse around technology has not changed. Mishra, Koehler, and Kereluik (2009) would argue that the above statement proclaiming revolutionary changes in education resulting from a technological advance is not unique. They note similar arguments made for other technologies:

The overhead projector was “opening new doors for teaching science” (Schultz, 1965) by offering new ways to present information to students with new technology. Edison thought that movies would mean the death of textbooks . . . Others claim that networking technologies will make “men into bandwidth angels,” that will allow us to fly, “beyond the fuzzy electrons and frozen pathways of the microcosm to boundless realm . . .” (Gilder, 2000). (pp. 48-49)

As teachers and teacher educators interested in the intelligent and sustainable use of technology for teaching and learning, we must consider this cycle between hype of a new technology and despair of technology’s inability to drastically reform education. We suggest that one reason we have not been successful at changing education is because we have not developed a systems view of the problem at hand. Currently, much of the research on technology integration focuses on teacher education. We believe this is appropriate; teachers are the end designers of educational technology: they turn a technology into a learning tool. However, when we focus just on teachers and their classrooms, we rarely consider (or encourage teachers to consider) the surrounding systems and culture. We argue that developing a deeper understanding of design and design theory can help us begin to address the underlying systems and cultures of education, enabling more impactful approaches to helping teachers design effective uses of educational technology.

Design plays a crucial role in the success of any learning technology solution. However, design, as traditionally conceived, focuses on the designed artifact or occasionally a designed scenario, process, or experience. *In this paper, we offer a framework for conceptualizing the design of learning technology solutions.* The framework we offer can help designers consider the broader context in which they design, pushing towards deep, systemic changes that can truly impact education.

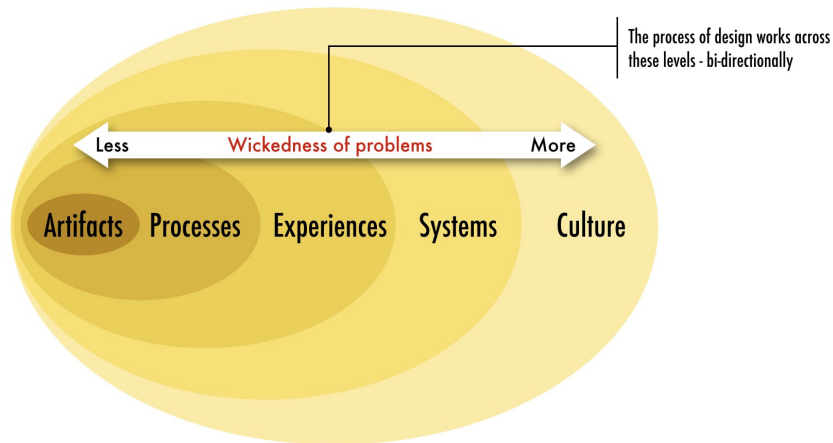
Our approach is consistent with how design theorists such as Richard Buchanan (1992, 2001) and Donald Schön (1987) described designers as reflective, action-oriented practitioners, akin to Deweyan concepts of inquiry (see Schön, 1992). Numerous others (Gallagher & Thordarson, 2018; Goldman & Kabayadondo, 2017; Jordan, 2016; Nelson & Stolerman, 2014; Scheer, Noweski, & Meinel, 2012) also wrote about the strong connection between design and educational practice. Thus, the idea that education and learning is an iterative and reflective form of practice that happens within complex, service-oriented systems of interaction and inquiry would seem to suggest a strong linkage between the fields of design and education.

We base our understanding of design on Herbert Simon’s (1969) foundational definition: “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (p. 111). *We see the educational landscape as a complex social system where educators are designers who operate at multiple levels.* We argue that teacher educators have not been sensitive to the multiple roles design plays in the success or failure of the tools and technologies we create.

In the framework presented here, we consider design as it plays out across different levels of the educational process. Each of these levels has its own discourse—hence, the *Five Discourses of Design* in educational technology (though the argument could also be applied to the broader field of education). Discourses, we suggest, are larger world-views, or ways of seeing, speaking, being, and doing that circulate in each time, place, and context. Discourses constrain what is possible to say, do, and think. We take inspiration from previous work in design theory articulating *orders* of design (Buchanan, 2001; Lockwood & Papke, 2017) as spaces for conceptualizing and enacting design practice.

Discourses also occur at multiple levels (macro, institutional, micro/everyday) as a constellation of words, images, and signs that are saturated with meaning. We are also deliberate about our use of the phrase *discourses of design* placing dialogic and communicative practices at the center of design practice. A dialogic approach is in line with Buchanan’s (2001) description of a fundamental shift in design thinking and practice around the turn of the 21st century, from a discipline based on logic to a discipline centered on rhetorical and dialectical practices. Discourse also highlights design as a conversation between various stakeholders, between the designer and the artifact being constructed, and between idea and reality (Schön, 1987).

Figure 1: The Five Discourses of Design



The Five Discourses of Design (as shown in Figure 1) are represented below (Table 1):

Table 1. The Five Discourses of Design

	Discourses of Design	General Examples	Education Examples
1	Artifacts	toy, building, software, cell phone	desk, museum display, SmartBoard, educational software, base 10 blocks
2	Processes	recipe, tax form, HR policy, transportation schedule	lesson plan template, classroom procedures, discipline procedures
3	Experiences	shopping experience, theme park, restaurant, video game	classroom activities, field trip, graduation ceremony, clubs, parent-teacher conferences
4	Systems	transportation, government, banking	teacher certification, degree program, district policy, testing and evaluation
5	Culture	Vision and mission statements, communication norms	perception of technology, open mentality, values, mind-sets

The framework allows us to address some key questions: *who* does the designing, *what* is designed, *when* does it happen, *where* it occurs, and *how* it is done. Discourses have specific and universal elements, such as knowledge, practices, tools, skills, techniques, and mind-sets, (which we call KEPTS for Knowledge, Elements, Practices and ToolS). For instance, designing an artifact such as a website or instructional video has very different KEPTS than devising an admission policy or a framework for technology integration. Table 2 provides examples of KEPTS that might be part of the discourse of teachers designing technology-enhanced learning opportunities.

Table 2. KEPTS of Teacher-Designers

Discourse Element	Description	Examples in Teacher Education and Technology
Knowledge	What the designer needs to know	TPCK, educational psychology, subject matter, child development
Elements	What the designer manipulates	Activities, learning objectives, interactions, open educational resources
Practices	What the designer does	Collaborating with other teachers, leading class activities, assessing learning
Tools	What the designer uses to design	Word processing software, textbooks, learning management systems

That said, considering work in each level as acts of design means that there are some key elements that are common across them. In each case, we are satisfying Simon's (1969) dictum that we are engaged in devising "courses of action aimed at changing existing situations into preferred ones" (p. 111). Scholars of design argued that the core of all design activity is certain universal mindsets (designerly ways of being; see Cross, 2006; designerly ways of inquiry; see Dalsgaard, 2017) such as openness, empathy, creative confidence, optimism, learning from or through failure, willingness to iterate, and so on.

There is also a change in how we traditionally view the *nature* of the problems being considered as we move across the figure from artifacts on the left to culture on the right. Problems go from being relatively structured to being ill-structured, or "wicked." Wicked problems, as first theorized by Rittel and Webber (1973), are a particular class of social problems that cannot be definitively formulated or exhaustively solved for. Not only does the nature of wicked problems make problem solving difficult, the problems themselves are hard to understand, making it difficult to identify the precise approach with which to solve them. As Stolterman and Nelson (2014) noted, the characteristics of wicked problems "are the result of the limits and paradoxes of reason when applied to real-world situations in human affairs that are unique, contingent, unpredictable, and complex" (p. 16). The system or cultural issues of educational technology are imbued with more wickedness across the spectrum of discourse than those involving solely artifacts. However, we argue that all discourses can be, and perhaps even should be, considered wicked: even artifacts must operate within complex systems and culture.

Finally, successful design requires us to understand both the top-down factors as well as the way artifacts and processes influence experiences, systems, and cultures. This means that the boundaries between the discourses are permeable and fluid. In other words, changes in design affects factors in both directions: from artifact to culture and from culture to artifact.

It must be added that these discourses, though essential, can also be a barrier to communication and understanding. People working at one level rarely understand the impact the other levels have on their work. This lack of understanding limits effectiveness of any technology or intervention. For instance, consider the TPACK framework (Mishra & Koehler, 2006). It is clearly one of the dominant theoretical frameworks for technology integration and teacher education. The significance of this framework can be gauged by the fact that in the past decade or so there have been over 900 journal articles, 240 book chapters, almost 300 dissertations and 27 books published around this framework (Harris, personal communication). This proliferation speaks both to the richness of the framework as well as the way it has been accepted by practitioners and researchers the world over. That said, there has been little change in the way technology is integrated within the educational system due to this framework.

The TPACK framework focuses on what teachers need to know to use technology effectively. It helps teachers consider the interaction of technology, pedagogy, and content knowledge—this is where we help teachers to develop professional judgment as they design technology use in their classrooms. The professional judgment develops through supported design of content-specific, pedagogically-effective lessons. However, we tend to ignore the complex and situated nature of teaching. Teachers don't teach in a vacuum (their classroom). They teach in a school, social system, political context, and culture. Although teachers' focus is necessarily their own classroom and student learning outcomes, they need to develop an understanding of the broader matrix of discourse we are embedded within. In other words, teacher educators must help teachers develop a sense of how their work operates within a system and culture, particularly as they design technology-rich learning experiences. Otherwise, their work risks clashing with the same systems and cultures, leading to frustration and limiting the impact of their work.

We argue that the lack of sustainable TPACK integration at scale is due to two key limitations of the framework. First, it focuses exclusively on teacher knowledge at the level of the individual teacher. Second, even at the level of the individual, the framework offers no discussion of teacher knowledge of systems and organizations. The Five Discourses of Design framework suggests that large scale systemic and system-wide change requires a lot more than knowledge of technology, pedagogy, and content. The framework highlights that the TPACK framework, laudably, goes beyond artifacts and into processes—but not much further. It sees the teacher as a designer but doesn't place the teacher as an intrapreneur.

In conclusion, we argue that part of the reason for the cycles of hype and despair is that, as teacher educators, we have not considered the role of design across multiple levels. We encourage teachers to focus on artifacts and processes: on designing them, evaluating their impact on learning and motivation, redesigning them, and so on. Perhaps there is some consideration given to the experience level of design—but this is few and far in between. We rarely discuss how our tools and technologies play out within the systems they reside in and the broader culture within which they work.

The framework presented here provides us with some new ways of moving forward and thinking about these issues. First and foremost, we, teachers, scholars, and designers, need to think as much about broader systems and contexts as the tools working within them. This requires going beyond seeing ourselves as designers of artifacts

and processes. We must consider ourselves intrapreneurs who are seeking to bring about systemic and cultural change. The framework also has significant implications for how we educate the next generation of teachers, scholars, and educational technologists. We need new kinds of research paradigms that allow fluid movement across the levels of discourse. We need methods of communicating findings to multiple audiences and discourse communities. We believe the framework introduced here is the beginning of a broader conversation about the many roles of design across the spectrum of educational technology research and practice.

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