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Fostering System-Level Perspective Taking when Designing for Change in Educational Systems

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Abstract

A core element of systems thinking is perspective taking. Perspectives help people distinguish between salient and irrelevant information, take particular types of actions, and make sense of the world. In this article, we consider what systems thinking and perspective taking means for designers in education. First, we present a framework, *the five spaces for design in education*, to illustrate design work in education. The framework presents five spaces for design: artifacts, processes, experiences, systems, and culture. We claim that most—if not all—educators participate in design work; however, the design spaces they work in vary. Consequently, educational designers often fail to consider the perspectives of those working in different spaces, resulting in failed reform efforts. We illustrate this concept through the technology integration attempts of the Los Angeles Unified School District. We argue more effective design in education occurs when designers both recognize their own design perspective and are aware of other perspectives.

Keywords Design theory · Systems thinking · Perspective-taking · Complex social systems

In Spring 2012, then-superintendent John Deasy started to plan an ambitious, $1.3 billion transformation of the Los Angeles Unified School District (LAUSD). The goal was to provide all of the district's roughly 500,000 students with iPads pre-loaded with educational software geared towards mastering Common Core standards (Gilbertson 2014). Yet, after its first-phase rollout, the LAUSD Common Core Technology Project received harsh criticism from the press (Lapowsky 2015; Molnar 2017), independent program evaluators (Margolin et al. 2015), and even from high-ranking district administrators (Lucas 2015). Technical issues, improprieties in the bidding process, and content inaccuracies in the software led to a firestorm of public disapproval, eventually resulting in the resignation of Superintendent Deasy. Under the guidance of a new superintendent, the program was redesigned with a more intentional focus on teacher instruction and student needs (with the intent to integrate as much of the $100 million worth of hardware and software already purchased as possible!) (Snelling 2018).

Although the LAUSD project has become a poster child for how *not* to integrate technology into a large educational system, it is most certainly not the only example (the much vaunted One Laptop Per Child initiative is another high-profile example; see Robertson 2018). Much has been written on the perils of relying on new technologies to be agents of revolutionary change within schools (Mishra et al. 2009; Cuban 2009; Sims 2017; Winner 2009). A part of the issue has been an inordinate focus on the device (or the specific technology) rather than the wider system within which the technology is to function. There is increasingly an awareness that the design of the device is just one part of the equation, and that the design of the system—usually the responsibility of educational administration—plays a critical role in the success or failure of the initiative.

This is not to say that this view of systems design or systems thinking has not received any attention. Research in

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design theory and systems thinking has led to more nuanced approaches regarding the development and implementation of new educational technologies, though it is clear that there is still much room for foregrounding these perspectives. One approach may be to better understand and appreciate the interplay between the various kinds of design that occur within a complex system (Buchanan 1992). In contrast to more traditional notions of design, technology-infused social systems are designed through the interactions of decisions made by many individuals who work within and across diverse and culturally contingent contexts (Dorst 2019). Although everyone may think they are effectively addressing the same problem, a systems-level analysis of these design interactions can reveal contradictions that often lead to dysfunction, paralysis, or, as Cuban put it, "change without reform" (2013, p. 4). Moreover, these design decisions often play out at different levels or spaces, some at the level of the material "thing" being designed and others at the level of the broader system. Those involved in educational technology would benefit from a framework that supports an examination of different design perspectives. Thus, in this article we propose a unifying framework which illuminates these perspectives and how the perspectives co-create opportunities and constraints for design within a complex social system.

Design and systems thinking have been popularized as effective and related tools for addressing complex and indeterminate problems (Buchanan 1992; Jordan et al. 2014). Many have written about the relationship between design and systems thinking (Archer 1984; Barba 2019; Buchanan 2019; Gropius 1970; Jones 1984). For example, Buchanan (2019) described systems thinking as a tool for identifying and understanding complexity, interrelationships, and interdependencies while design can move that understanding into action. For decades, design theorists have discussed the need for designers to understand the systems within which they work (Buchanan 2008; Nelson and Stolterman 2012; Simon 1962).

Although a systems perspective runs throughout much of the academic design literature, these approaches often do not filter down to practitioners (Barba 2019). Perhaps part of the challenge in combining systems and design thinking comes from the lack of clear models that connect them at a practical and actionable level. While some scholars have explored the application of systems design in the context of education (Banathy 1995, 2001; Senge 2012), this work either focuses on the large theoretical structures within educational organizations or foregrounds leaders as the primary system designers. Critically, no one has explicitly framed the range of work done by educational professionals, at different levels and scales, as essentially being part of or informing systems-design. To address this issue, we have created a framework for thinking about educational design in practice: the *five spaces for design in education* (Warr et al. 2019, 2020). We argue that, by better understanding the distinctions, commonalities, and connections across these spaces, the educator-designers who operate within them will be better able to conduct their own work and appreciate how they affect—and are affected by—other designs and designers.

The five spaces framework not only allows us to better understand the role of design in education, including the various types of design educators participate in, but specifically supports a systems view on education and design. In particular, it highlights perspectives of different types of design and designers and emphasizes the importance of cognitive flexibility and reflectivity (described by Barba 2019 as critical skills for designers). Within the context of educational technology implementation, such perspective-taking enables effective coordination and alignment of the activities taken by teachers, instructional designers, technical engineers, administrators, and policy makers.

In this article, we will explore how the five spaces for design in education framework can bring a design-oriented systems approach to large-scale educational technology change efforts. First, we describe the framework in more detail and illustrate how it supports perspective taking within systems. Given the multiplicity of systems thinking interpretations, we argue that a particularly useful and clear way to analyze how perspectives manifest within systems is the *distinctions, systems, relationships, and perspectives* (DSRP) model (Cabrera and Cabrera 2019; Cabrera and Colosi 2008). We then use the DSRP model to consider how the five spaces delineate different design perspectives. We explore how educators frame their own design perspectives, appreciate alternative perspectives, and align multiple perspectives in service of a system-wide goal. Finally, we apply the framework as an analytical tool for understanding the LAUSD's problematic educational technology implementation project.

The Five Spaces for Design in Education

At its most inclusive, design has been defined as "devis[ing] courses of action aimed at changing existing situations into preferred ones" (Simon 1969, p. 130). From this vantage point, design happens across a range of contexts. Buchanan described four "orders" of design, each a "place of invention. .. where one discovers the dimensions of design thinking by a reconsideration of problems and solutions" (1992, p. 10). His orders included (1) signs, symbols, and images; (2) physical objects; (3) activities, services, and processes; and (4) systems, environments, ideas, and values. Others have expanded on his framework, including Golsby-Smith (1996) who highlighted how domains of design require new skills of designers.

Buchanan's work has been highly influential in design scholarship. Discussion around his ideas centers on the work of traditional design professions such as architecture, industrial design, or interior design and is connected to the historical

evolution of the idea of design, from visual design all the way through systems design. Our framework, *the five spaces for design in education,* builds on Buchanan's work. However, the five spaces framework is focused specifically on the design work of educational practitioners and describes spaces for design as co-existing areas for design practice. The result is five interactive spaces for design in education (see Table 1).

The five spaces framework emphasizes that design plays out across all parts of education. In fact, we argue that almost every aspect of education is designed—from textbooks to policy, from learning experiences to admission procedures, and from professional development programs to institutional culture. Thus everybody who works in education is in effect a designer, though they may be working in different design spaces, each requiring different specificities of expertise, background knowledge, tools, and practices. This, of course, complicates the role of design in education. Design plays out differently in different spaces. Yet, these spaces are also connected: they constrain and influence one another in complex ways. Consequently, effective design in one space requires an awareness and appreciation of the other spaces. For instance, the educator who is developing a curriculum is constrained by state and national policies, standards, and broader social and cultural expectations.

We can represent the design spaces in many different ways, but one representation we have found useful illustrates the spaces in increasing levels of complexity and embedded in one another (see Fig. 1).

What is common across the spaces is the *potential* for design; each space represents an area where we can change existing situations into something more preferred (Simon 1969). Furthermore, there are certain attributes that the research and practitioner literature has identified as being important for designers to possess, regardless of the flavor of design they practice. Designers often approach ill-defined problems in a solution-focused manner, translating abstract requirements into concrete instantiations. They exhibit mindsets and attitudes such as openness, empathy, creative confidence, optimism, and a willingness to iterate and learn from failure (Cross 2006).

Design also requires working with specific elements and tools, and designers develop knowledge, tools, practices, and judgment that allow them to be effective. For instance, the kinds of knowledge, tools, practices, and judgement required for designing an app are very different from designing school furniture. Similarly, designing a process like a bell schedule is different in many ways from designing an engaging learning experience. In addition, these spaces are related to each other, sometimes constraining design and sometimes providing opportunities for new designs within a specific space. For example, consider a teacher designing a lesson plan. Changes in policy regarding, for example, standards-based testing can fundamentally change how the teacher approaches this particular design task.

It is also important to note that there is great variation even within these spaces. For instance, the design of an artifact can encompass anything from a mathematical manipulative to an app, or from a desk to a smart board. Similarly, designed processes may be as straightforward as submitting homework through a web-portal or as complex as securing a school during an active-shooter lockdown. Even culture, which appears all-encompassing at one level, can have local and global variations, from the culture within a class to the broader culture at the school or district level.

What this means is that constructing these five spaces is an analytic act that simplifies a complex network of design activities. Matters are always more complex than theoretical abstractions can capture. But again, that *is* the value of a theoretical framework: to provide ways of thinking and looking at the world that may be productive, even while acknowledging the simplification inherent in such an act (Warr et al. 2020).

The five spaces framework provides an overarching structure that contextualizes and unifies these distinct yet interdependent modes of design in education. It unifies them as being acts of design and yet acknowledges that how design plays out in each case can be, and is, different. For the purposes of managing a complex system in which all the design spaces coexist, it is critical that we also understand what differentiates them. In the next section, we

Table 1 Definitions of the five spaces for design in education

Space	Definition
Artifact	(Relatively) Stable objects that can be perceived through the senses
Process	A procedure or directions that can be used outside of the context within which it was created to achieve a goal
Experience	A piece of time with associated sights, sounds, feelings, and thoughts
System	An organized and purposeful structure of interrelated and interdependent elements
Culture	A pattern of shared basic assumptions that allows groups to perceive and interpret the world in similar ways, develop and communicate meaning, and transmit values to new group members

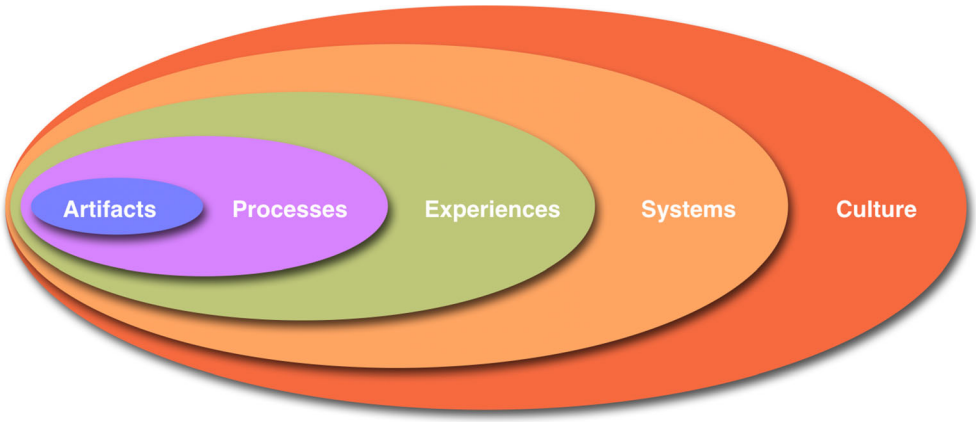

Fig. 1 Visualizing the fives spaces for design in education

will look at how these design spaces differ, specifically how they inform the perspectives of different professional roles within educational systems.

Designing Systems and Seeing Models

Despite being a relatively new field, the literature on systems thinking is varied and stems from a range of disciplines, research methodologies, and philosophical standpoints (Cabrera and Cabrera 2019; Meadows 2008; Miller and Page 2007; Page 2018). Cabrera and Cabrera's distinctions, systems, relationships, and perspectives (DSRP) theory takes a pluralistic approach to systems thinking and argues "that there are just four essential systems thinking skills: making distinctions, organizing systems, recognizing relationships, and taking multiple perspectives" (2019, p. 11). By taking a cognitive approach—literally considering how individuals think about and within systems—DSRP complements and in some ways operationalizes the five spaces framework. Though there is much to be unpacked in the DSRP model, in this paper we will focus specifically on the "P"—the perspective component.

Cabrera and Cabrera suggested that all perspectives are composed of two key elements: a *point* and a *view* (Cabrera et al. 2015). The point is generally the subject or viewer of an object, concept, or phenomenon, while the view is "that which is being looked at" (Cabrera et al. 2015, p. 537). Within a system, the same view may be seen or interpreted quite differently depending upon the mental models or perspectives of the point (see Fig. 2). Mental models give us the ability to distinguish between salient and irrelevant information and the cause-effect relationships between various components of the system. This not only helps us make sense of the world, but also provides rationale for the action we take. Unsurprisingly, mental models are a central element within most systems thinking approaches (Meadows 2008).

One of the primary affordances of the five spaces framework relates to perspective-taking. It encourages educator-designers within a space to see their work in relation to multiple, interrelated contexts. Many, if not most, professional roles inside educational systems can be conceived of as operating within one or more of these five design spaces. Highlighting how each plays a role in designing education encourages the development of new perspectives and a deeper understanding of the complexities of systemic change.

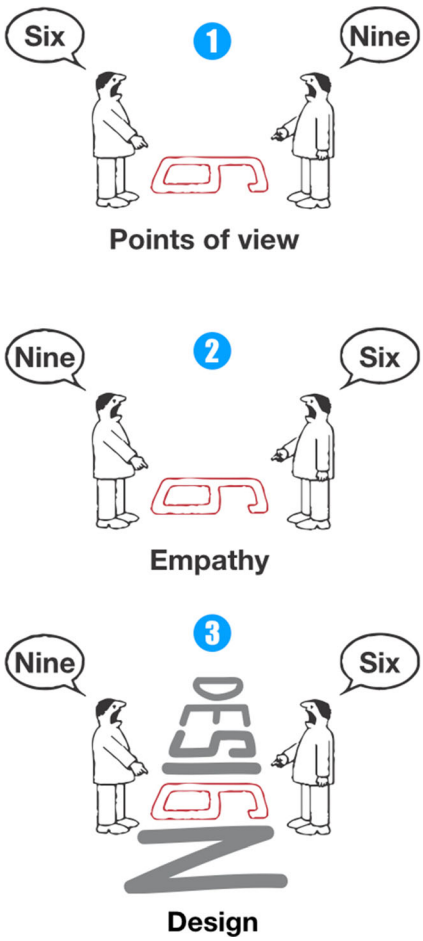

Fig. 2 Perspectives create different interpretations of the same phenomenon

Design, in Perspective(s)

By becoming aware of the assumptions, priorities, activities, and sensitivities inherent in each of the design spaces, we believe that educators, including instructional designers, can be more effective in fostering educational change efforts. Moreover, understanding other perspectives can provide a new view on a problem; it encourages the reassessment of assumptions and potentially yields insight into unforeseen solutions. Yet, before new views can be taken, all educators must first understand their own design perspective, both what it highlights and what it obscures.

Framing Educational Work as Design

The five spaces framework was specifically created to support a design perspective on education. It emphasizes that education is designed—it is a structure adapted for a purpose (to paraphrase Perkins 2013). And if education is designed, it can also be re-designed. This begs the question "Who is designing education?" We argue that all working in the education field play a role in the design of education. However, no one profession designs *all* of education. The five spaces framework helps us break down areas for design and discover new perspectives and possibilities. To better understand this, consider how the framework can be used to analyze the design work done by a classroom teacher.

While some research suggests that teaching can be conceived of as an act of design and that teachers may profit from such a framing (Warr and Mishra 2019; Dinham 1989; Jordan et al. 2014), this idea is not currently widespread or supported by mainstream teacher training or professional development (Asensio-Pérez et al. 2017). Yet, the five spaces framework highlights that teachers primarily design artifacts (worksheets, classroom spaces, bulletin boards), processes (lesson plans, classroom procedures), and experiences (the first day of school, field trips, a lesson in action). Teachers have a direct impact on how students experience school and learning. However, teachers still rely on others to design artifacts and processes for their classroom, and they must still work within the constraints of broader educational systems and cultures. For example, they use many artifacts and processes designed by others (digital hardware and software, textbooks, reading protocols), and have limited influence on the school calendar, academic standards, or policies. Designing these elements is the responsibility of instructional designers, curriculum specialists, administrators, and policy makers (See Table 2).

Although different educator-designers may be tasked with designing different elements, a single element can be viewed from the perspective of different design spaces. Consider, for instance, a teacher designing an assessment. The assessment does not exist in isolation, shaped just by the teacher's pedagogical content knowledge and their understanding of the learner's developmental trajectory. Broader systemic and cultural discourses, including teacher performance evaluation, school rankings, and maybe even the local housing market, all contribute to its design. We do not mean to suggest that teachers need to become real estate experts as much as they need to understand that their role (and perspective) is just one among many that support and constrain their actions. Using Cabrera et al.'s (2015) vocabulary, the teacher—a point—sees the assessment from a particular view, which is informed by a mental model. Other points (e.g. administrators, teachers from other disciplines, and even real estate economists) have developed different mental models and thus will see the significance and meaning of the assessment differently. In the next section, we consider how educator-designers can better understand and appreciate the views of their colleagues, even those with different roles and varied mental models.

Table 2 Applying DSRP perspective analysis to the Five Spaces for Design in Education framework

Space	Point (Designer-Educator)	View (Design Product)
Artifact	Coders, Engineers, Programmers, Teachers	Apps, devices, LMS, IT infrastructure (technical aspects), classroom design (bulletin boards, desk configuration, posters, etc.)
Process	Instructional designers, teachers, department heads	Apps, devices, LMS (functional elements), curricula, lesson plans, standards, assessments, schedules
Experience	Teachers, parents	First day of school, graduation, field trips, seminar discussions (teachers are both the designers and *part of the design*)
System (organizational)	School/District Administration	Course requirements, grading schemas, supporting IT infrastructure
Culture (organizational)	Everyone, but especially school/district leaders	Events/activities that either tacitly or explicitly display the values, beliefs, and priorities of the organization

Taking on Other Design Perspectives

As explained above, all educational professionals bring particular perspectives to their design work. These perspectives may not match up perfectly with only one of the five spaces, but generally do not span all of them. Teachers may spend little time thinking about designing new school schedules, tuition scales, or processes for maintaining school accreditation. Yet, when large-scale change efforts take place, such as implementing new technologies across an entire district, individuals with different design perspectives will necessarily have to work together.

In some ways, this can be seen as a liability built into the structure of the system: administrators, instructional designers, and teachers develop different conceptual models based on the capacities, constraints, and scopes of their roles. Moreover, a capacity from one perspective can be a constraint for another. An administrator might have the capacity to craft a district-wide policy or standard which may subsequently constrain a teacher's course structure, content, or teaching practices. So, how can educator-designers better understand and appreciate such different frames of reference?

First, we need to consider how multiple perspectives can actually be an advantage to designers. Noted complex systems scholar Page (2018) stated:

> As powerful as single models can be, a collection of models accomplishes even more. With many models, we avoid the narrowness inherent in each individual model. A many-models approach illuminates each component model's blind spots. .. We create the possibility of making sense of the complexity that characterizes our economics, political, and social worlds. In sum, when our thinking is informed by diverse. .. frames, we are more likely to make wise choices.

Due to the nature of complex systems, several perspectives can be "right," despite seeming very different or even at odds with one another. This suggests that, as Barba (2019) argued, designers need to develop a flexible cognitive point of view and reflectivity with regard to the parts and whole within which they work. For example, an industrial designer might shift perspective from the materials of a chair they are designing to the processes that go into producing that material and the related systems, be they chemical, economic, or ecological. Barba calls this approach "recursive design" and asserts that it "allows the designer to 'keep their mind's eye' on both parts and wholes and can result in more complex and organic solutions that address longer-term needs" (p. 158).

While Fig. 1 may suggest a nested or hierarchical relationship between the design spaces, it is not the only way to visualize the five spaces framework. Consider a different conception: one of various mappings of the same region. For example, imagine multiple maps of San Francisco, California. One map might show the major streets and roads, another the topography, another the current weather conditions around the bay, and another the areas affected by natural disasters throughout the city's history. It would be strange to say that any of these maps were more important than the others; in fact, depending upon the situation, any of them might prove to be critical to identifying an important problem. Rather than competing for primacy, these maps, like the five spaces, compliment and inform each other. Knowing the hilly topography of an area provides useful context for the various local weather patterns and helps explain how fires can spread through the city. (Note, there is an important limit to this analogy. Unlike the five spaces framework, most maps represent phenomena that are not easily influenced by the individuals doing the mapping. Unlike designers, mapmakers do not usually have the motive or capacity to change the phenomena they observe. With some exceptions, meteorologists and topographers generally focus on gathering knowledge about the world, not shaping it.)

Educators, like all designers, develop a deep reservoir of disciplinary knowledge and practices that give them the ability to leverage the capacities and navigate the constraints of their design space(s). By virtue of this expertise, educator-designers become more finely attuned to the elements necessary to competently do their work. This is generally a benefit to an organization; however, it can also cause a kind of perspective myopia, limiting the ability of educator-designers to see their work in the context of other perspectives or the greater system. The five spaces framework emphasizes the need to be sensitive to other design perspectives and understand their relationship to other designed elements in the system.

In many cases, designers view their own work as the most critical to the enterprise because of the familiarity, proximity, and agency their role affords. For example, an administrator might have more power to allocate financial resources based on standardized tests scores than they do over how any one particular student experiences a lesson; as such, they may come to tacitly believe that test score metrics are a more valid indicator of the system's overall success than student engagement. Since an instructional designer can craft course content that aligns with state standards more easily than they can ensure the content is implemented correctly, they may give more time and attention to the content development process and not recognize the critical role of implementation.

The issue is not that every designer needs deep expertise (or direct input) in all design spaces, but instead that they should be aware of alternative perspectives and be suspicious of the natural tendency to treat their perspective as the most important. To do so, they might ensure there is regular communication between people in different roles, and that everyone is encouraged to share their perspectives—especially where two perspectives may overlap. Senge suggested that

"problems with mental models arise when they become implicit—when they exist below the level of our awareness" (2010, pg. 165). Meadows encouraged systems thinkers to explicitly present their mental models and "invite others to challenge your assumptions and add their own. Instead of becoming a champion for one possible explanation or hypothesis or model, collect as many as possible" (2008, p. 172). This requires humility, an acceptance that one's perspective is but one among many—and though valuable, is limited in scope and explanatory power. This is consistent with research on forecasting where experts who aggressively and confidently extended the explanatory reach of their *one* approach significantly and consistently underperformed those who were skeptical of single unifying narratives and were willing to bring together *diverse* frameworks (Tetlock 2017).

A common source of conflict between design perspectives may have little to do with the core technical work of a particular role but rather involve issues that span design spaces. Interactions between designers with different perspectives might improve if each designer first describes their view of the central issues and explicitly calls out the relevant design capacities and constraints. Calling attention to these differing interpretations and approaching the task with humility and a willingness to see different perspectives may help unearth assumptions about each other's roles, goals, or priorities early in the collaborative process.

Orienting Multiple Design Perspectives to Work Together

Successfully achieving system-wide change requires not only that educators with different perspectives appreciate and understand each other's views, but also that the outcomes of their design work are aligned towards a singular goal. This requires a systems-level coordination not unlike that of an orchestra. While each musician's area of expertise is integral to the whole group, all play in service of the larger piece. The metaphor here, however, is somewhat flawed since it is predicated on the existence of a conductor with a master score who knows precisely how everything ought to go. Even in the most well-run school, it would be impossible for the principal to be an expert in every design space and have full knowledge of every single faculty and staff member's design perspective. The design of dynamic social systems in the real world must account for constantly changing circumstances that cannot practically be addressed by one executive designer.

Perhaps a more apt comparison would be an improvisational jazz group, in which nobody has a precise, fully-articulated vision of the whole system, but there is a collective understanding of the desired sound and feel. Anderson, a graphic design theorist, said that "as designers seldom produce work in a vacuum, they must engage in some form of team collaboration with various stakeholders and potential end-users during the creative process. Designers must establish some level of improvisation, behavioral integration, and/or cohesion in order to respond to their collaborators in an equitable fashion" (2018 p.). Exhibiting this kind of responsive coordination often develops when musicians spend considerable time working together, learning each other's strengths and weaknesses, and eventually developing a collective intuition for performing as a unified entity.

In the context of educational systems (usually composed of far more individuals than a jazz quartet), this kind of alignment is certainly ambitious. Yet, the five spaces framework suggests that an organization's culture has the capacity to help guide design activity across other spaces. There is a bit of a paradox here—though it is the *individual's* beliefs, values, and principles that are the primary elements of the system's culture, culture belongs to no one person. It is a characteristic of the whole. It is unsurprising, therefore, that culture seems to be not only the hardest of the spaces to assign ownership to, but is even difficult to conceive of as an object of design. That said, culture is the space where educational leaders have the greatest design capacity. They can work with their staff to construct a broad persuasive vision then follow through by providing time, resources, and guidance to make the vison a reality. The best leaders know and are comfortable with the inherent paradox of leadership: an acknowledgement that, even as they are asked to provide a bigger vision for the organization, their success resides in the acceptance and internalization of this vision by individuals. To extend the improvisation analogy described earlier, leaders can be seen to provide the core melody of a piece, making sure the other musicians understand it and have practiced it, and then give them space to riff and make it their own.

Coming Full Circle

We opened this article with the story of the LAUSD technology integration project. We presented the story as an example of what *not* to do. Clearly, Deasy's design decisions did not play out well for the district.

There are always value judgements associated with design. That said, given the complexity of the relationships between these different spaces, there never will be a perfect solution to a given issue. In fact, if we see educational problems as wicked problems (Rittel and Webber 1973), there will even be disagreement on what the problem *is* in the first place. We suggest that we step away from the idea of good and bad to a more nuanced approach, where we see better and worse solutions, and, most importantly, understand that getting better requires factoring in the multiple spaces within which designs are situated. Though this does not guarantee a better solution, not doing so almost certainly leads to failed solutions.

We can use the five spaces framework to analyze the perspective at play in the LAUSD technology initiative, considering what design approaches seemed to be more and less effective. In this section, we retell the LAUD story through the five spaces framework. Then, we speculate as to how Deasy—and other educational administrators—might use the framework to design systems for technology integration. Finally, we describe the more effective design process of the next LAUSD superintendent, Ramon Cortines.

Several of the initial challenges of the LAUSD technology initiative stemmed from former superintendent John Deasy's misunderstanding of his own design perspective, its relationship to that of the staff and external technology organizations, and, consequently, the absence of a unified organizational culture. Although Deasy's actions seem to have been born out of an earnest interest to improve the school district, he failed to understand how to leverage his design capacities to realize his vision. Email correspondence from early 2012 suggests that Deasy's first concrete action was to begin discussions with representatives from Apple and Pearson about purchasing hardware and educational software (Lapowsky 2015). If the design perspective of leaders lives largely within the space of systems and culture, then Deasy made a very strange choice: to begin with decisions about artifacts. Moreover, this seems to have been done with minimal input from the primary designers of educational processes and experiences: teachers and instructional designers. Among the few other perspectives that he took into consideration was that of Jaime Aquino, the district head of curriculum, ostensibly a role with a process and systems-level design perspective. Aquino voiced considerable reservations about the plan, stating, "My major concern is that there are a lot of unanswered questions, particularly financial/political/infrastructure implications" (quoted in Gilbertson 2014, p. 20).

It is perhaps ironic that, by failing to take into account the key design perspectives that would have helped translate his vision into reality, Deasy doomed the entire endeavor. Consider what might have happened if Deasy had been aware of his own perspective—anchored in systems and culture—while also considering the perspectives of other educator-designers. Instead of purchasing hardware and software on his own, he might have formed a committee of educator-designers from each design space to inform his decisions. Technology experts could provide insight into the devices and programs themselves, including an evaluation of technical requirements and potential problems. Educators who work in areas of process design, such as teachers, curriculum planners, and instructional designers, could evaluate the sequencing of software as well as its alignment with curricular standards. Teachers could also provide feedback on the experiences of technology in the classroom, highlighting the needs and preferences of students. Deasy could have considered his own expertise in systems design, as well as consult others who work in the systems space, such as technology system designers. They could ensure that purchased technology would work within the district infrastructure. Finally, various teachers, administrators, and community members could provide insight as to the beliefs and feelings towards technology in the community culture.

Although this type of deliberate and measured approach to designing a technology initiative would have taken significant time and effort, the recognition and inclusion of various perspectives likely would have led to a more positive outcome. In fact, the next administrator, Ramon Cortines, demonstrated the difference incorporating diverse perspectives can make. He rebooted the project, not with a focus on technological artifacts, but by first assembling a large task force composed of diverse stakeholders from throughout the district (Snelling 2018). This group embarked on a two-year-long process of determining a coherent strategy and set of standards for integrating digital tools into existing classes and curricula. Frances Gipson, LAUSD Chief Academic Officer, said that instructional technology usage is now seen "like breathing—a continual, simultaneous exercise that is both simply elegant and complex. .. It's about leading with instruction, instead of leading with a tool" (quoted in Snelling 2018). It is notable how much this statement parallels descriptions of musical improvisation. By providing a structure for integrating design perspectives, Cortines demonstrated a far more expert use of the design capacities of a leader.

Conclusion

Implementing large-scale changes within educational systems can be a challenging task. Doing so requires many actors, working at different organizational levels (and perhaps across organizations), to not only be unified in their overall goals and coordinated in their actions, but also have the freedom to respond to changing local circumstances and unanticipated issues. We have argued that these efforts are design activities that take place within a complex social system. In some sense, what we are saying here is not new. What *is* new, however, is the articulation of a framework (the five spaces for design in education) that we believe can help parse the many ways that design occurs within such systems. It highlights how the design perspectives of educational professionals can either work at cross-purposes or be aligned to a larger goal. A sensitivity to these five spaces and an understanding of their interconnected nature can provide us with tools and approaches to bring about significant, sustainable change in education.

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Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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