A Systems View of Technology Infusion

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Let us begin with a story, a story about a car factory in Fremont, California, and how it changed over time. In the beginning, this factory, run by General Motors (GM), was one of the worst factories in their lineup—inefficient and sloppy. As reported by Adler (1993) and Glass and Langfitt (2010), nobody associated with the factory was happy—not the workers, not the managers, and not even those who would eventually drive the cars. Factory workers were so unhappy that they purposely messed up cars—scratching them, adding extra bolts to make the doors rattle, even putting the engines in backward. The union made it almost impossible for employees to be fired. Absenteeism was high, and drug and alcohol abuse ran rampant. The result was a whole lot of wasted time, energy, and money. Eventually, GM closed the factory (Adler, 1993).

A year later, the factory was reopened, the result of a collaboration between GM and Toyota, and it was a completely different story. The plant ended up becoming one of their most profitable and efficient car factories, and within a couple of years, it was meeting and exceeding every industry standard in terms of quality and efficiency. So, what changed? Well, let's start with what did *not* change. The workforce did not change. The new factory included 85% of the previous employees, including the same union leaders. The brand did not change. For the first four years after the factory reopened, it continued to produce Chevrolets.

What had changed were the systems and culture. In addition to financial investment, Toyota brought their team-based production system to the factory. Toyota had a record of consistently turning out high-quality cars, and they believed their production system was key. To start the project, Toyota brought GM employees to Japan, where they worked in Toyota factories next to Toyota employees. In the Toyota production system, workers were put into teams of four or five employees. They rotated assignments to stave off boredom. When workers were behind, others offered assistance. Whereas in Fremont the assembly line never stopped, at Toyota, if a team had a problem, they could pull a cord and a team-chosen tune would play,

informing a manager that help was needed. If necessary, workers could stop the production line to fix problems. The focus was on quality, not quantity. Employees received bonuses for finding ways to make their work more efficient, resulting in new innovations such as special tools and processes. This was a new kind of factory culture—one where managers and laborers worked together and respected one another to create a product they could all be proud of.

The results were astounding. The new factory's quality met the same high standards as the Japanese factories. Workers enjoyed coming to work, absenteeism dropped, and overall production increased. Finally, according to the Consumer Report Reliability Index, the quality of the cars themselves improved (Adler, 1993).

This is the difference that the thoughtful design of systems and culture can make.

The obvious question that readers of this foreword must be asking is, What does the story of the turn-around of a car company have to do with technology infusion, the topic of this book? Essentially, we argue that most teacher preparation programs have seen technology integration as being "somebody else's problem" (Koehler, Mishra, Hershey, & Peruski, 2004). Technology and teaching are domains ruled by different groups of people—teacher educators, who are in charge of pedagogy and learning; and technologists, who are in charge of technology. The solution that emerges from this division is often that of providing a stand-alone technology course to teacher candidates who are taught by technology faculty. In contrast, a framework for technology infusion suggests technology integration should be a concern of the *entire* teacher preparation program, not only that of educational technology faculty. What is needed is a programmatic and systemic approach where the charge is a shared responsibility among all teacher preparation faculty.

There are complex historical precedents that have led to the "somebody else's problem" situation. Scholars have commonly labeled applying technology to teaching and learning as technology integration. Early attempts at integration laudably focused on learners and how they could harness new digital tools for new kinds of learning. For example, Jonassen's mindtools placed technology as a knowledge construction tool, emphasizing that students should be learning with, not from, technology (Jonassen, Carr, & Yueh, 1998). Others have emphasized that technology integration must focus not on the technology itself, but on the teaching and learning the technology enables (Knezek, Christensen, Miyashita,

& Ropp, 2000; Mills & Tincher, 2003; Norum, Grabinger, & Duffield, 1999). Teachers and teacher educators became the focus of attention with the advent of the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). The TPACK framework described the need for teachers (and teacher candidates) to simultaneously call on their knowledge of technology, pedagogy, and subject matter content. Though the focus on teachers and teacher knowledge was a valuable insight provided by TPACK, the framework does not address how best to develop that knowledge in a teacher preparation program.

We argue that perhaps there has been an inordinate focus on the teacher as the central adopter and agent of change, and we have neglected the role of systems and culture in technology integration efforts. We do not argue that the research has completely neglected the impacts of external barriers, systems, and culture on technology integration. Indeed, much research has considered both internal and external barriers (Ertmer & Ottenbreit-Leftwich, 2013; Rogers 2000), compared the impact of individual versus systemic factors on technology integration (Reid, 2014; Teo, 2015), and emphasized the need for systemic change (Ellsworth, 2000; Fullan, 2007). However, most of this work has focused on studying how the *current* system interacts with and affects teacher actions and beliefs, not on the type of influence a *new* system might have on technology use in education. And *this* is the lesson of the car factory in Fremont, California, with which we began our foreword—that *one can thoughtfully design not just tools and experiences but also systems and culture*.

We argue that it is productive to see tools, processes, experiences, systems, and culture as overlapping spaces of design, what we have called the Five Spaces for Design in Education (Figure F.1).

Each circle in the model depicted in Figure F.1 represents a space for design activity. Although design occurs across all the spaces, in each space the outcome of design is focused on a particular category of product: artifacts, processes, experiences, systems, or culture.

Although technology is not distinctly mentioned in the diagram, one can easily see how technology fits within each of these spaces. For instance, artifacts could be digital artifacts such as apps or websites, while processes could be technology-assisted lesson plans, and so on. It is also important to note that the complexity of the design spaces increases as we go from artifacts to culture. This is not to say that creating a good educational app is easy—rather that it is a relatively tame problem

compared to changing systems and culture. These spaces, though they appear nested within each other, do influence meaning-making bidirectionally. Thus, effective design in any design space requires an awareness of all design spaces.
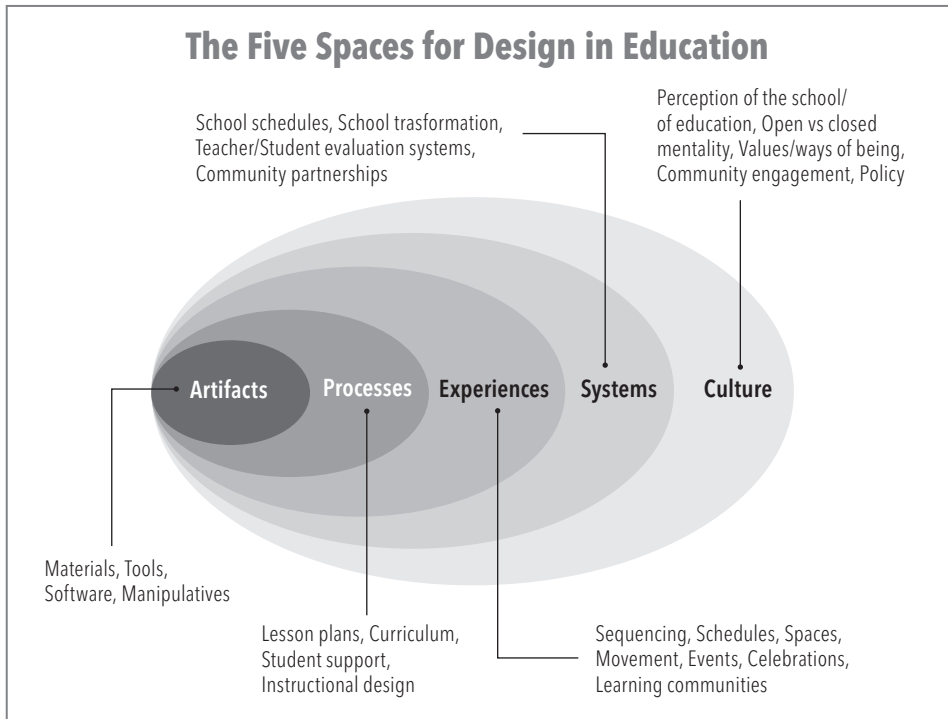
The Five Spaces for Design in Education

School schedules, School trasformation, Teacher/Student evaluation systems, Community partnerships

Perception of the school/ of education, Open vs closed mentality, Values/ways of being, Community engagement, Policy

Artifacts   Processes   Experiences   Systems   Culture

Materials, Tools, Software, Manipulatives

Lesson plans, Curriculum, Student support, Instructional design

Sequencing, Schedules, Spaces, Movement, Events, Celebrations, Learning communities

Figure F.1 The Five Spaces for Design in Education (see Warr, Mishra, & Scragg, 2019). Image property of Punya Mishra, Ben Scragg, and Melissa Warr.

We believe that the Five Spaces for Design in Education provides a broad vision of technology in education and emphasizes the importance of designing systems and culture. Most research on technology in education has focused on knowledge needed to design artifacts and processes, and sometimes experiences, but has at times ignored systems and culture which, as we saw in the Fremont factory, can entirely change how artifacts, processes, and experiences gain meaning and are used. Systematic, sustainable change requires attention to all five spaces of design: artifacts, processes, experiences, systems, and culture. This brings us to what we mean by technology infusion. *Whereas technology integration typically focuses on*

a particular instance when technology is used for teaching or learning, technology infusion is a program-deep and program-wide effort in teacher preparation programs to help teacher candidates learn how to effectively teach with technology. It emphasizes redesigning experiences, systems, and cultures of teacher education systems rather than focusing on stand-alone technology integration courses and tool-specific applications. It infuses technology into the culture of the teacher preparation program, enabling rich experiences for teaching and learning with technology.

The chapters in this book explore elements of a technology infusion framework. Teacher education is a complex system, consisting of multilayered and deeply contextual environments that provide students with a range of experiences to help them prepare for the future. Clearly, creating a coherent learning experience for teacher candidates (even when not considering technology) in complex contexts such as these requires thinking at the level of systems and culture. Additionally, teacher education does not work within a vacuum but is driven by structures, visions, and policy constraints that can be both internal to the organization (such as existing regulations, conventions, etc.) and external (such as the needs for certification, and so on). Making sustainable change in these types of situations is often fraught with ambiguity. In this context, teacher preparation programs that seek to make technology a key component of teacher education need to be seen as learning organizations—they are organizational structures adapted to a purpose. Change efforts need to consider relevant situations, constraints, and contexts. This is just a roundabout way of suggesting that the task the authors of these chapters have taken on is not an easy one.

Establishing a technology infusion framework is hemmed in by multiple social, organizational, interpersonal, and structural constraints. Thus, technology infusion is complicated, requiring negotiation and thoughtful design with multiple stakeholders. That is what makes technology infusion difficult. And yet, it is only through this deep engagement with systems of teacher education that technology infusion can truly take hold and allow for the development of the next generation of educators. This is not an easy task, but it is an important one. We praise the editors of this book and the authors of each of the chapters for taking on this challenge. The theories of change, the data and practical evidence they provide, and, as importantly, the stories they tell, will be invaluable to others who take on this challenge. We believe this broader perspective, that of technology infusion, requires expanding our focus to include experiences, systems, and culture to help *all* teachers effectively integrate technology into teaching and learning.

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Champions as Water Carriers: Prioritizing Technology Infusion in Teacher Preparation

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> Change that is well managed and well led is much more likely to be beneficial and accomplished more quickly. Whether institutions apply formal frameworks and theories or generic best practices, more institutions are including change management as a component of new initiatives and organizational development.
>
> — Grajek, S., & The 2017–2018 EDUCAUSE IT Issues Panel, 2018, p. 14.

We have been hoping for change. We have research, articles, and even books that clarify the concepts and strategies for leadership and change. But what we need are champions—a champion at each institution who brings vision, motivation, and tenacity, and who is supported by a culture that embraces innovation.

Infusing technology in teacher preparation is the vision. Hard work will be required, as exemplified by the champion who is also willing to serve as a water carrier. According to Walker (2018), carrying water is the "invisible art of leading from the back" (p. 133). Champions are individuals who provide support through their interactions, serving as a conduit to elevate priority setting, decision making, and achievement. Champions who are water carriers know when to step forward and when to lead from the sidelines, staying attentive to needs and timing. They also know when to retreat and regroup to be more strategic. Consider the scenarios below—examples of the kind of well-managed change, hard work, and water carrying that is needed by champions of technology infusion.

Sound Familiar?

Picture yourself in one of these situations:

Scenario 1. The subject line in an email from the dean of the School of Education read, "Outcomes of the Spring State Legislative Session." The email announced that the governor had signed a long-awaited bill for the construction of a new, state-of-the-art, 85,000-square-foot education building. The dean, delighted with the news, wrote: "Securing the funding for a new education building is something we have been working on for years. Now is the time to think big, share your vision for the space, and design a building that will help us place the School of Education on the map for its innovative technology." The dean ended his email with a request: "Take time over the summer to think about your dreams for embedding technology into the new building. Be prepared to discuss your ideas at the fall retreat."

Scenario 2. With an eye to the future, the College of Education Technology Committee at a large university lobbied the dean to accept the "challenge" issued by the Department of Education Office of Educational Technology (DOE/OET) to more adequately prepare teacher candidates to effectively use technology in support of teaching and learning. Following a proud moment when their institution was listed among other innovative institutions on the DOE/OET website (tech.ed.gov/edtechprep) that were willing to step up to this call, the committee quickly added references to the principles outlined in a DOE/OET policy brief to the college's technology plan document. These principles included program-deep and program-wide experiences for teacher candidates and establishing systems of professional learning for faculty. As the committee reviewed the revised technology plan, they realized that a lot of the statements in the document were philosophical and "aspirational." They did not really have an action plan and, further, did not have access to resources to support specific programmatic changes and faculty training. The academic year was coming to a close, and there would be several new committee members next year; they elected an incoming chair in anticipation of next year's committee work.

Scenario 3. Due to the increase in virtual K–12 schools opening across the US, the dean from a small liberal arts college announced at a faculty meeting that she wanted the college to develop a teacher preparation program focused on training a cadre of teachers with a credential in K–12 online teaching. She noted that, as

outlined in the college's new strategic plan, key stakeholders such as teacher educators, liberal arts and sciences faculty, administrators and teachers from K–12 virtual schools, and instructional designers would be invited to be at the table from the onset of planning for the new program. An educational technology faculty member spoke up, insisting that planning for the new program must include someone to provide leadership to technology infusion throughout the curriculum, rather than in just one or two courses. Another faculty member expressed concern that even with significant resources devoted to development of the program, how could they be sure newly enrolling students would find the program of value to their future employment?

The faculty and staff from all three scenarios above were faced with deciding "What next?" Ideally, they will all work toward a similar outcome: that is, the infusion of technology throughout their programs. However, as outlined in the scenarios, each representing a different context, the participants must overcome obstacles that are unique to their situation.

> **Scenario 1 Obstacle.** *Funding* for technology is just one element in achieving desired goals.

> **Scenario 2 Obstacle.** Fluid *participation* of faculty and staff, as well as lack of action planning, can lead to the ball being dropped.

> **Scenario 3 Obstacle.** Untested *instructional methods* may lead to failed or unsustainable programming or lack of enrollment.

Obstacles such as these must be considered and addressed in planning when programs are working to build capacity for effective change in teacher preparation. Given the complexity of teacher preparation programs, champions carefully ponder, "How should we proceed?"

A Vision for Technology Infusion

We believe that technology, when used in innovative and powerful ways, can equalize educational opportunities (especially in areas of diverse needs). We have been calling a program-deep and program-wide effort to address technology an "infused" approach. Some colleges and schools of education have eliminated a stand-alone educational technology course for an infused approach. We are aware

that other colleges and schools of education are considering this or other alternative methods for improving the way they prepare teacher candidates to teach with technology.

The vision for technology infusion is that teacher candidates are supported throughout all aspects of their preparation and that they are proficient in teaching with technology by the time they enter the field as certified teachers. For this vision to come to fruition, any and all individuals associated with a preparation program need to be responsible for and responsive to infusing technology. Thus, an infused program involves *all the systems and personnel* surrounding teaching and learning in preparation programs, including teacher educators, administrators, professional developers, instructional designers, field supervisors, district and school administrators, mentors, etc.

A large-scale change effort like this does not happen overnight, and long-term change requires close oversight of incremental adjustments. Success in academic transformation depends on educational leaders' commitment and strategic goals for leveraging technology and effective pedagogical practices (Grajek, S. & the 2017–2018 EDUCAUSE IT Issues Panel, 2018). In most cases, even with a strong leader who is focused on discovery, adoption, and implementation of new strategies (Freeman et al., 2017), a cultural acceptance of a systemic effort to adopt a technology-infused approach takes time. As experienced at Arizona State University, a cultural acceptance may not be attained for several years (Foulger, Wetzel, & Buss, 2019), and even then, preparation programs should be forewarned that needs shift, personnel changes, and visions evolve, making ongoing leadership, support, and championing all the more important (Buss, Foulger, Wetzel, & Lindsey, 2018).

At the core of each of the scenarios above lies an organizational champion, an "enlightened change maker who is personally committed to mutual values, rather than self-centered ones, and relentlessly driven by possibilities" (Thompson, 2009, p. 6). Change champions assist in instituting a change; advocating for and promoting the change from within, they are instrumental in the implementation of the change (Warrick, 2009). Champions for technology infusion are concerned with continually advancing a long-term change effort. In doing so, they rely on these skills:

- Champions are key communicators of the change and work to deescalate conflict when necessary.

- Champions problem solve to remove barriers of change, while at the same time they create supports for the change.

- Champions promote new ideas for change, supporting the vision and motivating others to share in this experience.

- Champions believe in the change, are driven by the vision, and are energized by their passion for change.

- Champions are the driving force of organizational change, leading their teams through the change, toward innovation.

If you are reading this book, you are probably a champion for technology in education.

Champions are leaders of systems. The International Society for Technology in Education (ISTE) Standards for Education Leaders, Visionary Planner, describe the role of leaders as evaluating progress on the strategic plan, making course corrections, measuring impact, and scaling effective approaches (The International Society for Technology in Education, 2018). Walker (2018) confirms that leaders who are effective at supporting system-wide efforts where teams are involved are persistent. They are not necessarily good at giving large-group inspirational speeches, but rather create inspiration by circulating "widely, talking to everyone with enthusiasm and energy" (p. 170). In addition, Walker's research supports the importance of "servant" leadership, where an individual is willing to serve in a functional role, assist others, and step up when needed. "A water carrier can improve a team by focusing on shoring up weaknesses and enforcing high standards" and expectations to move the group forward (Walker, p. 145).

Why Is Technology Infusion Important?

The contributors to this book, all of whom are faculty and staff engaged in the preparation of teachers within their own institutions, agree that *effectively* preparing teacher candidates to integrate technology is a priority. And we are not alone.

In 2016, the US Department of Education's Office of Educational Technology issued a policy brief entitled *Advancing Educational Technology in Teacher Preparation* and invited teacher preparation and technology leaders to a White House summit in Washington, D.C. The importance of teacher preparation was highlighted in this call to teacher educators across the nation. As reported in the policy brief and affirmed at the summit:

> Schools of education should work with P–12 schools and school districts to provide meaningful opportunities for pre-service teachers, in-service teachers, school and district leadership, and faculty to co-learn and collaborate to better understand and use technology as a tool to transform teaching and learning experiences for learners of all ages. (Office of Educational Technology, 2016, p. 4)

Further, as researched by a working group of teacher education faculty that was formed at the summit, teacher preparation institutions need to address six areas in their systematic approach to infusing technology: related research; faculty time, incentives, apathy, and competing demands; leadership and pedagogy; technical skill, training, and communities of practice; financial investment and speed of new trends; and connection between PK–12 and higher education (Kolb, Kashef, Roberts, Terry, & Borthwick, 2018).

The US Department of Education's National Educational Technology Plan (NETP) calls for a common vision and collaboration across institutions to create action plans for learning that is enabled through technology (Office of Educational Technology, 2017). The NETP specifically directed teacher educators to take more responsibility for the preparation of teacher candidates to "use technology to realize each state's learning standards from day one" upon their entry to the field as certified teachers (p. 35). Further, the NETP confirmed most state-adopted standards include relevant uses of technology.

> Schools should be able to rely on teacher preparation programs to ensure that new teachers come to them prepared to use technology in meaningful ways. No new teacher exiting a preparation program should require remediation by his or her hiring school or district. Instead, every new teacher should be prepared to model how to select and use the most appropriate apps and tools to support learning and evaluate these tools against basic privacy and security standards. It is inaccurate to assume that

because pre-service teachers are tech savvy in their personal lives they will understand how to use technology effectively to support learning without specific training and practice. This expertise does not come through the completion of one educational technology course separate from other methods courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs. (Office of Educational Technology, 2017, pp. 35–36).

The vision put forth by the National Educational Technology Plan clearly puts the onus for technology integration on all teacher educators.

The evidence is clear that establishing a strong connection between PK–12 and higher education is essential in providing powerful learning experiences for teacher candidates during clinical practice (Brenner & Brill, 2016). In their study of early career teachers, Brenner & Brill examined practices in teacher preparation that supported and "prohibited" technology integration and transfer of skills. Prohibiting factors included "having only one instructional technology-related course; and limited opportunities to practice with technology in content-specific and methods courses" (p. 141). The status of technology in teacher preparation has also been reflected in "SpeakUp" surveys of K–12 students, parents, administrators, and, more recently, teacher candidates. Beginning in 2009, Project Tomorrow (tomorrow.org), in collaboration with Blackboard, surveyed "tomorrow's teachers." Candidate responses about their experiences, knowledge, and aspirations were compared to those of inservice teachers and administrators. Results confirm the relevance of topics covered in various chapters in this book, including the importance of infusion of technology in methods courses, modeling by faculty and classroom teachers, and clinical practice (Project Tomorrow, 2013, 2017).

On a broader level, results from an international survey conducted in 2018 by the Organisation for Economic Co-operation and Development (OECD) in forty-eight countries confirmed inadequate preparation of new teachers.

Only 50% of teachers across the OECD received training in the use of ICT [Information and Communication Technology] for teaching as part of their formal education or training, and only 43% of teachers felt well or very well prepared for this element when they completed their initial education or training. (Organisation for Economic Co-operation and Development, 2019, p. 29)

For US respondents, the percentage of teachers reporting that use of technology for teaching was part of their teacher preparation program was higher, at 63%. However, only 45% of these individuals felt well prepared or very well prepared for using technology for teaching (Organisation for Economic Co-operation and Development, 2019).

Leading the Way to Infusing Technology in Teacher Preparation

Championing Technology Infusion in Teacher Preparation: A Framework for Supporting Future Educators was written by twenty education experts and practitioners in the field. The book targets readers who support technology integration curriculum and innovative delivery methods in teacher preparation institutions, including deans and other administrators in colleges/schools of education, teacher education faculty, educational technology faculty, faculty developers, field experience supervisors and cooperating teachers, and others serving teacher candidates in their field-based experiences.

This book is sequenced to help readers understand the big picture of technology infusion and leadership, as well as targeted aspects of a framework for technology infusion, including curriculum design, clinical practice, teacher induction, program evaluation, and related expectations for teacher educators. Separate chapters can stand alone and may be useful for study and reference at various points during a change process.

The book is divided into four sections:

Section I: Planning for Technology Infusion. Background chapters on technology infusion in teacher preparation, frameworks for organizational change, and technology use in PK–12 teaching and learning.

Section II: Implementing Technology Infusion. Methods and guidance for enhancing technology infusion in teacher preparation, with leadership suggestions for program-wide and program-deep adoption through appropriate curriculum design; expectations for teacher educator knowledge, skills, and dispositions; clinical experiences; and teacher induction.

Section III: Evaluating Technology Infusion. Methods and guidance for assessing candidate outcomes and reviewing program- and college-level processes and progress leading to program-deep and program-wide technology infusion focused on candidate learning.

Section IV: Advancing Technology Infusion. A vision and action steps for nation-wide collaboration for technology infusion in teacher preparation, including the role of state-level government entities and NGOs.

Table P.1 at the end of the preface provides a brief overview of the content of each chapter.

Audience and Use of This Book

Championing Technology Infusion in Teacher Preparation: A Framework for Supporting Future Educators is an ideal read for leadership and teams to thoughtfully examine their current preparation programs and consider their unit's framework for advancing technology infusion, facilitating action planning, and implementing change. The content and organization of the book are particularly appropriate for "book club" use, with chapter-by-chapter discussion and planning by groups of faculty, staff, and external partners. University, state-level, and nongovernment organization (NGO) leaders will benefit from how this book addresses change from a multisystems approach and establishes a national vision for transforming teacher preparation.

Throughout the text, readers will find references to research, theory, and practice. Each chapter concludes with a list of "Getting Started Resources," facilitating access to additional pertinent information. These resources will allow readers to more fully explore and understand the ideas and information presented in each chapter as they seek to adopt a customized approach to advancing their framework for technology infusion. As well, the index at the end of the book provides a quick and useful list of topics of interest.

A Commitment to Technology Infusion from the Editors and Contributors

As editors of this book, we came together with very different histories surrounding educational technology but with a common passion: *to help colleges and schools of education, across the country and internationally, be more effective in their efforts to prepare teacher candidates to teach with technology.* We invited the chapter authors to join us due to their unique area of expertise related to advancing technology infusion. Like ISTE's Visionary Planners, we want to encourage professionals throughout the field to "share lessons learned, best practices, challenges and the impact of learning with technology with other education leaders who want to learn from this work" (International Society for Technology in Education, 2018, p. 1). Together, we are committed to ensuring successful change in the field, and we hope you will join us, working as both water carrier and champion for technology infusion!

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Table P.1 Content Overview for Championing Technology Infusion in Teacher Preparation: A Framework for Supporting Future Educators

Section or Chapter and Authors		Topic	Overview	Theoretical and/ or Conceptual Framework
FOREWORD	A Systems View of Technology Infusion *Punya Mishra and Melissa Warr, Arizona State University*	Technology infusion as systems and culture change	The authors of the foreword argue that technology development in teacher preparation has been limited by a lack of attention to systemic factors. Technology infusion, with its emphasis on addressing systems and culture in teacher preparation, offers a better way forward.	• Systems change • Organizational change
PREFACE	Champions as Water Carriers: Prioritizing Technology Infusion in Teacher Preparation *Arlene C. Borthwick, National Louis University* *Teresa S. Foulger, Arizona State University* *Kevin J. Graziano, Nevada State College*	Vison and rationale for technology infusion in teacher preparation and use of this book	The preface presents the vision and rationale for technology infusion in teacher preparation. The authors address obstacles that may exist and suggest that champions are needed to ensure that technology infusion is a priority in schools and colleges of education. The preface provides an overview of the contents and best use of the book for achieving successful change.	• Leadership • Teamwork

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Section or Chapter and Authors	Topic	Overview	Theoretical and/ or Conceptual Framework
Section I. Planning for Technology Infusion Background chapters on technology infusion in teacher preparation, frameworks for organizational change, and technology use in PK–12 teaching and learning.			
CHAPTER 1 Design Considerations for Technology-Infused Teacher Preparation Programs *Teresa S. Foulger, Arizona State University*	Defining technology infusion Design considerations for program-wide, program-deep efforts to address technology integration	It is important that colleges/schools of education create a customized approach for how they address technology in their curriculum. In a technology-infused preparation program, technology integration is addressed by *all* instructors in a program-deep and program-wide manner. With this vision in mind, the goal for this chapter is to provide program planners with research-based design considerations and theoretical frameworks that will help them establish a personalized vision, initiate efforts, and expand upon their technology infusion initiatives.	• Developing Technological Pedagogical Content Knowledge (TPACK) • Technology integration • Technology infusion
CHAPTER 2 Building Capacity for Technology Infusion through Systemic Change in Colleges and Schools of Education *Robert D. Muller, National Louis University*	Organization development for technology infusion	This chapter proposes a framework for leaders of colleges/schools of education, to help guide their thinking through the choppy waters of technology-driven change. The first section briefly summarizes why and how technology integration and infusion approaches should be important to leaders of programs designed to prepare and advance teachers. The chapter proposes a framework for leaders to attend to the interrelated web of functions and roles that comprise complex organizational systems, and identifies some of the common pitfalls that impede change and recommendations for mitigating them.	• Technical vs. adaptive problems (Heifetz & Linsky) • Change management (Fullan; Kotter) • Networked Improvement Communities (NICs) (Bryk, Gomez, Grunow, & LeMahieu) • PELP Coherence Framework (Childress, Elmore, Grossman, & Johnson)

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CHAPTER 3	Rethinking Teacher Preparation: Learning from the PK–12 Edtech Story *Sheryl Nussbaum-Beach, Powerful Learning Practice*	Technology integration and infusion in PK–12 education	This chapter describes PK–12 initiatives and limitations in educational technology. Based on PK–12 needs, the chapter discusses implications for the role of teacher preparation programs in preparing teacher candidates to be visionary, forward-thinking leaders of change who are fully prepared to hit the ground running once they complete their programs. Teacher candidates need to personally adopt the values and dispositions that drive the use of new pedagogies connected to digital learning environments.	• Collaborative, connected educators • PK–12 drivers for change • Four domains of Future Ready Leadership
Section II. Implementing Technology Infusion Methods and guidance for enhancing technology infusion in teacher preparation.				
CHAPTER 4	Frameworks That Scaffold Learning to Teach with Technology *Liz Kolb, University of Michigan*	Using appropriate frameworks to support teacher candidates in their development of TPACK	This chapter describes four frameworks in educational technology—SAMR, PICRAT, TIM, and Triple E—and proposes how each might be used as a scaffold in teacher preparation programs for teacher candidates who are learning how to teach with technology. This chapter calls on teacher educators to use the frameworks as tools to improve their effectiveness with integrating technology into their teaching. Recommendations are provided for which framework to use during various phases of teacher preparation.	• Technology Integration Matrix (TIM) • Substitution, Augmentation, Modification, Redefinition (SAMR) • Passive, Interactive, Creative and Replaces, Amplifies, Transforms (PICRAT) • Triple-E Framework

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Section or Chapter and Authors		Topic	Overview	Theoretical and/ or Conceptual Framework
CHAPTER 5	Professional Expectations for Teacher Educators: The Teacher Educator Technology Competencies (TETCs) *David A. Slykhuis, University of Northern Colorado* *Denise A. Schmidt-Crawford, Iowa State University* *Kevin J. Graziano, Nevada State College* *Teresa S. Foulger, Arizona State University*	Technology competencies for teacher educators	This chapter introduces the Teacher Educator Technology Competencies (TETCs) in the context of technology infusion efforts and explains how teacher preparation programs and teacher educators can provide a strategic effort to help *all* teacher educators prepare to teach with technology, teach about technology, and support teacher candidates as they become proficient users of technology in their teaching. The TETCs represent the knowledge, skills, and attitudes *all* teacher educators need. This chapter also explores approaches for how teacher educators can address professional expectations and development related to teaching with technology throughout the teacher preparation program.	• Research-based tech competencies for teacher educators • Frameworks for professional development of teacher educators
CHAPTER 6	The Necessity of Preparing Teacher Candidates to Teach Online *Michael McVey, Eastern Michigan University*	Preparing teacher candidates to teach online	The tools and applications for online instruction appropriate for PK–12 teaching have increased in quality, and soon, access to them will be nearly universal. The consequence of this vastly improved online platform is that many teaching activities traditional to the physical classroom may move beyond those classroom walls and into a *virtual* teaching space. Teacher preparation programs need to prepare teacher candidates to use web-based tools and related instructional design in their teaching practice. This chapter describes how programs should be modeling online instructional strategies, providing teacher candidates opportunities to practice online teaching throughout their programs, and assessing teacher candidates as they expand their capacity to use online tools in blended or fully online PK–12 learning environments.	• Community of Inquiry (CoI) (Garrison, Anderson, & Archer)

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Section or Chapter and Authors		Topic	Overview	Theoretical and/or Conceptual Framework
CHAPTER 7	Technology Infusion in Clinical Experiences *Debra R. Sprague, Seth A. Parsons, and Audra K. Parker, George Mason University*	Considerations for mutually beneficial school-university partnerships to support clinical practice	Since the National Council for the Accreditation of Teacher Education published its Blue Ribbon Panel Report in 2010, teacher preparation has experienced a shift to resituate clinical experiences at the core of teacher preparation. Inherent in this turn toward clinically centered teacher preparation are mutually beneficial school-university partnerships. One outcome of these efforts is an opportunity to support theory-to-practice connections. In this chapter, we explore how clinically centered teacher preparation affords opportunities for a program-wide and program-deep approach to address technology infusion. We suggest school-university partnerships afford teacher preparation programs opportunities to actualize technology infusion through both course-based field assignments as well as field experiences (e.g., student teaching) to help teacher candidates develop their ability to integrate technology.	• Clinical experience • Development of practice
CHAPTER 8	Technology Integration in the Induction Years: The Importance of PK–12 Partnerships *Jo Williamson, and Julie Moore, Kennesaw State University*	Teacher induction and transfer of learning from preservice to inservice	It is easy to think that teacher induction is exclusively the purview of PK–12 schools and districts, but this landscape is changing. In this chapter, we assert that a program-deep and program-wide technology preparation experience will transition into a graduates' first few years of teaching. To help teacher educators envision new roles and responsibilities related to graduates' early-career success, this chapter provides a review of what is known about teacher induction and new teachers' technology use. The chapter concludes with three practical strategies and meaningful resources to help teacher preparation programs support inductees' technology integration.	• Sociocultural theories of learning • Zone of proximal development (Vygotsky)

Section or Chapter and Authors	Topic	Overview	Theoretical and/ or Conceptual Framework
Section III. Evaluating Technology Infusion Methods and guidance for assessing candidate outcomes and program- and college-level processes and progress.			
CHAPTER 9 Leadership for Technology Infusion: Guiding Change and Sustaining Progress in Teacher Preparation *Jon M. Clausen, Ball State University*	Leading transformational change for technology infusion in teacher preparation programs	In order for technology infusion to be successful, leaders at the upper administrative levels within teacher preparation programs must facilitate change, prioritize competing initiatives, and shape the change process for faculty and teacher candidates. Education leaders can draw on several theories, frameworks, and tools to support change. This chapter discusses the essential role of leadership for those who seek to promote and support the advancement of technology infusion within their teacher preparation programs and offers suggestions for how education leaders can initiate the process of transformational change for technology infusion.	• Diffusion of innovations theory (Rogers) • Change process (Fullan) • Concerns-Based Adoption Model (Hall & Hord)
CHAPTER 10 Evaluating Technology Infusion: Teacher Candidate and Program Outcomes *Ray R. Buss, Arizona State University*	Assessing teacher candidates' progress in a technology infusion program	This chapter provides information for teacher educators and college/school of education leaders on two ways to assess the effectiveness of technology infusion. First, this chapter focuses on evaluating the ultimate outcome of technology infusion, the development of teacher candidates' technology integration abilities, defined as their capabilities to teach K–12 students using technology. The chapter describes four theoretical perspectives that have influenced assessment efforts related to technology integration—the technological pedagogical content knowledge (TPACK) framework, the self-efficacy perspective, the Theory of Planned Behavior, and the Decomposed Theory of Planned Behavior. Secondarily, complementary assessment work in which teacher candidates evaluate effectiveness of their technology-infused program is discussed.	• TPACK • Self-efficacy • Theory of Planned Behavior (Ajzen) • Decomposed Theory of Planned Behavior (Sadaf, Newby, & Ertmer)

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Section or Chapter and Authors		Topic	Overview	Theoretical and/ or Conceptual Framework
Section IV. Advancing Technology Infusion Vision and action steps for nationwide collaboration for technology infusion in teacher preparation.				
CHAPTER 11	What Can We Achieve Together? A Call to Action for the Future of Technology Infusion in Teacher Preparation Programs *Joseph B. South, and Ji Soo Song, International Society for Technology in Education*	Sustaining technology infusion in teacher preparation through collaborative efforts of NGOs, government agencies, and education institutions	In the past decade, an explosion of access to technology in American schools has contributed to a fundamental change in the teaching environment. More classrooms than ever are equipped with the connectivity and devices necessary to leverage digital teaching opportunities. Yet, teachers continue to report that they do not feel well prepared to integrate new technologies across student learning experiences. As highlighted throughout *Championing Technology Infusion in Teacher Preparation*, teacher preparation represents a critical juncture in tackling this issue. This concluding chapter highlights five key areas that stakeholders from the public, private, and nonprofit sectors can collaboratively engage to systemically and sustainably improve teacher preparation pipelines and ensure that all teachers are prepared to use technology effectively from day one: setting a vision, incentivizing mastery, building capacity, prioritizing funds, and leveraging accountability.	• Interagency collaboration

Note: Brief biographical information for each of the contributors and editors is located in the front matter of this book.