Preface

The digital technologies of the 21st century are revolutionizing education with increased access to information in new and faster ways, with more emphasis on social interactions in learning where collaboration and communication play important features of educational experiences. Today’s teachers are faced with increasing expectations that they respond to the influence of multiple digital technologies not only to integrate them in their instruction but also to examine the impact of these capabilities on the curriculum and the pedagogies of this digital age. The International Society for Technology in Education (ISTE) introduced the ISTE Standards for Teachers (now called ISTE Standards•T and formerly known as the National Educational Technology Standards or NETS for Teachers) in recognition of the knowledge that teachers need for teaching in this digital age. According to these standards, teachers need the knowledge to:

- Facilitate and inspire student learning and creativity;
- Design and develop digital age learning experiences and assessments;
- Model digital age work and learning;
- Promote and model digital citizenship and responsibility;
- Engage in professional growth and leadership. (ISTE, 2008, p. 1)

Through these Teacher Standards, ISTE redirects teachers’ knowledge and thinking toward students’ thinking, curriculum content, and pedagogical approaches within the context of integrating technologies for guiding student learning. Teachers are thus challenged with incorporating multiple digital technologies for teaching and learning in various subject matter topics.

Meeting these standards requires teachers to have a knowledge significantly different from that needed for teaching in previous centuries, centuries devoid of the digital technologies that are ever present in today’s society. However, these digital technologies are ones with which many teachers are (1) unfamiliar, (2) have not used in learning in their own precollege education, or (3) have not learned to integrate in their teacher preparation programs. The challenge of this teacher knowledge is that it requires teachers to think outside their traditional views of how content is learned and communicated as well as what content is important for a digital citizenry. Instructional designers, teacher educators, and professional developers now must design, redesign and offer pre-service and in-service programs, courses, and workshops in new ways, ways that support the development of this knowledge for teaching with technology.

Teacher knowledge for the digital age has received serious attention from numerous scholars and researchers. Collectively, they have been instrumental in redirecting the attention toward an integration of technology, pedagogy, and content in much the same way that Shulman proposed pedagogical content knowledge (PCK) in the late 1980s. Technological pedagogical content knowledge (originally cast as
TPCK, now recast as TPACK) has been framed as the interconnection and intersection of technology, pedagogy (teaching and student learning), and content (Angeli & Valanides, 2005; Margerum-Leys & Marx, 2002; Mishra & Koehler, 2006; Niess, 2005, 2008; Pierson, 2001; Thompson & Mishra, 2007; Zhao, 2003). The TPACK theoretical framework offers at least two views on this teacher knowledge: (1) an integrative view that distinguishes among the areas of knowledge (technological (TK), pedagogical (PK), content (CK)), pedagogical content (PCK), technological content (TCK), technological pedagogical (TPK), and technological pedagogical content (TPACK), and separates context from these knowledge areas (Koehler & Mishra, 2008); and (2) a transformative perspective view that claims a transformation of teachers’ knowledge where the knowledge inputs that have been rearranged, merged, organized, assimilated, and accommodated into a new knowledge such that the multiple areas are no longer individually discernible in the thinking and reasoning for teaching in today’s digital age (Angeli & Valanides, 2009, 2013; Niess, 2015). As the research on teacher knowledge development has evolved, scholars are more recently focused on the context portrayed in the TPACK framework (Angeli & Valanides, 2009, 2013; Kelly, 2010; Koehler & Mishra, 2008; Porras-Hernández & Salinas-Amescua, 2013). Again, the views on context have been diverse: (1) a focus on knowledge of context leads toward the context that surrounds teachers, how the context independently affects them, and on how they develop their knowledge of context; and (2) a focus on knowledge in-context emphasizes the context interwoven with teachers’ knowledge and thus part of a complex system.

With the scholarly investigation and research on teacher knowledge, multiple perspectives now exist for guiding current thinking and future research in this digital age in the fields of curriculum design, pre-service teacher education, continuing teacher education, and distance education. The complexity of the learning environments and changes influenced by new and emerging technologies suggests a need for compiling the current research on teacher education in this digital age. Therefore, the Handbook of Research on Teacher Education in the Digital Age provides the relevant theoretical frameworks and the latest worldwide empirical research in the area of teacher education for teaching with digital technologies. The Handbook is designed to support professionals who want to improve their understanding of the strategic impact of technology in education. The perspective used in the identification of these scholarly works recognizes that the knowledge teachers rely on for teaching with technologies is “complex, multifaceted, and situated” (Mishra & Koehler, 2006, p. 1017).

The primary goal of this Handbook is directed toward teacher change that integrates instruction about the technology with instruction about the content, while incorporating effective pedagogical methods for teaching the content. The Handbook is divided into three sections to accommodate the multiple conceptions of teacher learning through knowledge and practice. Cochrane-Smith and Lyttle (1999) provided three prominent concepts of teaching learning for these three sections:

- **Knowledge-for-practice** is the research-based, scholarly formal knowledge for teaching acquired through traditional instructional avenues as in university courses; teachers’ practice is when they “use the formal knowledge base in their daily work of the classroom” (p. 257).
- **Knowledge-in-practice** is wisdom that teachers gain from the practice of teaching in classrooms, where what they know is embedded “in the artistry of practice, in teachers’ reflections on practice, in teachers’ practical inquiries, and/or in teachers narrative accounts of practice” (p. 262).
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- *Knowledge-of-practice* is knowledge gained through “systematic inquiry about teaching” with technology that considers “learners and learning, subject matter and curriculum, and schools and schooling” (p. 274). This knowledge-of-practice conception incorporates for and in aspects, integrating them in a manner that transforms teachers’ knowledge of practice for teaching with technology – their TPACK.

SECTION 1: KNOWLEDGE-FOR-PRACTICE

In the first chapter, Bush, Driskell, Niess, Pugalee, Rakes and Ronau examine four decades of research on how pre-service mathematics teachers have been prepared for teaching with current and emerging digital technologies. The goal of this examination is to identify recommendations for future mathematics teacher preparation research that show promise for revising teacher preparation in this digital age.

In Chapter 2, Carpenter and Krutka highlight the rise of social media and how such media might support learning. The authors summarize and synthesize research concerning social media use in teacher education to consider preparing teachers for maximizing the educational potential of social media technologies by considering the affordances and challenges.

In Chapter 3, Lee and Brett introduce a double-layered community of practice model for teacher educators designing online courses for in-service teachers’ technological knowledge learning and practice. Four cases illustrate how the model facilitates teachers’ learning processes.

In Chapter 4, Amador, Kimmons, Miller, Desjardins, and Hall focus their work on the relationship between performance tasks and pre-service teachers’ self-reflective and self-assessment practices. The purpose is to further understand how pre-service teachers critically think about technology and their competence in technology integration. The results indicate that pre-service teachers were self-reflective about the extent to which technology influences students’ learning. They conclude that teacher education programs should consider how they support pre-service teachers to become self-reflective consumers of technology.

In Chapter 5, Sprague and Katradis share their mixed-method study of a cohort of elementary pre-service teachers’ perceptions of technology and their abilities to integrate technology in their teaching practices. They used the TPACK framework in identifying that although their Technological Knowledge was an issue for some, the majority struggled with Pedagogical Knowledge when it came to actually implementing technology into their practice.

In Chapter 6, Vasinda, Kander and Redmond-Sanogo discuss the finding of an exploration to integrate iPads in a university reading and mathematics clinic that impacted pre-service teachers, K-8 community students, and the teacher educators. The teacher educators discovered that digital native pre-service teachers needed support in developing their technological knowledge in an educational setting.

In Chapter 7, Forbringer examines the use of interactive remotes (clickers) in teacher education courses. Previous studies have shown an increase in student interaction, participation and learning in a variety of other disciplines. This study replicates those findings with pre-service and practicing teachers who report that using the technology develops their understanding of targeted pedagogical practices after having used the interactive remotes.
In Chapter 8, Harrington and Rhine describe a model for how teacher preparation programs can use research and technology to facilitate the development of pre-service teachers and accelerate their effectiveness. Their study is situated in the content of algebra to illustrate a specific collection of teacher preparation tools. Case study data indicate that the tools impact pre-service teacher practice regarding the anticipation of student thinking.

In Chapter 9, Baert investigates the perceptions of physical education teacher education faculty towards their technology proficiency, their use of technology in their courses, and the approaches their programs use to integrate technology and address the preparedness of pre-service teachers. Results show that these faculty use technologies such as computer technologies, pedometers, heart rate monitors and digital cameras most often, yet in general, perceive their proficiency and integration levels to be low. Their technology proficiency levels significantly predict their level of integration.

SECTION 2: KNOWLEDGE-IN-PRACTICE

In Chapter 10, Greenhalgh and Koehler offer seven “pretty good practices” (Mishra, 2008) for designing portfolio courses: peer feedback, authentic, audience, diverse resources, learning by doing, open access, confidential spaces, and self-pacing. The practices were developed from the authors’ extensive work helping teachers to develop portfolios that demonstrate their learning in their graduate studies.

In Chapter 11, Porras-Hernández and Salinas-Amescua describe how and why a phenomenological research approach applied to the reconstruction of rural teachers’ experiences in incorporating information and communication technologies (ICT) to teachers’ practices can be helpful for research purposes as well as for inspiring the avenues that rural teacher education in the digital age should follow. The chapter describes how, as part of a construction of their own rural pedagogies, these teachers integrated ICT into their practice in response to three levels of contextual demands.

In Chapter 12, Owusu, Conner, and Astall explore TPACK levels through embedded case studies of five science teachers who were regular users of technology in their teaching. The teachers use technology to support inquiry learning through a wide range of ways in lower levels of high school but mostly to clarify concepts and theories for senior level students.

In Chapter 13, Arya, Christ, and Chiu explore undergraduate and graduate literacy teachers’ self-reflections and reflective discussions with peers that were mediated by digital video. Findings show that recursive viewing of videos, across different contexts or within a context, facilitate shifts in purposes for discussing videos and broaden the foci of the discussions.

In Chapter 14, Rish, Bylen, Vreeland, and Wimberley investigate the teacher practices of how a teacher educator and three practicing teachers consider their experiences in an English education methods course that explicitly uses Google Drive to support dialogic writing and learning. The chapter concludes with the major benefits and drawbacks of teaching writing within a sociocultural framework, including the issue of “heavy borrowing” and other tensions that arise within the institutional constraints of teaching writing within schools.

In Chapter 15, Foster, Shah, and Duvall use the Game Network Analysis (GaNA) framework as a methodological approach developed to aid teachers in teaching and learning with games in educational contexts. Case studies of pre-service and in-service teachers how GaNA, through a focus on game analysis, game integration, and ecological conditions impacting game use, can empower teachers to adopt game-based learning in a systematic, but adaptive manner.
In Chapter 16, Crichton and Carter examine the Maker Movement and how this model actively engages teachers in four distinct yet related elements. Drawing on a qualitative, iterative process, initial research findings and experiences suggest that such a model may support good professional learning and development for educators designing and developing 21st century learning environments.

SECTION 3: KNOWLEDGE-OF-PRACTICE

In Chapter 17, Rosenberg and Koehler focus on the importance of context as an essential aspect of educational research on TPACK. The authors find that context is important but often missing from research about TPACK and that the meaning of context differs widely. The authors discuss these findings in relation to the TPACK literature as well as for educational technology research.

In Chapter 18, Hunter reports on a case study of a high school teacher from a larger study of 'exemplary' teachers and how they conceptualized their knowledge of technology integration in education contexts. This study provides an important theoretical and practical exemplar of technology integration in practice for teacher education in a digital age.

In Chapter 19, Polly, Binns, Putman, Rock and Good, through a design-based research study, demonstrate how statewide mandates to revise the teacher education program are used in promoting subsequent revisions influencing the course components and teacher candidates’ development of TPACK. Cases of four undergraduate elementary education courses and the advanced licensure elementary education program are described.

In Chapter 20, Lyublinskaya describes a two-year development of a graduate pedagogy course for pre-service special education teachers to integrate technology into teaching mathematics and science. The chapter discusses the modifications made to the course from semester to semester based on the analysis of lesson plan TPACK scores and information drawn from pre-service teachers' written feedback.

In Chapter 21, Adegbenuro, Gumbo and Olugbara apply factor analysis for exploring technological knowledge of beginner and veteran Office Data Processing teachers at Further Education and Training or Technical and Vocational Education and Training colleges in South Africa. The findings generally revealed that Procedural Functional Content Knowledge is the most important factor in explaining the technological knowledge of these teachers.

In Chapter 22, Hennessey, Olofson, Swallow and Downes describe the pedagogy of middle grades mathematics teachers who participated in professional development in conjunction with classroom integration of 1:1 technology. When viewed through the lens of the TPACK framework, the data suggest a technology-mediated shift in pedagogy in the area of differentiation in instruction and assessment in mathematics classrooms.

In Chapter 23, Yarnall and Fusco examine the use of domain-specific technologies for instruction. The chapter presents a framework for supporting in-service teachers to integrate these technologies and describes the strategies that included decomposing knowledge, identifying one-of-a-kind learning opportunities, classroom management planning, and broadened assessment strategies.

In Chapter 24, Gilow-Wiles and Niess use a descriptive, cross case analysis that reveals the impact of Google Docs in facilitating reflection and collaboration in an online integrated mathematics, science, and technology education graduate program has on developing in-service teachers’ TPACK. Results suggest Google Docs provides a rich online environment where teacher participants are able to engage in and reflect on a community that develops both individual and shared knowledge.
In Chapter 25, Figg and Jaipal-Jamani discuss how findings from a design-based research study of how gamification is used in a teacher education technology methods course, to engage pre-service teachers in activities that develop TPACK. The findings provide guidance on how to design courses incorporating gamification as an instructional strategy appropriate for meeting the needs of digital learners.

In Chapter 26, Mishra, Henriksen and Mehta posit the need to develop critical and creative thinkers to allow for fluency and effective use of educational technology. This chapter builds on a theoretical framework for creativity in teaching, as an approach for creative, transformational teaching with digital technology. Trans-disciplinary thinking centers on a set of seven meta-level, cognitive skills for thinking creatively across domains. The authors demonstrate how a course, designed around these skills, gives teachers new ways to think about student learning, and their own teaching practices, with technologies.

REFERENCES


