

## Foreword

Digital devices and educational technology are more prevalent than ever in all educational settings from Kindergarten through university levels (New Media Consortium, 2017). In the past decade, educational technology experts have posited that teachers who effectively teach with technology possess a Technological Pedagogical Content Knowledge (TPACK; Mishra & Koehler, 2006; Niess, 2005), which reflects a nuanced balance of knowledge and skills related to the use of technology, with related pedagogies, and in the context of teaching specific content. The TPACK framework has been used to design professional development experiences for teachers as well as a construct by which to examine teachers' knowledge as enacted during professional development as well as in their own classroom (Niess et al., 2009; Polly, 2011; Polly & Orrill, 2016a).

The TPACK construct extends to all aspects of teaching with technology. This book and its balanced focus on online professional learning experiences as well as the systematic design of technology-rich instruction have potential to contribute to what we know about how to best develop and support teachers' TPACK. Specifically, this book addresses a need in the research base, in that it features multiple conceptual chapters and research studies related to supporting teachers' use of technology-rich teaching and learning in mathematics, science and STEM education. This current book reflects a healthy balance of chapters that provide theoretical underpinnings for this work, empirical studies, and constructive reflections of the featured graduate program's design and impact on teachers and student learning.

The intersection of knowledge-of-practice and TPACK which led to the novel idea of TPACK-of-practice is one that should continue to be examined further by scholars. It is intuitive to think that a construct such as TPACK should be related to and embedded in practice, but more work is needed to empirically determine what is meant by TPACK-of-practice, and how teachers' and pre-service teachers' TPACK-of-practice influences how they choose to

use technology to support teaching and learning. More so, there is a need to extend this work to examine how these choices impact not only teachers' instructional decisions and how they teach, but also how these influence students' learning outcomes.

One important aspect of this work is that the chapters include a wide variety of stakeholders and participants in the development of teachers' TPACK. This includes education faculty, STEM content faculty, inservice teachers, teacher leaders, and school administrators. This text focuses on two unique much-needed areas: online learning and instructional design. Opportunities for teachers to participate in online professional development continue to increase with teachers able to complete a wide variety of courses, modules, and certificate programs (Darling-Hammond, Hyler, & Gardner, 2017). Research related to online professional development to develop TPACK is needed. This book extends the work of TPACK in needed areas through the establishment of an empirically-based online learning trajectory featured in Chapter 3. The framework provides structure and details on how to best use online learning experiences to support teachers' development of TPACK and skills.

Since the seminal work of Gagne (1985), there has been attention on instructional design and how instructional segments and learning experiences are designed and developed. In order for online professional development to be effective there is a need for instruction to be based off theory and research (Darling-Hammond et al., 2017). In this book, various chapters showcase the instructional design of professional learning opportunities that is based on theory and research about how teachers learn and how to best support teachers' development of TPACK.

In the digital age where technology access is at an all-time high, a book like this is a valuable contribution as educational leaders, professional development designers and facilitators, and teacher educators consider ways to support teachers' development of TPACK. Through the vehicles of on online learning and aspects of instructional design, this book provides insight into empirical studies and theoretical constructs related to developing teachers' TPACK related to mathematics, science, and STEM education.

*Drew Polly  
University of North Carolina at Charlotte, USA*

## **Foreword**

**Drew Polly** is an associate professor in the Department of Reading and Elementary Education at the University of North Carolina at Charlotte. His research agenda focuses on examining how to support the implementation of technology and standards-based pedagogies. More information can be found at: <http://drewpolly.org/me>.

## **REFERENCES**

- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Retrieved from: [https://learningpolicyinstitute.org/sites/default/files/product-files/Effective\\_Teacher\\_Professional\\_Development\\_BRIEF.pdf](https://learningpolicyinstitute.org/sites/default/files/product-files/Effective_Teacher_Professional_Development_BRIEF.pdf)
- Gagne, R. (1985). *The Conditions of Learning* (4th ed.). New York: Holt, Rinehart & Winston.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. doi:10.1111/j.1467-9620.2006.00684.x
- New Media Consortium. (2017). *Horizon Report: K-12 Edition*. Retrieved from: <https://www.nmc.org/publication/nmccosn-horizon-report-2017-k-12-edition/>
- Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, 21(5), 509–523. doi:10.1016/j.tate.2005.03.006
- OCED. (2012). *Programme for International Student Assessment: Results from PISA 2012, United States*. Retrieved from: <http://www.oecd.org/pisa/keyfindings/PISA-2012-results-US.pdf>
- Polly, D. (2011). Developing teachers' technological, pedagogical, and content knowledge (TPACK) through mathematics professional development. *The International Journal for Technology in Mathematics Education*, 18(2), 83–96.
- Polly, D., & Orrill, C. H. (2016). Designing Professional Development to Support Teachers' TPACK in Elementary School Mathematics. In M. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge* (2nd ed.; pp. 259–268). New York: Routledge.