Chapter 22
Evolving Pedagogy and Practice:
The 1:1 Mathematics Classroom through a TPACK Lens

Susan Hennessey
University of Vermont, USA

Mark W. Olofson
University of Vermont, USA

Meredith J. C. Swallow
University of Vermont, USA

John M. Downes
University of Vermont, USA

ABSTRACT

This chapter presents qualitative research describing the pedagogy of middle grades mathematics teachers who participated in professional development in conjunction with classroom integration of 1:1 technology. Through a multiple-case study design, the expression and development of teacher pedagogy that occurred as teachers created self-designed action research projects grounded in pedagogical goals is illustrated. The use of action research in these four case studies as a vehicle for professional growth and as a reflective evaluation tool is discussed. When viewed through the lens of the TPACK framework (Mishra & Koehler, 2006), data suggest a technology-mediated shift in pedagogy in the area of differentiation in instruction and assessment in mathematics classrooms. Future implications regarding technology integration, professional development programs, and the use of the TPACK as a descriptive tool are considered.

INTRODUCTION

Student success in the K-12 mathematics classroom is an important predictor of postsecondary participation and success. Students with higher math achievement in high school are more likely to stay on track towards degree completion once entering college (Klepfer & Hull, 2012). As early as middle school, indicators such as completion of rigorous coursework (Wimberly & Noeth, 2005) and passing Algebra I (Lee, 2013) correlate with postsecondary success. Yet access to high-level mathematical content remains inequitable, owing in large part to the challenges of differentiating instruction to meet the wide-ranging needs of students. Mathematics teachers, more than other content teachers, have turned instead to tracking (Loveless, 2013), a practice that increases in the middle grades and leaves students in lower tracks with poorer quality and less engaging curriculum than their higher track peers (Ansalone, 2010).

In recent years 1:1 technology initiatives, in which each student and teacher receives a portable internet-capable device such as a netbook or tablet computer, have presented educators with opportunities to reinvent how they shape and deliver instruction (Argueta, Huff, Tingen, & Corn, 2011; Penuel, 2006). Many middle grades mathematics teachers have turned to a variety of technologies to differentiate learning opportunities and track performance to meet the diverse needs of their students (Smith & Throne, 2009). Others have explored using 1:1 technology to shift their practice from teacher-directed to student-centered approaches (Sauers & McLeod, 2012; Sell, Cornelius-White, Change, McLean, & Roworth, 2012), including allowing students in the same classroom to progress at different rates (Loveless, 2013).

This chapter describes four cases of middle grades mathematics teachers who explored the potential of 1:1 computing to differentiate instruction and assessment. Our professional development work with these teachers combined technol-ogy integration with learner-centered pedagogy through action research. Previous studies have focused on inquiry and action research models with pre-service teachers to move them toward technological, pedagogical, and content knowledge (TPACK) development (Jacobsen, Clifford, & Friesen, 2002; Manfra & Spires, 2013). Our research explored in-service mathematics teachers' pedagogical knowledge development in 1:1 computing environments as they moved through a professional development sequence founded in the action research model. The TPACK framework (Mishra & Koehler, 2006) provided a theoretical tool to disentangle complex teacher knowledge and to holistically interpret how teachers applied their knowledge and beliefs in technology-rich mathematics classrooms. We speculated that the removal of barriers to technology access along with professional development that required teachers to explicitly align technology integration with student-centered practices and reflect upon that alignment through the action research cycle would lead to shifts in teacher pedagogy. Accordingly, our study addressed the following questions:

- How did 1:1 technology access in the mathematics classroom influence teachers' ability to differentiate instruction and assessment?
- In what ways did integrating 1:1 technology into a mathematics classroom influence teachers' pedagogical beliefs about differentiation?

In this chapter, we examine literature on effective 1:1 initiatives and how the TPACK framework can be used to study technology integration. We then describe the context and structure of our professional development and this study. Next, we portray each case of the teachers' efforts to integrate technology and conduct their action research. We conclude with a discussion, recommendations, and research opportunities regarding differentiation with technology, development of

Related Content

Application of Playful Robotics to Advance Cognitive Development and Meaningful Learning Among Early Learners
Mary L. Meadowsand Basiyr D. Rodney (2021). *Handbook of Research on Empowering Early Childhood Educators With Technology (pp. 264-284).*
www.irma-international.org/chapter/application-of-playful-robotics-to-advance-cognitive-development-and-meaningful-learning-among-early-learners/282563

Regression Analysis on the Effect of Lecturers' Competencies on Students' Performance
Choi Sang Longand Ng Chiaw Gee (2018). *International Journal of Teacher Education and Professional Development (pp. 14-28).*
www.irma-international.org/article/regression-analysis-on-the-effect-of-lecturers-competencies-on-students-performance/204531

Using Self-Mentoring to Increase Teacher Efficacy and Confidence as Leaders: A Review of Multiple Studies from the Field
Marsha L. Carr (2016). *Handbook of Research on Professional Development for Quality Teaching and Learning (pp. 307-320).*
www.irma-international.org/chapter/using-self-mentoring-to-increase-teacher-efficacy-and-confidence-as-leaders/156793

Learning to Teach During Novice Years: A Case Study on an Elementary School in Xi'an, China
Chenbing Wu, Yingming Liuand Jiacheng Li (2019). *Examining the Teacher Induction Process in Contemporary Education Systems (pp. 1-35).*
www.irma-international.org/chapter/learning-to-teach-during-novice-years/209618

Differentiated Fieldwork and Practicum Experiences: Matching Teacher Candidate Assignments to Their Skills and Needs
Stephen T. Schrothand Jason A. Helfer (2018). *Innovative Practices in Teacher Preparation and Graduate-Level Teacher Education Programs (pp. 306-326).*
www.irma-international.org/chapter/differentiated-fieldwork-and-practicum-experiences/193367