

Chapter 22

Mathematics, Social Structure, and Technology: A Categorical Framework to Support Online Middle School Mathematics Teaching

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ABSTRACT

This chapter provides insights gained from a collaborative action research project with university and middle school mathematics faculty. A categorical framework that considers the relationship between technology, mathematics content, and social interaction was used by the researchers to more deeply examine the varied uses and types of technology related to online teaching. In particular was the use of a relatively new category of software, Interactive Mathematics Classroom Builders, which integrates powerful mathematics tools with highly interactive classroom management features. The teachers found opportunities to try several novel uses of technology in their online lessons, advancing their teaching and the student experience, while learning lessons about teaching with technology that may apply to both remote teaching and the face-to-face classroom.

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INTRODUCTION

Before the pandemic of 2020, there was an increased use of online instruction in the K-12 educational field of study. However, during the calendar year 2020, schools across the United States were required to conduct virtual class online in an unprecedented volume. This chapter describes a collaboration among the authors, in the context of a project between the middle school teachers and university faculty to consider various forms of online technology to foster meaningful socio-mathematical interaction in an online virtual environment. The goal of this project was to support the middle school teachers in identifying online mathematical technology to foster an engaging online learning environment. However, a secondary consideration was reflecting on how any meaningful online learning activities could also be used in a traditional face-to-face classroom environment. Using a categorical framework to help focus the discussion, the teachers shared with the university faculty lessons they were teaching from the *Connected Mathematics Project*, (Lappan, Phillips, Fey & Friel, 2014) in an online, and later hybrid sessions. Together they all discussed the current circumstances and goals for their students, found and evaluated resources, and provided feedback and development new uses of technology. This chapter explains the framework, illustrates with examples, and shares the narrative of the collaboration during which both middle school teachers incorporated innovative new practices and technology in their teaching.

BACKGROUND

Much of the research pertaining to technology use in the mathematics classroom focuses on student or teacher use of mathematics-specific technology, or of general technology (Young, 2016). However, a great deal of work has been done on the importance of discourse, problem-solving, and other important pedagogical matters. But, how are K-12 teachers to implement these pedagogical goals while teaching remotely? Mishra and Koehler (2006) introduced the teacher knowledge framework titled Technological Pedagogical Content Knowledge (TPACK). TPACK is a technology integration framework that focuses on the intersection of different bodies of knowledge upon which teachers draw for instruction, Pedagogical Knowledge (PK) and Content Knowledge (CK). Shulman (1986) suggested that the interaction between PK and CK was a new domain of knowledge required for teacher growth, calling it Pedagogical Content Knowledge (PCK). Mishra and Koehler then posited Technological Knowledge (TK) as a domain, creating new intersectional domains for teacher knowledge, Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK) and, relating all three domains, Technological Pedagogical Content Knowledge (TPACK). Most studies of TPACK have been set in the context of a typical face-to-face classroom which has very different social structures and interactions from a fully online class session. In the remote setting, the teachers may need to explore territory more commonly found in studies from researchers of learning in a computer setting, such as Hakkarainen (2009), essentially a study of Technological Pedagogical Knowledge, considering online pedagogy, where they have considered how social dynamics are mediated by a digital environment.

Meanwhile, the variety of applications and purposes for technology has expanded at a rapid pace. The Google Suite (workspace.google.com) of products, including Documents (Docs), Spreadsheets (Sheets), Slides, and more, has made publishing documents to the internet transparently easy, and offers real time collaboration. Another Google product, Jamboard, is a collaboration-enabled digital whiteboard, originally developed for remote business use. It did not take long, however, for educators

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