Chapter 73
Developing an Online Mathematics Methods Course for Preservice Teachers:
Impact, Implications, and Challenges

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ABSTRACT

This chapter presents the theoretical background and overview of the design of an asynchronous online mathematics pedagogy course taken by graduate students who are seeking their initial teacher certification. The authors provide the theoretical underpinnings for the design of the course, and then using design-based research, describe the refinement of the course over three iterations of designing and implementing the course. Lastly, implications for the design and delivery of asynchronous online courses are discussed.

OVERVIEW

The increased demand in online course offerings in higher education has brought on increased pressure for all Colleges and Universities to offer their curriculum and course offerings in 100% online formats (Ko & Rosen, 2010). College and university students are demanding flexible, technology-rich course experiences that provide students with opportunities to learn a variety of content in engaging, online learning environments (Polly, 2013). To this end, there is increased pressure from higher education administration placed on faculty to redesign face-to-face courses into online versions of the same course. While some content areas have succeeded in the successful migration of face-to-face courses into online formats, a problematic area for online instruction has been education courses, focused on content-specific pedagogies that preservice teachers are expected to master in order to become a successful classroom teacher (Dede et al., 2009; Sobel, Sands, & Dunlap et al., 2009).

Prior studies (Polly, 2013; Polly, under review) have examined preservice teachers' quality of work and their reported experiences while participating in an online mathematics pedagogy course designed to teach preservice teachers how to

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effectively teach mathematics to primary school children (ages 5-11). This chapter looks to extend that line of work by describing the theoretical framework behind the design of the course. I then use design-based research as a framework for describing how the course has been modified across 4 years based on formative data.

THEORETICAL FRAMEWORK

The theoretical foundation for this course is heavily rooted in the epistemological framework of learner-centered instruction (National Partnership for Excellence and Accountability in Teaching, 2000; Polly & Hannafin, 2010) as well as the construct of zone of proximal development ([ZPD]; Tharp & Gallimore, 1991).

Learner-Centered Instruction

The American Psychological Association Work Group (APA Work Group, 1997) conducted an extensive synthesis of the research base on teaching and learning, learning theory, and educational psychology, and published a set of *Learner-centered Principles* available here: http://www.apa.org/ed/governance/bea/learner-centered.pdf.

The *Principles* have been derived to provide empirically-based recommendations for K-12 education (McCombs & Whisler, 1997) and professional development (Orill, 2001; Polly, 2011). Further, these *Principles* provide a foundation for teacher education courses (Polly, 2013). Specifically, learner-centered experiences for teachers or preparing teachers should: prepare teachers/teacher candidates to identify and impact issues related to student learning (Heck, Banilower, Weiss, Rosenberg, 2008), give teachers/teacher candidates some ownership and choice about their learning experiences (Garet et al., 2001), support collaboration among teachers/teacher candidates and more knowledgeable others (Glazer & Hannafin, 2006), be part of a larger comprehensive change processes with ample ongoing support (Fishman, Marx, Best, & Tal, 2003; Orrill, 2001), deepen their knowledge and proficiency related to specific pedagogies, content and the intersection of content and pedagogy (Heck et al., 2008; Garet, et al., 2001); and provide opportunities to reflect on lessons and work samples from classroom-based activities (Loucks-Horsley et al., 2009). Table 1 provides an overview of features of the online mathematics pedagogy course and how they embody principles of learner-centered instruction for teacher education.

Table 1. Alignment between characteristics of effective teacher learning environments and course activities Adapted from (Polly, 2013)

Characteristics of Learner-centered environments for teachers	Course Activities Teacher candidates…
Address student learning issues	Complete the Culminating Diagnostic Project, which involves pre-assessing, teaching and post-assessing students.
Provide teachers with ownership	Select topics for Culminating Diagnostic Project, Curriculum Evaluation and other activities.
Promote collaboration	Collaborate with classmates on blogs and with in-service teachers on all clinical projects.
Provide ongoing support	Turn in the Culminating Diagnostic Project at various times during the semester for feedback and support.
Develop knowledge of content and pedagogy	Complete cognitively-demanding mathematical tasks in each module, analyze curriculum, and examine video-based and text-based vignettes.
Support the reflection process	Write on blogs throughout the semester and reflect on the impact on students during the Culminating Diagnostic Project.