Chapter 2
Supporting the Enactment of Standards-Based Mathematics Pedagogies:
The Cases of the CoDE-I and APLUS Projects

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ABSTRACT

In order for professional development in the STEM fields to be effective, teachers need worthwhile experiences to simultaneously develop their knowledge of content, pedagogy, and understanding of how students' learn the content. In this chapter we provide an overarching framework of learner-centered professional development and describe the implementation of two mathematics professional development projects designed to support elementary school teachers' mathematics teaching. We follow our description by highlighting some of the findings from our line of professional development research and provide implications for the design of learner-centered professional development programs in mathematics.

OVERVIEW

The Need for Mathematics Professional Development

Professional development continues to be held up on a pedestal as a potentially powerful vehicle for supporting practicing teachers' adoption of new pedagogies and knowledge (Borko, 2004; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Desimone, 2009; Polly & Hannafin, 2011). In the field of mathematics education, administrators and district leaders must provide effective profes-

sional development so that teachers have a robust understanding of mathematics content and are also prepared to enact the most effective strategies in their classrooms (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2010; United States Department of Education, 2008).

In the United States, this has been especially true in the last few years with the large-scale adoption of the both standards-based (reform-based) mathematics curriculum as well as the Common Core State Standards in Mathematics ([CCSSM]; Common Core State Standards Initiative, 2010). More school districts than ever before have adopted standards-based mathematics curriculum; these sets of instructional resources are described by having alignment with the National Council for Teachers of Mathematics ([NCTM], 2014) *Principles to Action*, in that students learn mathematics by exploring cognitively-demanding mathematical tasks and mathematics games, engaging in discussions about mathematical tasks and concepts, and reasoning and justifying their paths to solving tasks and problems.

Learner-Centered Professional Development

Large-scale syntheses of research studies on professional development have yielded components of highly effective learning experiences for teachers (Garet et al., 2001; Darling-Hammond, et al., 2010). The construct learner-centered professional development (LCPD) (Polly, 2006; Polly & Hannafin, 2011; Hawley & Valli, 2000) has been used to describe professional development programs that focus on meeting the specific professional needs of teachers and align with the American Psychological Association's *Learner-centered Principles* (hereafter *Principles*) (APA Work Group, 1997). The *Principles* were grounded on empirical findings related to teaching and learning and reflect both cognitivist and constructivist views of how people learn (Alexander & Murphy, 1998). Hawley and Valli (2000) identified nine primary design recommendations associated with LCPD:

1.   LCPD should focus on content that students need to learn and problems that students face learning that content;
2.   LCPD should be driven by addressing the difference between goals and standards for student learning and actual performance;
3.   LCPD should involve allowing teachers to identify their own learning needs, and when possible, involve them in the design of professional learning activities;
4.   LCPD should be primarily school based and integral to school operations;
5.   LCPD should relate to individual learning needs but should include collaborative problem solving;
6.   LCPD should be continuous and ongoing involving follow-up and support for further learning;
7.   LCPD should include an evaluation that includes multiple sources of information including classroom implementation;
8.   LCPD should allow teachers to develop a deep theoretical understanding of the content and pedagogy;
9.   LCPD should be part of a comprehend change process that addresses impediments to and facilitators of student learning.

Many of these nine design recommendations have been verified by an extensive synthesis of the *Principles,* Hawley and Valli's (2000) recommendations and research on professional development (Polly & Hannafin, 2010). To that end, LCPD provides a robust framework for the design of professional development programs.

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