The single most important determinant of what children learn is what teachers know (Darling Hammond & Braaten, 2006). To often, preschool teachers are insufficiently prepared to teach math to young children (NRC, 2009), which less to less time devoted to math content (Chicago Program Expectation Project, 2008), a narrow range of knowledge covered (Copley, 2010), and a low level of understanding in children's math learning (Ginsburg, Lee, & Boyd, 2008). Substantial and meaningful improvements in teaching practice occur and are maintained when there are school-embedded systems to provide ongoing, on-site, on-the-job support (Darling Hammond & McLaughlin, 1995; Louis & Marks, 1998).

Research Design

The PD was evaluated in two, consecutive, year-long studies. 

**Study 1** utilized a cluster randomized controlled trial. A total of 28 Head Start centers were stratified based on center size and half-day vs. full-day on 8 centers; then within each stratum were assigned to either the intervention condition (Cohort A; n=14) or the business-as-usual control condition (Cohort B; n=14). Study 2 utilized a quasi-experimental successive-cohort design. The remaining 13 comparison centers (Cohort B) participated in the PD intervention in the following year. Year 2 teacher gains on attitudes, knowledge, and practice were compared to Year 2 gains. Children's math skill gains in the Year 2 cohort were compared to children's gains in the Year 1 cohort.

Whole Teacher Approach to PD
Simultaneous development of teachers' content knowledge, confidence, and classroom practice elicits and sustains the most comprehensive, meaningful, and effective teacher change (Chen & Chang, 2000; Chen & McClary, 2012). This approach has particular relevance to PD efforts in early math. Specifically, subject knowledge is crucial in mathematics. Addressing it with thoroughness is the only way to counteract the weak understanding held by many teachers of young children (NRC, 2009). Confidence is particularly important for math PD because many preschool teachers doubt their math ability and thus avoid teaching it to children (Ginsburg, Lee, & Boyd, 2008). Direct attention to and support of practice is a powerful mechanism for making instructional shifts actually occur, as it encourages teachers to try new methods and learn from their experimentation.

Collaborative Math PD Program

Collaborative Math is a one-year professional development (PD) initiative designed to help early childhood sites become centers of excellence in mathematics. Collaborative Math is guided by three principles: 

- Attend to the Big Ideas of Early Mathematics (Early Math Collaborative, 2013)
- Engage whole centers (i.e., lead teachers, assistant teachers, and paraprofessionals) in striving for math teaching excellence
- Provide professional development (PD) for teacher teams as a whole

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