

# What Does the Research Say About (Middle School) Mathematics Teacher Preparation and Teacher Effectiveness? What Research is Still Needed?

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# What We Know: Certification

- Students of certified teachers outperform peers taught by teachers without certification (Darling-Hammond, 1999; Fuller & Alexander, 2004; Neild, Farley-Ripple, & Byrnes, 2009; Richardson, 2009)
- As of 2004-05, about 35% of California Algebra I teachers in middle school did not have a subject matter credential in mathematics (Esch et al., 2005)

# What We Know: Content Knowledge

- More mathematics courses = Greater student achievement (Kukla-Acevedo, 2007; Monk, 1994; Weglinsky, 2000)
- How much is “enough” depends on level taught (Monk, 1994)
  - after five non-remedial college mathematics courses, additional coursework in mathematics had smaller effect on student achievement
  - additional undergraduate mathematics courses do positively impact achievement for students in advanced courses

# What We Know: Pedagogical Content Knowledge

(aka, Mathematical Knowledge for Teaching)

- Three dimensions of PCK (Krauss et al., 2008)
  - knowledge of mathematical tasks as instructional tools,
  - knowledge of students' thinking and assessment of understanding, and
  - knowledge of multiple representations and explanations of mathematical problems
- **Content knowledge is necessary but not sufficient**
  - “CK remains inert in the classroom unless accompanied by a rich repertoire of mathematical knowledge and skills relating directly to the curriculum, instruction, and student learning.” (Baumert et al., 2009, p. 139)

# What We Know: Pedagogical Content Knowledge (cont'd)

- **Content Knowledge had little direct effect**
  - no direct impact on potential for cognitive activation
  - no direct impact on learning support teachers provide when learning difficulties occur
- **PCK emerged as a powerful predictor**
  - explained 39% of the between-class variance in achievement at the end of Grade 10
  - largely determines the cognitive structure of mathematical learning opportunities
- **Structure and design of teacher training**
  - “programs that compromise on subject matter training...have detrimental effects on PCK and consequently negative effects on instructional quality and student progress.”
  - “Differences in CK that emerge during preservice training persist across the entire teaching career”

Baumert et al. (2009)

# What We Know: U.S. vs. Others

One issue that begins to emerge from these data concerns the preparation of the middle school teachers through programs aimed specifically at the middle school. It would appear that in some ways the training associated with that program provides teachers with the worst of both worlds. Their opportunities in mathematics were not different from the opportunities provided by the elementary program but were substantially different from the preparation provided by the secondary program — a difference on the order of covering 20 or 35 percent fewer topics. On the other hand, those same future teachers received less practical pedagogical training than was the case in the elementary program. In this case, they are trained more like those teachers prepared in a secondary program.

(Schmidt et al., 2007, p. 32)

# PCK: Promising Practices

- Video Analysis
  - “[participating teacher candidates] were more likely to attempt to explain what students meant when they analyzed student thinking, how a teacher move may have influenced student understanding, or how the discourse evolved in the classroom” (van Es & Sherin, 2002, p. 590)
  - “students of teachers who included suggestions for instructional improvement that they connected to mathematical content showed greater learning gains than did students of teachers who included either general pedagogical suggestions or no suggestions at all.” (Kersting et al., 2010, p. 178)



# Questions

- What do we still need to learn?
  - What specific courses are critical?
  - What sequence of coursework is best?
  - What sort of learning experiences within courses are most effective?
- Others?

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