STEM Education Research and K-12 Policy Considerations

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Day 1: What Research Tells Us about Effective K-12 STEM Teacher Preparation, Recruitment, and Retention
SESSION 1 OUTLINE

• Identify who our target population is (…or should be)

• Describe research on effective K-12 STEM teacher preparation, recruitment, and retention from 3 vantage points:
  • index of success
  • developmental processes
  • contexts

• Discuss ways to harness the research in our application approaches
AN IMPORTANT CAVEAT

NRC (2010) report concludes: “Because the information about teacher preparation and its effectiveness is so limited, high-stakes policy debates about the most effective ways to recruit, train, and retain a high-quality teacher workforce remain muddled.”
WHO ARE K-12 STEM TEACHERS?

• Public school systems were slated to employ about 3.1 million full-time-equivalent (FTE) teachers in Fall 2016

CHARACTERISTICS OF TEACHERS (2011-2012 data)
• 76% of public school teachers were female
• 44% under age 40
• 56% had a master’s degree or higher

6-year enrollment and completion status of 1st full-time STEM aspirants at 4-year institutions who began in 2004, by initial STEM field

(Eagan et. al, 2014, Fig. 6.)
RECRUITMENT  NEW REPORT BY AMERICAN PHYSICAL SOCIETY 6,000 CURRENT AND RECENT MAJORS (2015-2016) IN “HIGH-NEEDS FIELDS (PHYSICS, CHEMISTRY, AND COMPUTER SCIENCE)

Recommendations for universities:

• Promote middle and high school teaching with undergraduate majors and graduate students

• Provide accurate information about the actual salary and positive features of teaching

• Support high-quality academic programs that prepare students for STEM teaching, and expand good models to more universities.

• Provide improved coursework, prevent certification from requiring extra time, and provide academic and financial support
Retention

Public School Teacher Retention Rates (2011-2013)

- 84% "stayers"
- 8-13 % "movers"
  - 59% moved from one public school to another public school in the same district
  - 38% from one public school district to another public school district
  - 3% moved from a public school to a private school
- 8% "leavers"

About 50% who left teaching in 2012–13 reported new job had:
  - more manageable work load
  - better work conditions

Caveats in the Research Findings

Attrition does not differ or differences are small based on:

- degree level
- alternative path (21%) versus traditional path (16%)
- urban/suburban (17.2%) versus small town/rural (17.5%)
- schools with above 50% free/reduced lunch (19%) versus those with less than 50% (16%)

What happens where teachers work?

Figure 1. Percentage distribution of reasons for public school teacher movers changing schools from 2011–12 to 2012–13

- Reason for moving schools:
  - Changed schools involuntarily: 30%

- Reason for voluntarily moving schools:
  - Personal life factors: 23%
  - School factors: 23%
  - Other factors: 16%
  - Assignment and classroom factors: 5%
  - Salary and other job benefits: 4%
  - Student performance factors: 1%
Contextual Factors

- Johnson, Kraft and Papay (2012) 25,135 K-12 teachers in MA
  - teachers chose to leave schools with poor work environments
    NOT working conditions: facilities, resources, or planning time, BUT contextual issues: school culture, principal’s leadership, relationships with colleagues.
    - Poor working conditions more common in schools who enrolled more African American students and those from low-income backgrounds.

- Kraft & Papay (2014) 3,145 North Carolina teachers
  - teachers at schools with the most supportive learning environments had higher student test score gains AND as this gets better the more time spent working at the school

- Research also suggests improving the professional life and community of STEM teachers is important
IMPLICATIONS OF RESEARCH FINDINGS

• Who are teachers? Who do we need to target
  – NOTE: more ethnic minority teachers leave teaching

• What do “potential” teachers bring to the table?
  – knowledge and expertise
  – experience
  – cultural capital
  ❖ NOTE: these confer both strengths and vulnerabilities

• What is our index of success?
  – Teacher value-added
  – Student outcomes

• How do we uncover contextual factors?
  – For education—in particular—a multifaceted approach is best
THE WHY......WHAT SHOULD WE CONSIDER?

**FIGURE 2-1** A model of the effects of teacher preparation on student achievement. SOURCE: Adapted from Boyd et al. (2006, p. 159).
Two main conclusions from review studies on preparation (specifically for math and science teachers):

1. Strong content knowledge (a body of conceptual and factual knowledge)

2. Pedagogical content knowledge (understanding of how learners acquire knowledge in a given subject) is critical

- Teachers are largely underprepared
- Enable teachers to: 1) foster students’ understanding of the core elements of mathematical proficiency; 2) understand how mathematics learning develops and of the variation in cognitive approaches to math problem solving

Math

Science

- Enabling teachers to foster 21st century skills is key!
  - Manipulatives
  - Instructional materials
  - Assessment strategies
  - Inquiry strategies
  - Context strategies
  - Instructional technology

TEACHING TEACHERS: BUILDING “EXPERTISE”

• Intuitive
  – relies on past experiences and immediate context as opposed to formal procedures and rules
    • Caveat: intuition arises from practice BUT practice does not always lead to intuition

• Automatic
  – complex action and thought required for performance have become routine
    • Caveat: not everyone becomes an expert over time, but everyone needs time to become an expert

• Strategic
  – more and better strategies especially when unexpected problems arise
    • Caveat: strategies require updating

• Flexible
  – readily adapt to individual cases and exceptions
What we know about professional development?

Key Findings from IES study of 3 large scale randomized assigned studies

- intensive, content-focused PD improved teachers’ knowledge and some aspects of their practice
- Improving teachers’ knowledge or practice did **not** translate into improvements in student achievement

SOME RESEARCH-BASED CONSIDERATIONS

• Harness research across the tracks—NOTE: some implications cut across the areas (e.g. money matters!)
• Consider expanding targets for training
  • improving teachers’ understanding of who students are
  • culturally-responsive practice
• Enhancing teachers’ ability to harness technology
• Enable teachers to understand and effectively use assessment