

# Effects of Teacher Professional Development on Gains in Student Achievement

How Meta Analysis Provides Scientific Evidence Useful to Education Leaders

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# NSF Grant

- **Meta analysis study– math and science, 2006-2008**
- **Research for the paper supported by an NSF grant (#REC-0635409)**
- **Synthesis study, now under REESE**

# Study Questions

- 1. What are the effects of content-focused professional development (PD) for K-12 math teachers on improving student achievement as demonstrated across a range of studies?**
- 2. What characteristics of PD programs (e.g., content focus, duration, coherence, active learning, and collective participation of teachers) explain the degree of effectiveness, and are the findings consistent with prior research on effective PD?**

# Study Goals

- 1. Present results of the meta analysis**
- 2. Report on use of meta analysis as a method for providing evidence for education leaders**

# Overview of Study

## **Rationale: state education leaders need for research evidence**

- **Federal legislation – push from NCLB**
- **Student achievement preferred measure of effects of programs**
- **Recent research findings**
- **State leadership needed with teacher development resources**

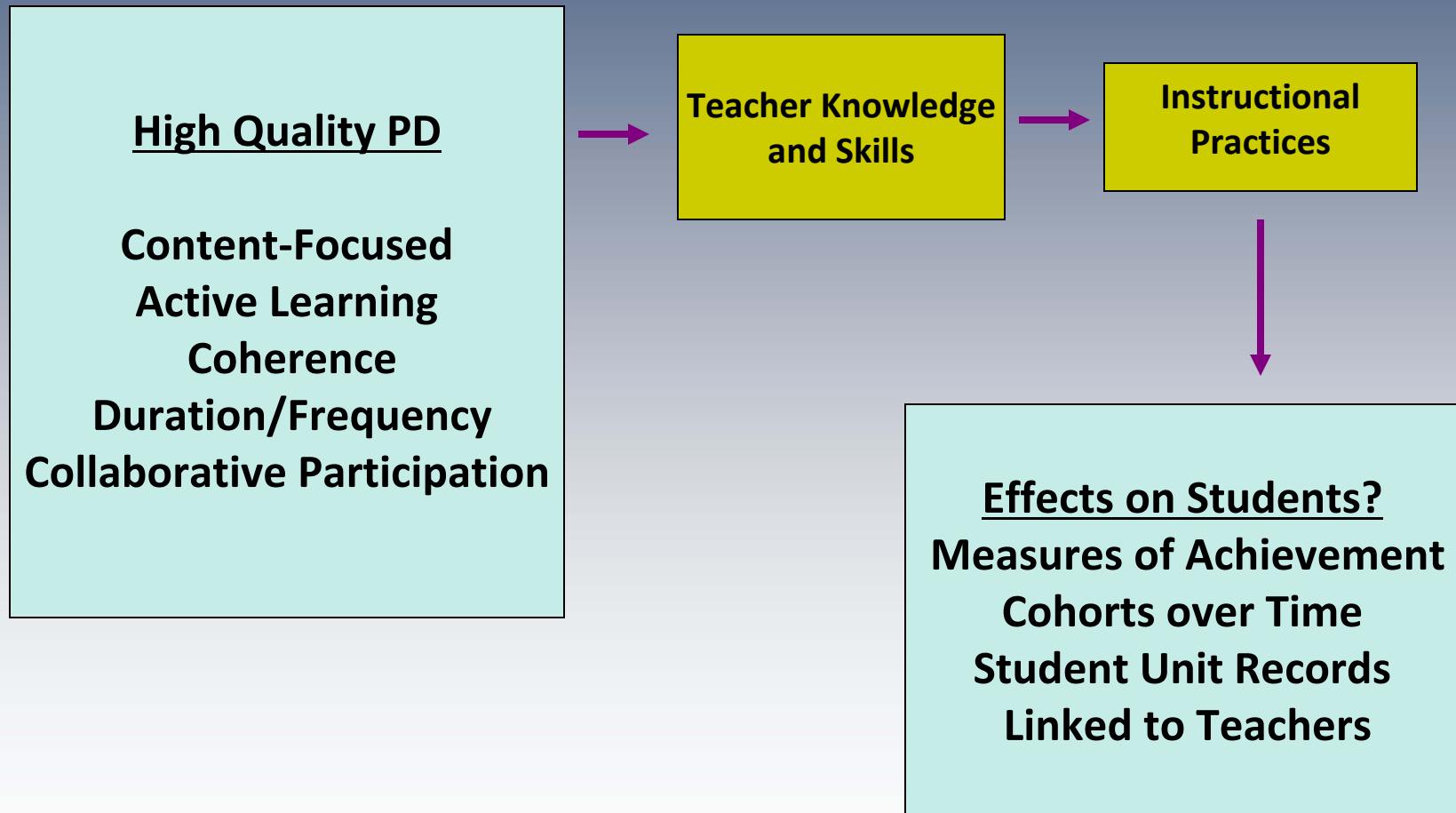
# Research on Professional Development Effects

- **CCSSO/AIR/WCER Evaluation of Math, Science Professional Development (2006)**
- **Effect on change in instruction – 2 years period**
- **Alignment to standards –dependent variable**
- **Surveys of Enacted Curriculum – data, alignment**
- **[www.SECsurvey.org](http://www.SECsurvey.org)**

# Research on Professional Development Effects

- **Blank, de las Alas, & Smith. (2008). Does *teacher professional development have effects on teaching and learning?* Washington DC: CCSSO.**
  - Cross state study of professional development (PD) programs from 14 states
  - Evaluation designs, metric, findings
- **Consensus research findings on effective PD models– 1995 - 2007**

# Logic Model





# Steps in Study

- **Design review and analysis**
- **Identification and collection of potential studies**
- **Pre-screening**
- **Paper review, training & coding process**
- **Data analysis**
- **Report & dissemination**

# Pre-screening Criteria

<b>CRITERION</b>	<b>DESCRIPTION</b>
<b>Topic Focus</b>	<b>Effects of teacher in-service professional development (PD) on student learning</b>
<b>Population Focus</b>	<b>Teachers of math and/or science and their students in grades K-12</b>
<b>Study Design</b>	<b>Quantitative empirical study</b>
<b>Outcomes</b>	<b>Reports direct student achievement outcomes (<u>NOT</u> feelings, impressions or opinions of students)</b>
<b>Time Frame</b>	<b>Between Jan. 1, 1986 and August 31, 2007</b>
<b>Country</b>	<b>United States</b>

# Definition Issues

- **Curriculum vs. professional development**
- **Content-focused math or science PD**
- **“In-service” vs. Pre-service**
- **Student achievement measures**

# Flow of Documents Reviewed

<b><u>Stage I, Pt. 1</u></b>	<i>Is the document an <b>empirical quantitative</b> research paper on an <b>in-service PD program</b> for <b>teachers of math and/or science</b> with <b>student achievement outcomes</b>?</i>
<b>Total # of Documents</b>	<b>74</b>
<b># of Documents Rejected</b>	<b>41</b>
<b># of Documents Passed</b>	<b>33</b>
<b>Inter-rater Reliability Rate (=60/74)</b>	<b>0.81</b>

# Flow of Documents Reviewed – cont'd

<u>Stage I, Pt. 2</u>	<i>Does the document's research design produce <b>valid measurable results?</b></i>
<b>Total # of Documents</b>	<b>33</b>
<b># of Documents Rejected</b>	<b>11</b>
<b># of Documents Passed</b>	<b>22</b>
<b>Inter-rater Reliability Rate (=30/33)</b>	<b>0.91</b>

# Flow of Documents Reviewed – cont'd

<u>Stage II</u>	<i>Does the document have <b>enough data to compute an effect size or reports an effect size?</b></i>
<b>Total # of Documents</b>	<b>22</b>
<b># of Documents Rejected</b>	<b>2</b>
<b># of Documents Passed</b>	<b>20</b>
<b>Inter-rater Reliability Rate (=21/22)</b>	<b>0.95</b>

# Flow of Documents Reviewed – cont'd

<u>Post-coding</u>	<i>Are there <b>comparable effect sizes</b> for each document to conduct a meta-analysis?</i>
<b>Total # of Documents</b>	<b>20</b>
<b># of Documents Rejected*</b>	<b>4</b>
<b># of Documents Passed</b>	<b>16</b>

## \* Rejected because

- was an earlier incomplete version of another
- did not have n size data to compute an effect size
- used hierarchical linear modeling without sufficient information to calculate comparable posttest effect size
- eliminated after a series of homogeneity tests were run which showed that it had generated unusually large effect sizes --- extreme outlier

# Identified Studies

## Overall

- 16 studies, math = 12; science = 4
- Include published journal articles and unpublished articles (dissertations, evaluation reports)

## Research Designs

- 5 RCT designs (math = 4, science = 1)
- 11 quasi-experimental designs (math = 8, science = 3)
- Grades covered (elementary = 11, middle (7<sup>th</sup> & 8<sup>th</sup>) = 7, high school = 2)
- Types of assessments (national = 6, statewide = 4, PD-specific = 8, where n = # of studies)



# Identified Studies – cont'd

## Effect Size

- 16 studies generated 104 effect sizes, ranging from 2-21 ES per study (mean = 6.5 effects per study)
- ES from posttest only analysis and pretest-posttest gain analysis
- *56 percent of ES are small (.01 to .2), 20 percent had negative ES, & 8 percent had medium ES*

# Meta-Analysis: Mathematics PD

Categories	Math Pre- Post Mean Effect Size (SE)	N Effects	Q statistic
Math Studies	0.21 (0.08)	21	$Q_T = 153.7^*$
<u>Research Design</u>			$Q_B(1) = 46.1^*$
RCT	0.27 (0.13)	5	$Q_W = 53.2^*$
QED	0.17 (0.08)	16	$Q_W = 53.3^*$
<u>Measure Type</u>			$Q_B(1) = 84.5$
PD Specific	0.32 (0.08)	15	$Q_W = 46.8$
State Criterion- Referenced	0.006 (0.08)	6	$Q_W = 22.4$

# Summary of Findings

- **Mean ES for math studies = .21 (pre-post design); .13 (posttest-only design)**
- **Studies of science PD were not statistically significant due to the small number of studies identified with effect sizes**

# Summary of Findings

## Professional Development Designs

**PD measures with significant correlation ( $p = .01$ , in two-tail)**

- **Time (more contact hours, longer duration)**
  - Summer institutes ( $r=.577, .655$ )
  - College courses ( $r=.744, .596$ )
- **Active teacher learning**
  - Summer institutes with developing assessments/reviewing student work ( $r=.345$ ) and observing other teachers ( $r=.418$ )
  - Classroom mentoring, engaging in learning network ( $r=.796$ ) and developing assessments/reviewing student work ( $r=.883$ )
- **Integrated content and pedagogy PD intensive and follow-up with multiple PD activities**
- **Role of outcome measures used**

# Recommendations to Ed Leaders

- **Adopt meta analysis design & procedures instead of single evaluations by program for**
  - **identifying common findings**
  - **determining studies and their results with high standards of validity, reliability**
- **Scientific research design answers efficiency question through use of existing tools and measures**
- **Use of experimental designs can and should become standard practice**

# Recommendations - cont'd

- **Include multiple outcomes measures**
- **Collect measures of PD implementation**
- **Use longitudinal data systems, with teacher-student links**
- **Procedures for coding studies and determining validity and reliability—linking reviews and quantified judgment scores**

# Meta Analysis Study Website

Address  [http://www.ccsso.org/projects/improving\\_evaluation\\_of\\_professional\\_development/](http://www.ccsso.org/projects/improving_evaluation_of_professional_development/)



The screenshot shows the CCSSO website with a search bar and navigation menu. The main content area features a sidebar with a list of links under 'IN THIS SECTION' and a main text area with two project descriptions. The first project is 'Improving Evaluation of Professional Development' and the second is 'Study of Math and Science Professional Development Programs'.

**CCSSO** COUNCIL OF CHIEF STATE SCHOOL OFFICERS

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IN THIS SECTION

- Improving Evaluation Of Professional Development
  - Meetings
  - Resources
  - Study Results

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STATE EDUCATION AGENCIES

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see all projects 

## Improving Evaluation of Professional Development

The Council has initiated a new project to assist states in improving evaluations of the quality of professional development for teachers, and especially evaluations for programs and activities aimed toward improving teaching of K-12 mathematics and science. The current policy emphasis on improving the quality of professional development for teachers is driven by the demand for highly qualified teachers in every classroom and the need to upgrade knowledge and skills of teachers for standards-based instruction. States have strongly expressed a need for effective evaluation designs that will measure impact as well as inform program developers about effective practices. CCSSO is studying current professional development programs for teachers across the states in relation to research-based characteristics of high quality, effective activities and methods of evaluation. States will receive practical guidance, tools, and recommendations from our review of best practices and studies of program impact using scientifically based evidence.

## Study of Math and Science Professional Development Programs

The CCSSO work on this project is initially supported by a grant from the National Science Foundation. The study objectives are to: identify high-quality professional development programs that meet criteria established by research, and then, report on the effects of the identified programs on

[http://www.ccsso.org/projects/improving\\_evaluation\\_of\\_professional\\_development](http://www.ccsso.org/projects/improving_evaluation_of_professional_development)

# More Information

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