Improving Evaluation of Professional Development in Mathematics and Science Education

Table Excerpts

from

Cross-State Analysis of Evaluations of Professional Development for Mathematics and Science Teachers

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Table 2: Evaluations Reporting Measurable Effects of Teacher Professional Development on Student Outcomes

Evaluation Report, PD	Outcome Measure	Study Design	Treatment/ Comparison	Finding
META Associates. (2007), **NE Front Range**-CO	Student gains on CSAP Math for two years	Quasi-experimental Pre-/posttests	Matched comparison group of teachers	CSAP state assessment results show statistical significant mean gain of 13.5 points for students of participant teachers, with 70% improved in scale score, and higher gains than students of comparison teachers (higher initial scores).
Schmidt, D. L. (2006), **Launch II**-FL	Student gains on FCAT elementary math, science assessment	Quasi-Experimental Pre-/posttests	Teacher PD whole school vs. weighted district level performance	FCAT results show statistically significant gains on FCAT math in Grades 4-5 for treatment schools (+2.1%) vs. comparison (+.8%).
Evansville-Vanderburgh Schools. (2006), **iCATS**-IN	ICAT math gains for Grades 3, 4, and 5 for 2 years	Quasi-experimental Pre-/posttests	Treatment students vs. students participated in direct teaching environment	Statistically significant gains on ICAT Math for Grades 3 – 5 students of teachers receiving PD with Educational Technology (gain scores 4 points higher than comparison students).
Grip, R. S. (2006), **TaLL**-NJ	Gains on district-wide Terra Nova test in math & science	Pre-/posttests School-by-school analysis	Treatment vs. non-treatment teachers in same school	Over two years, significant gains on Terra Nova test for students of teachers in PD (in math 7-pt. higher gain; in science 2-pt. higher gain).
Hansen, J. B. (2006), **Willamette Valley**-OR	Gains on Student Science Achievement Level Test (developed with Northwest Evaluation Assoc.)	Quasi-experimental Pre-/posttests	Matched comparison group of teachers	Treatment group outperformed the comparison group at grades 8, 9, but not grades 6, 7. Effect size moderate (.106) across grades.
Weaver, D. (2007), **OMLI**-OR	Change in student discourse as observed thru teacher surveys, Student Discourse Protocol	Quasi-experimental Pre-/posttests	Teachers in treatment matched to non-participant comparisons	Student discourse in classes of teachers in treatment group significantly greater than comparison teacher classes.
Niess, M. L. (2005), **High Desert**-OR	Student gains on state math assessment for elementary & middle grades	Quasi-experimental Pre-/posttests	Matched comparison group of teachers	From 2004 to 2005 elementary treatment group showed statistical gains in math achievement (214 to 220, $p<.05$) vs. comparison group (210 to 217 $p<.05$).

Table 3: Evaluations with Findings on Student Outcomes but not Measurable Effects

Evaluation Report, PD	Outcome Measure	Study Design	Treatment/ Comparison	Finding
Heath, B. P, et al. (2007), **Rocky Mountain MS**-CO	Change in student attitudes about math and/or science after teacher PD	Case study with pre-/post-treatment attitude surveys of student camp participants	No comparison group	Student attitudes about math and science courses more positive after teacher professional development, but small N-sizes. Attitudes are indirect measure of learning gains.
JVA Consulting, LLC. (2006), **TQE-STEP**-CO	Change in student achievement in grades 6-10 on state assessment scores across 4 subjects areas (math, science, reading, writing)	Analysis of scores of students of new teachers in SY2005-2006 compared to scores of students of teachers hired before SY2005-06	No comparison group – sets baseline prior to treatment teachers entering classrooms	Shows students of teachers hired before 2005-06 to have nearly the same scores compared to students of new teachers.
Howard, M. N. (2006), **Launch II**-FL	Changes in percent of students proficient in state math assessment; changes in mean scale scores in grade 5 and 8 state science assessment	Analysis of student achievement results in state math and science assessments aggregated to participating schools compared to districts	No comparison group	Students of teacher participants have the same level of improvement as district overall average. Limitations of results include: masking actual participant teachers' impact on student achievement due to PD, math and science results are not comparable, and science effects of participant teachers not in grade 5 or 8 not measured.
Rosenblum, J. (2006), **MATHS**-ME	Change in student engagement and cognitive activity, change in student attitude; change in a Gr. 9 Algebra Concepts Assessment	Mixed-method with class observations, student focus group interviews, and analysis of results from Gr. 9 Algebra Concepts Assessment	No comparison group	Increased range in student engagement and cognitive activity after teacher PD and improved attitudes toward math course; Slight improvement in mean scores on one strand of the assessment.
Chen, A. (2006), **Edutron**-MA	Changes in percent of students proficient in state math assessment at each school levels	Analysis of change by year in participating districts' student proficiency percentages in math	No tracking of treatment group	Student proficiency percentages increased at all 3 school levels but cannot be attributed to Math PD for elementary teachers.
Perry, M. (2005), **Nash-Rocky Mount**-NC	Change in percentage of students proficient in end-of-grade state tests for the district	Analysis of change by year and grade (6, 7, 8) in participant districts' student proficiency percentages in math	No tracking of treatment group	Aggregated at the district level, percentage of students deemed proficient increased on average by about two percentage points for middle grades.

Table 4: Teacher Knowledge Effects: Evaluations Reporting Measurable Effects of Teacher Professional Development on Teacher Content Knowledge

Evaluation Report, PD	Outcome Measure	Study Design	Treatment/ Comparison	Finding
META Associates. (2007), **NE Front Range**-CO	Gains in teacher knowledge as measured by Content-Based Teacher Assessment	Analysis of pre-/posttests given before/after summer institutes	Treatment teachers only	Statistically significant gains by teachers on biology assessment (N=21, 25% gain <.001), earth/space (N=17, 26% gain, <.001) force & motion (N=25, 22.3% gain, <.001
Heath, et al. (2007), **Rocky Mountain MS**-CO	Impact of courses as measured by teacher gains on Teacher Content Inventory	Analysis of pre-/posttests given before/after summer institutes	Treatment teachers only	12 of 15 academy courses with medium to large effect sizes on teacher knowledge: Earth Science II (3.8), History of Math (3.35), Physics II (2.23), Earth Science I (1.89), Discrete Math (1.69), Math Modeling (1.68), Chemistry I (1.63), Physics I (1.5), Biology I (1.41), Biology II (1.25), Geometry (1.18), and Statistics (.7).
Schmidt, D. L. (2006), **Launch II**-FL	Gains in teacher knowledge as measured by Teacher Content Knowledge Assessment	Analysis of pre-/posttests given before/after summer institutes	Treatment teachers only	Substantive increase in grades K-5 teacher scores in PD program for three cohorts: Cohort I (2004-06, N=10, 16% pt. mean gain), Cohort II (2005-06, N=36, 27% pt. mean gain, and Cohort III (N=50, 18% pt. mean gain. pre/post 2006 summer institute)
Brendefur, J., et al. (2005), **Developing Math Thinking**-ID	Gains in teacher knowledge as measured by Number Knowledge Inventory	Analysis of pre-/posttests given before/after treatment	Treatment teachers only	20% gain by teachers in number knowledge was statistically significant (Pretest mean score=31.35; Posttest mean score=40.49, $p < .01$)
Chen, A. (2006), **Edutron**-MA	Number of teachers passing the Massachusetts Tests for Educator Licensure (MTEL); Gains in teacher knowledge as measured by course assessments	Analysis of posttest only treatment (MTEL); Analysis of pre-/posttests given before/after courses	Treatment teachers only	14 of participant teachers passing MTEL; teachers showed knowledge gains in geometry (N=19, 22.6 pt. gain from 61.3; and probability (N=19, 34.1 pt. gain from 48.1)
Lesley University. (2006), **Coalition for higher math standards**-MA	Gains in course assessments	Analysis of pre-/posttests of courses	Treatment teachers only	19 of 30 K-5 teachers, 24 of 40 middle school teachers and 5 of 7 high school teachers showed statistically significant ($p<.05$ level) increase in knowledge of mathematics.
Hankerson, L. (2006), **Nash Rocky Mount**-NC	# of teachers passing PRAXIS, thus earning HQ status	Analysis of pre-/posttests	Treatment teachers only	Number of non-HQ math and science teachers who reached HQ status increased from 80 to 101 and from 101 to 105, respectively.

Table 4 - continued

Evaluation Report, PD	Outcome Measure	Study Design	Treatment/ Comparison	Finding
Niess, M. L. (2005), **High Desert**-OR	Gains in DTAMS, PRAXIS	Quasi-experimental Analysis of pre-/posttests of DTAMS, Analysis across 2 teacher groups	Treatment and comparison groups (PRAXIS)	Treatment group increased math knowledge on DTAMS (N=24, pretest mean=76.9167, posttest mean=97.7500, SD=19.49861 significant at p<.05 level). In PRAXIS, there is a statistical difference between the two groups on the problem solving domain, with treatment (N=14) group teachers scoring significantly better than their comparison (N=13) counterparts. (T=2.848, significant at p<.05).
Hansen, J. B. (2006), **Willamette Valley**-OR	Gains in knowledge assessment specific to PD; Changes in lesson plans content as seen thru Chief State Science Supervisors rubric	Quasi-experimental Pre-/posttests	Treatment and Non-equivalent comparison group (self-selected)	Statistically significant gains for treatment teacher group (pretest mean=73.0, gain=6% pts.) vs. comparison group; lesson plan analysis showed statistical difference (p<.05 level) in treatment & comparison groups: *proposing explanations* (.p=.006), *alternative explanations* (p=.002), *linking explanations (*p=.016), *communication* (p=.024).
Weaver, D. (2007), **Math Leader Institute**-OR	Gains in U. of Michigan Content Knowledge Assessment (CKT-M)	Analysis of CKT-M results	Treatment teachers only	Secondary school treatment teachers showed statistically significant math gains (N=81, mean difference=.025), and elementary teachers showed significant math gains (N=93, mean difference=.037).

Table 6: Instructional Practices Effects: Evaluations Reporting Measurable Effects of Professional Development on Teacher Instructional Practices

Evaluation Report, PD	Outcome Measure	Study Design	Treatment/ Comparison	Finding
Howard, M. N. (2006), **Launch II**-FL	Changes in instructional methods as shown in participant teacher survey with 100-pt. scale of practice indicators	Analysis of pre-/posttests	Treatment teachers only	Decrease in traditional methods (from 59% to 25% use traditional methods); increase in standards-based methods (from 19% to 28%).
Brendefur, J., et al. (2006), **Developing Math Thinking**-ID	Correlation of gains in teacher knowledge inventory and instructional changes as observed in the classroom	Analysis of pre-/posttests	Treatment teachers only	Strong, statistically significant relationship between teachers' content knowledge gains and instructional practices (2-tail test, Pearson correlation coefficient=.327, significant at $p < .05$).
Niess, M. L. (2006), **High Desert**-OR	Changes in instruction as recorded in RTOP teacher observation	Content analysis of and scoring of classroom observations	Treatment teachers only - classroom observations	High average post scores on RTOP scales (N=32 observations): lesson design/implementation (13.728), content-propositional (15.548), content-procedural (12.758), communicative interactions (13.099), student/teacher relationships (16.365), and total (71.498).
Weaver, D. (2007), **OMLI**-OR	Changes in instruction as recorded in RMC Teacher Survey with class practices index	Analysis of pre-/posttests results	Treatment (School Leadership Team or SLT) teachers and comparison teachers	SLT teachers reported statistically significant decrease in use of traditional teaching practices across the two years the survey was conducted (2005-06 and 2006-07 (N=110, mean difference=6.382, significant at $p<.05$)

Table 8: Characteristics of Teacher Professional Development Designs that show Measurable Effects – Student Achievement or Instructional Practices

Evaluation Report, PD	Method of PD	Content of PD, Learning goals	Providers & Activities	Duration and Contact Hours, Treatment Group Size
Howard M. (2006), **Launch II**-FL	Focus on elementary and middle schools in the same feeder pattern, Gr. 3-8 teachers; summer institutes and follow-up activities through next school year	Content knowledge and instructional skills for math and science using "space" as an integrating theme; participating schools commit to building and sustaining a leadership cadre for mathematics and science	Providers: Florida Gulf Coast Univ., Florida Space Research Institute and NE Florida Educational Consortium. Activities: Two-week summer institutes, in-school activities engaged participants, district-based workshops, online learning modules, and one-on-one mentoring from staff	1 year, 60 hours, 150 Gr. 3-8 teachers in math and science/year
Brendefur, J., et al. (2006), **Developing Math Thinking**-ID	Elementary teacher-administrator teams focus on math content and assessment; University summer institutes plus in-school weekly activities	Increase elementary teachers' capacity to teach for understanding, focusing on conceptual understandings and misunderstandings behind arithmetic calculations; uses cognitively guided instruction (CGI) framework	Provider: Boise State University Activities: One-week summer institute with university math faculty with teacher- administrator teams; weekly meetings with university faculty that include development and use of multiple student assessments and analyses of the data	3 years, 135 hours, 56 teachers and four administrators
Niess, M. L. (2005), **High Desert**-OR	Math content and pedagogy for Gr. 3-8 teachers in full-year program, using off-site (university) and on-site (school-based) activities	Prepare teachers with rigorous math content, pedagogical content knowledge, and collaborative techniques; target those teaching minority and disadvantaged students not meeting state standards in mathematics	Provider: Oregon State University Activities: Two-week summer institute with higher education partnered with districts; three terms of math courses & pedagogy (Fri-Sat, 8 hrs./week); in-school modeling and observation with master teachers	1 year, 304 hours, 25 Gr. K-8 math teachers
Weaver, D. (2007), **OMLI**-OR	Develop math leader teams in schools through summer institutes and school-based activities	Goal is development of a cadre of math teachers as school- and district-based intellectual leaders and master teachers through intensive summer institutes and follow-up academic year activities; train two teachers and one administrator (per school) to work as change agents for math instruction within schools	Providers: OR State Univ., Portland State University, Teacher Development Group. Activities: Institutes combine rigorous math content coursework with leadership development in seminars; academic year activities facilitate professional learning communities K-12; teacher content emphasizes student discourse, and teachers learn model pedagogical techniques	3 years, 27 graduate course credit hours or 360 hours. 280 elementary, middle, high teachers and administrators in math

Table 8 – continued

Evaluation Report, PD	Method of PD	Content of PD, Learning goals	Providers & Activities	Duration and Contact Hours, Treatment Group Size
Meta Associates. (2007), **NE Front Range**-CO	Summer institutes plus lesson study with teacher teams	Develop content knowledge of target group of teachers in specific content areas: analysis & probability, geometry, earth/space science, forces & motion, and life science	Providers: Colorado School of Mines, Univ. of Colorado, Boulder & Denver, University of Denver, Univ. of N. Colo., Denver Museum of Nature and Science Activities: Summer institutes with five districts; four follow-up institutes with same faculty and content specialists; teachers participate in lesson study, viewing and critiquing a lesson taught by a colleague to different groups of students	1 year, 120 hours 70-150 Gr. 6-8 teachers in math and science/year
Evansville-Vanderburgh Schools. (2006), **iCATS**-IN	Monthly workshops for teachers by grade level; focus on Gr. 3-5 teachers in schools with lower than expected math scores in Gr. 6	Facilitated interventions in schools' grade level teams that provide training and support for teachers to use hands-on approach to teaching math and use manipulatives and technology	Provider: District Curriculum and Technology Specialists Activities: Workshops focus on teaching math concepts, modeling the methods to be used in the classroom with grade level teams. Teachers construct and teach lessons based on State Standards and specific mathematical concepts. Lessons all posted on the web for reflection and discussion	1 year, 45 hours 50 Gr. 3-5 teachers/year
Grip R. S. (2006), **TaLL**-NJ	Graduate courses in math content and methods for middle grade teachers	Graduate credits in mathematics and teaching methods toward MA. Emphasis on NJ state standards; teachers get math specialization and highly qualified status	Provider: The College of New Jersey, Schools of Education and Science Activities: Courses offered to middle grade teachers in high risk schools, with non-participating teachers serving as comparison for evaluation.	3 years, 37.5 graduate credit hours, 100-200 Gr. K-8 math teachers/year
Hansen, J. B. (2006), **Willamette Valley**-OR	Summer institutes plus lesson study with teacher teams	Science teachers design a lesson for a two week unit in the classroom based on content in summer workshop and observe/ work with treatment colleagues when they introduce new content.	Providers: Oregon State University and the Teaching Research Institute of Western Oregon University Activities: Summer institute and three release days during school year to work with other teachers in program	1 year, 9 graduate credit hours 15 Gr. 5-8 math teachers/year