

**A Report on the Implementation of Teacher Quality Research to Improve Mathematics in Urban Schools: Quantitative and Qualitative Reasoning about Quantitative Reasoning**  
**June 7, 2007, IES 2007 Research Conference**



This presentation is based on a research grant funded by the Institute of Education Sciences, U.S. Department of Education, Award Number R305M040127

**Presenters:**

Vince Cyboran, Ed.D., Roosevelt University  
 Barbara Radner, Ph.D., DePaul University

**OVERVIEW**

During 2004-5 and 2005-6, a one-year three-part intervention was provided to two cohorts of teachers of 5<sup>th</sup>-8<sup>th</sup> grade students in high poverty Chicago public schools. The treatment, designed to demonstrate a professional-development structure to improve algebra instruction, included three algebra courses, one course in assessment, “scaffolds” to guide and assess student learning, and support by a “coach” between September-June. A limited treatment group received only the student scaffolds. A control group matched the treatment and limited treatment groups in terms of poverty level, LEP, and academic achievement as measured by ITBS prior to the treatment.

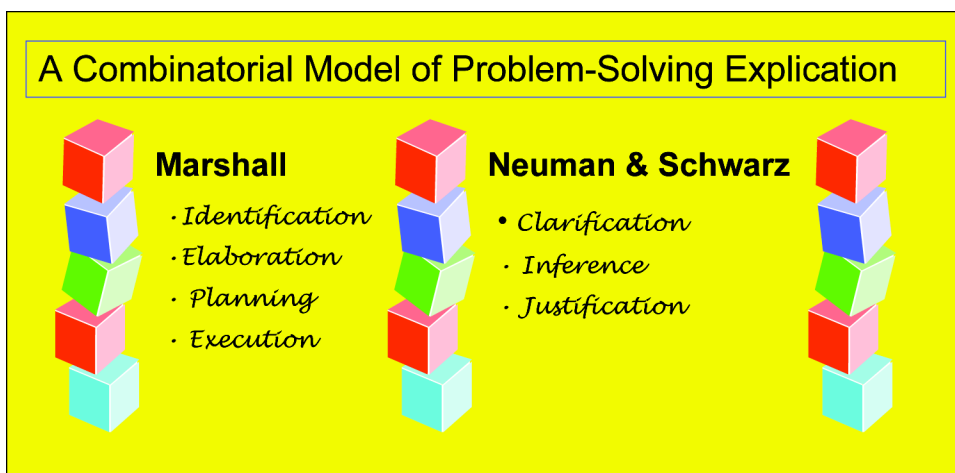
	Treatment	Limited Treatment	Control
2004-5	14 teachers 331 students	233 students	All students grades 5-8, 6 schools
2005-6	15 teachers 325 students	218 students	All students grades 5-8, 6 schools

Analysis included an examination of treatment teacher work, as represented in lesson plans and assessments, treatment student learning as represented in student responses to open-ended questions, and quantitative results of ITBS and ISAT tests of students in treatment, limited treatment, and control group. Results of these analyses are summarized here. Although some significant effects were identified, they are limited by the small size of the study.

**CONTENT ANALYSIS OF TEACHER AND STUDENT WORK**

**CONTENT ANALYSIS FRAMEWORK**

Vince Cyboran of Roosevelt University developed a framework for analyzing the work of teachers and the work of students based on theories of Marshall and Neuman and Schwarz. The content analysis for the teachers' written responses was informed by the 'Performance Model' of professional development developed by Nowlen (1988). Content analysis was conducted for pre- and post-treatment constructed response assessments of teachers and students.



**Teachers' Beliefs Change**

After the treatment, teachers increasingly wrote of their beliefs that the following elements, where are emphasized in the treatment, were important in their teaching of mathematics:

- *Active, social learning*
- *Individualized instruction*
- *Planning*

## Student Schemas Change

Scaffolds guided students' problem solving.

**B. Use your skills to solve this problem.**

The baby-sitter had no money on Monday. Then the babysitter earned \$9.00 on Tuesday, spent \$6.00 on Wednesday, earned \$8.00 on Thursday, and \$6.00 on Friday. How much money did the babysitter have then?

Step 1. What are you going to figure out?  
*I am going to figure out how much the babysitter had in all.*

Step 2. What information will you use to solve it?  
*Underline the information you need to find the answer.*

*I will do this by adding how much she had on Tues., Wed., Thurs., and Friday. After seeing how much she had, subtract how much she spent.*

Step 3. Solve it here. Show your work.

Analysis of student problem solving explanations indicates that student writing practices led to improvements in their problem-solving skills, particularly in the following areas which were emphasized in the treatment:

- *Restatement*
- *Variety of strategies used*
- *Explicit math techniques, such as charting, underlining, and math paths*

## POST-INTERVENTION TEACHER PARTICIPANT EVALUATION

In spring 2007, the University of Chicago Survey Lab conducted interviews and questionnaires of teachers about their experiences with the program, including reasons for enrollment and program benefits. They obtained feedback from 30 of 38 teachers, including 6 of 7 early leavers and 24 of 31 completers. Feedback was strongly positive.

### Influence on Teaching Subsequent to the Treatment

#### Relative Use of Teaching Techniques Since Enrollment as a Result of Program Participation

What was the effect of this program on your use of the following techniques?	A lot more	A little more	No effect	A little less	A lot less
Peer interaction teaching methods	63% (N=15)	33% (N=8)	0% (N=0)	4% (N=1)	0% (N=0)
Student initiated cognitive and meta-cognitive techniques	75% (N=18)	21% (N=5)	0% (N=0)	4% (N=1)	0% (N=0)
Practice	75% (N=18)	21% (N=5)	0% (N=0)	4% (N=1)	0% (N=0)
Teacher-initiated instruction*	52% (N=12)	35% (N=8)	4% (N=1)	4% (N=1)	4% (N=1)
Teaching to multiple learning styles	67% (N=16)	29% (N=7)	4% (N=1)	0% (N=0)	0% (N=0)
Reframing techniques	58% (N=14)	29% (N=7)	4% (N=1)	4% (N=1)	4% (N=1)
Applications and practical examples	67% (N=16)	33% (N=8)	0% (N=0)	0% (N=0)	0% (N=0)
Affective domain	50% (N=12)	33% (N=8)	13% (N=3)	4% (N=1)	0% (N=0)
Assessment*	50% (N=12)	33% (N=8)	13% (N=3)	0% (N=0)	0% (N=0)
Teacher instruction of cognition	58% (N=14)	38% (N=9)	4% (N=1)	0% (N=0)	0% (N=0)

\* One respondent left this question blank.

### Limits on Participation and Application

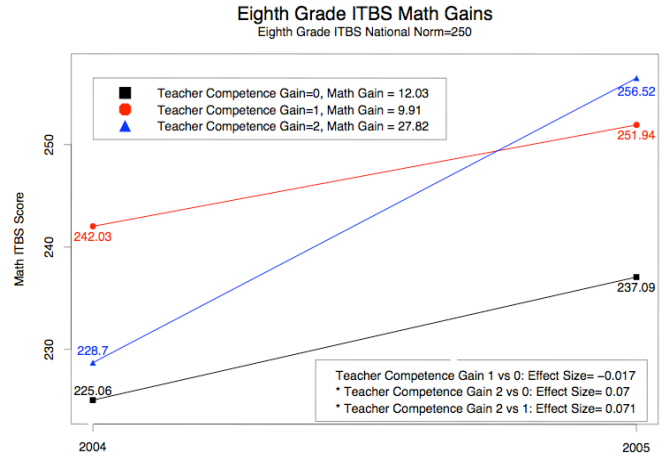
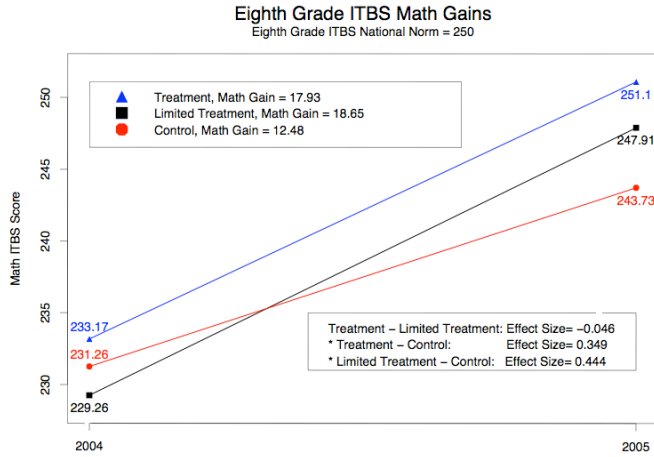
- After-school/Saturday hours add stress to jobs that are already demanding.
- Content taught did not match level of some students--"...expectations among math teachers at some schools may fall below grade-level learning." It also was difficult for some teachers.
- Learning styles of some teachers may limit their ability to learn in a group-work approach.

## CONCLUSIONS BASED ON CONTENT ANALYSIS AND INTERVIEWS

- A differentiated instruction approach to teacher education is indicated.
- High quality instruction in professional development is important to teachers.
- Having "enforcement" is a strength of teacher development programs.
- Having immediate "next-day" applicability of lessons is valuable.
- Teachers' zone of proximal development considered in planning professional development and recruiting participants.

# ACHIEVEMENT DATA ANALYSIS

Data analysis by Steve Ponisciak, Ph.D., Consortium on Chicago School Research, University of Chicago



When comparing 2005 ITBS, there were significant differences at 8<sup>th</sup> grade using raw data (in the above figure) and also when analyzed with HLM (in the table below).

Both analyses—using raw data and HLM—found that there was a significant effect of increase of teacher competence on student achievement at 8<sup>th</sup> grade.

## 2005 ITBS Analysis Using HLM

**Difference in ITBS gain for students in treatment and limited treatment groups**, controlling for Concentration of Poverty, Gender, Race/Ethnicity, Grade, whether students were retained or skipped a grade. Results are in ITBS math scale score points, and represent the difference in gain score from the average non-treated student in the relevant grade.

Results come from two-level HLM with students at level 1 and schools at level 2.

	Grade 5	Grade 6	Grade 7	Grade 8
Treatment	<b>3.92</b>	3.22	-3.61	<b>4.70</b>
Limited Treatment	1.46	2.91	-1.26	<b>6.73</b>

**Bold** = significant at p=0.05

### Difference in ITBS gain for students in treatment group with varying levels of teacher commitment

	Grade 5	Grade 6	Grade 7	Grade 8
Commitment=1	na	na	na	na
Commitment=2	na	na	-3.62	-0.37
Commitment=3	-1.19	na	na	3.65
Commitment=4	<b>5.99</b>	3.39	na	<b>4.95</b>
Limited Treatment	1.46	2.91	-1.26	<b>6.73</b>

### Difference in ITBS gain for students in treatment group with varying levels of teacher competence gain

	Grade 5	Grade 6	Grade 7	Grade 8
Competence gain=0	3.89	na	na	2.91
Competence gain=1	<b>8.12</b>	3.57	-2.55	<b>-6.49</b>
Competence gain=2	-1.43	na	na	<b>14.86</b>
Limited Treatment	1.46	2.91	-1.25	<b>6.73</b>

## ITBS Math Scale:

Grade	Bottom of scale	ITBS Norm	Top of scale	CPS average gain	SD of gain	CPS average	CPS SD
3	101	185	238	na	na	180.6	18.8
4	101	200	262	14.2	11.3	196.8	21.9
5	101	214	284	12.9	11.8	208.4	24.3
6	101	227	305	12.4	12.4	221.9	27.6
7	101	239	324	11.7	13.0	233.5	29.9
8	101	250	340	13.9	14.1	247.3	32.2

**2006 ITBS Raw Data** HLM was not used for the 2006 analysis since the ITBS was administered only to the Treatment and Limited Treatment classrooms.

### Difference in ITBS gain for students in treatment and limited treatment groups

Results are in ITBS math scale score points

	Grade 5	Grade 6	Grade 7	Grade 8
Treatment minus Limited Treatment	<b>9.24</b>	<b>-6.12</b>	0.48	2.02

**Bold** = significant at p=0.05

### Difference in ITBS Gain for students in treatment group with varying levels of teacher commitment

	Grade 5	Grade 6	Grade 7	Grade 8
Commitment=4 vs. 3	na	6.56	na	<b>11.49</b>
Commitment=4 vs. 1	na	na	na	<b>9.27</b>
Commitment=3 vs. 1	na	na	na	-2.22

### Difference in ITBS gain for students in treatment group with varying levels of teacher competence gain

	Grade 5	Grade 6	Grade 7	Grade 8
Competence gain=1 vs. 0	na	-3.50	na	4.64
Competence gain=2 vs. 0	na	<b>14.46</b>	na	4.82
Competence gain=2 vs. 1	8.08	<b>17.96</b>	na	0.18

## 2006 ISAT (Illinois Standards Achievement Test) Analysis Using HLM

Prior to the 2005-06 school year, Chicago Public Schools administered the ISAT only to students in grades 3, 5, and 8. Therefore, 2005 ISAT data were not analyzed for this project.

In 2005-06, CPS discontinued the use of ITBS district-wide, and instead began administering ISAT to grades 3 through 8, which is why 2006 ISAT data are included in the analysis.

**Difference in ISAT score for students in treatment and limited treatment groups**, Controlling for Concentration of Poverty, Gender, Race/Ethnicity, Grade, whether students were retained or skipped a grade, and ITBS score.

Results are in ISAT math scale score points, and represent the difference from the average non-treated student in the relevant grade.

Results come from two-level HLM with students at level 1 and schools at level 2.

	Grade 5	Grade 6	Grade 7	Grade 8
Treatment	-2.17	<b>6.91</b>	-2.18	0.88
Limited Treatment	<b>4.23</b>	<b>7.88</b>	<b>-4.87</b>	-3.33

**Bold** = significant at p=0.05

### Difference in ISAT score for students with varying levels of teacher commitment in treatment group

	Grade 5	Grade 6	Grade 7	Grade 8
Commitment=1	NA	NA	NA	-1.18
Commitment=2	NA	NA	NA	NA
Commitment=3	NA	-5.72	-2.62	0.87
Commitment=4	-2.17	<b>10.77</b>	NA	1.67
Limited Treatment	<b>4.24</b>	<b>7.88</b>	<b>-4.87</b>	-3.33

### Difference in ISAT score for students with varying levels of teacher competence gain in treatment group

	Grade 5	Grade 6	Grade 7	Grade 8
Competence gain=0	NA	-5.55	NA	-1.18
Competence gain=1	-8.01	<b>11.88</b>	-2.45	1.89
Competence gain=2	-1.53	<b>9.53</b>	NA	0.3
Limited Treatment	<b>4.24</b>	<b>7.89</b>	<b>-4.8</b>	-3.25

## ISAT Math Scale:

"All ISAT scores are now expressed on a 'vertical' or continuous scale across grades 3 through 8 in reading and mathematics, and in grades 4 and 7 in science. This scoring system shows the performance of students in all grades on the same scale...scores for students in higher grades will be higher on average than scores for students in lower grades, indicating that they have learned more."

Source: Illinois State Board of Education

[http://www.isbe.state.il.us/assessment/pdfs/ISAT\\_Scale\\_and\\_Cut\\_Scores.pdf](http://www.isbe.state.il.us/assessment/pdfs/ISAT_Scale_and_Cut_Scores.pdf)

Grade	Bottom of scale	Warning/ Below	Below/ Meets	Meets/ Exceeds	Top of scale	CPS average	CPS SD
3	120	162.5	183.5	223.5	342	198.7	29.1
4	120	171.5	199.5	246.5	355	214.8	26.6
5	120	179.5	213.5	270.5	369	223.0	26.9
6	120	193.5	224.5	275.5	379	235.2	25.2
7	120	206.5	234.5	280.5	393	245.2	27.4
8	120	220.5	245.5	287.5	411	258.1	25.9

## CONCLUSIONS BASED ON QUANTITATIVE ANALYSIS

- Based on analysis of ITBS and ISAT, there are individual class and grade level gains that are significant, some for treatment and some for limited treatment.
- That the Limited Treatment had some significant effects for individual classes may indicate that this relatively low-cost intervention could be implemented with the potential of increasing math learning.
- That there was such variation in achievement gains among the classes in the treatment group demonstrates the need to have much larger samples of classes in such a study.
- To further analyze such interventions, a study would require substantial monitoring for fidelity of implementation, which in itself would bias the outcomes.
- The results for some classes indicating that the Limited Treatment contributed to significant gains provides a basis for further research in using that relatively low-cost intervention and assessing outcomes to determine its effectiveness.

## ADDITIONAL PROJECT MATERIALS AND DATA ANALYSIS:

<http://teacher.depaul.edu/AlgebraConnections.html>