The Middle School Math Problem: Professional Development Challenges

An examination of the effect of teacher education on student learning.

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Abstract

The session reports on findings about the influence of professional development of teachers on math achievement of middle school students. Findings from an IES-sponsored experimental research project that analyzed effects of a three-component intervention to increase teachers' competence to teach math will be reported. The session will present data and introduce a framework for content analysis of teacher development. Participants will discuss findings in terms of the balance between content and process for teacher education about mathematics; issues of fidelity of implementation in studies based in urban schools; and implications for pre-service and in-service teacher education. The findings are relevant to teacher educators, researchers, and school districts.

Teacher Analysis Framework

Findings: After the treatment, teachers increasingly wrote of their beliefs that the following were important in their teaching of mathematics:

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

Achievement Data Analysis

2005 ITBS Analysis

Difference in ITBS Gain for Students in Treatment and Limited Treatment groups, controlling for Concentration of Poverty, Gender, Race/Ethnicity, Grade, and 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	**3.92**	3.22	-3.61	**4.70**
Limited Treatment	1.46	2.91	-1.26	**6.73**

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	**5.99**	3.39	na	**4.95**
Limited Treatment	1.46	2.91	-1.26	**6.73**

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	**8.12**	3.57	-2.55	**-6.49**
Competence gain=2	-1.43	na	na	**14.86**
Limited Treatment	1.46	2.91	-1.25	**6.73**

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 ISAT (Illinois Standards Achievement Test) 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	**6.91**	-2.18	0.88
Limited Treatment	**4.23**	**7.88**	**-4.87**	-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	**10.77**	NA	1.67
Limited Treatment	**4.24**	**7.88**	**-4.87**	-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	**11.88**	-2.45	1.89
Competence gain=2	-1.53	**9.53**	NA	0.3
Limited Treatment	**4.24**	**7.89**	**-4.8**	-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

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

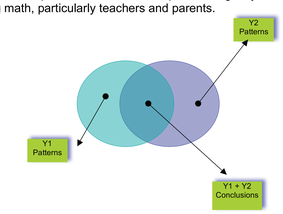
Content Analysis of Student Surveys

Based on an analysis of student responses to open-ended questions before and after treatment about their feelings about math and how they best learn it.

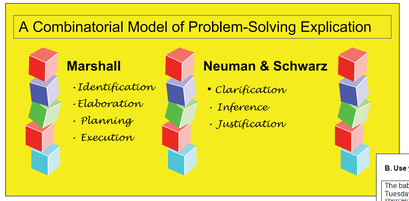
Year One (Y1) Patterns (281 Student Responses)
- Post-treatment, students expressed more positive feelings and fewer negative feelings about math in general.
- Post-treatment, students indicated they had assumed more independence, ownership, and personal accountability for learning math, requiring less support.

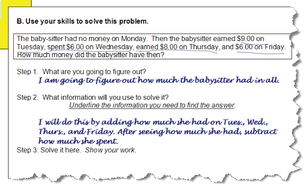
Year Two (Y2) Patterns (302 Student Responses)
- Post-treatment, students expressed more feelings about math in general, both positive and negative.
- Post-treatment, students indicated a decrease in self-reliance, self-discipline, commitment, and personal agency for learning math with increased dependence on others for learning math, particularly teachers and parents.

Conclusion: Consistent in Years 1 and 2
- Increased feelings: students had more to say in their post-treatment survey responses.
- Motivation: students post-treatment appeared to have an increased awareness of their motivations (both intrinsic and extrinsic) for learning math.



Student Schemas Change





Findings:
Analysis of student problem solving explanations indicates that student writing practices led to improvements in their problem-solving skills, particularly in the following areas:
- *Restatement*
- *Variety of strategies used*
- *Explicit math techniques, such as charting, underlining, and math paths*

CONCLUSIONS

- The zone of proximal development for teachers should be considered in planning professional development.
- Consistent implementation of teacher professional development can significantly influence student learning.