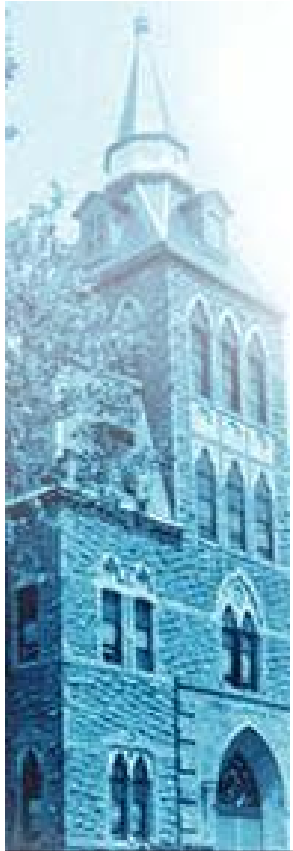


Increasing Elementary Teachers' & Students' Science and Engineering Content Knowledge Through Science Inquiry and Engineering Design Activities

Augusto Macalalag & Mercedes McKay

NJ Math Science Partnership:

- Stevens Institute of Technology
Montclair State University
Liberty Science Center
- 43 Grade 3-5 teachers in
18 public & 3 non-public urban
schools in Northern New Jersey
- 737 students of MSP teachers



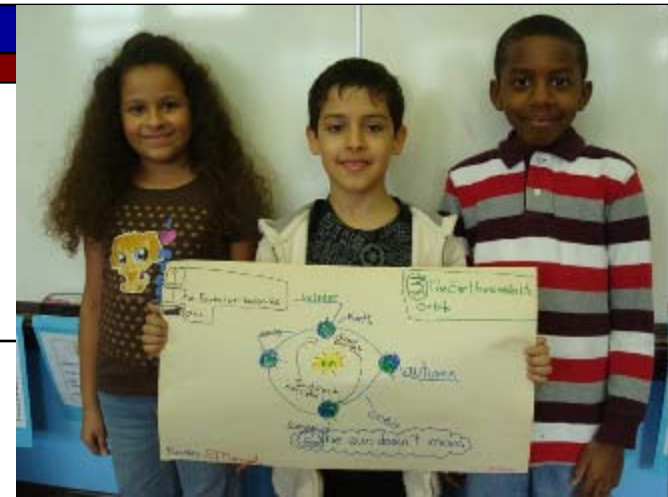
STEVENS
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Center for Innovation in Engineering and Science Education

Engineering
Our Future NJ

Goals

- Improve teachers' content knowledge in science & engineering
- Improve teachers' pedagogical knowledge in creating & adopting science inquiry & engineering lessons
- Improve students' content knowledge in science & engineering (Grades 3-5)



Year 1: 2007-08

Life &
Environmental Science

Year 2: 2008-09

Earth & Space Science

Year 3: 2009-10

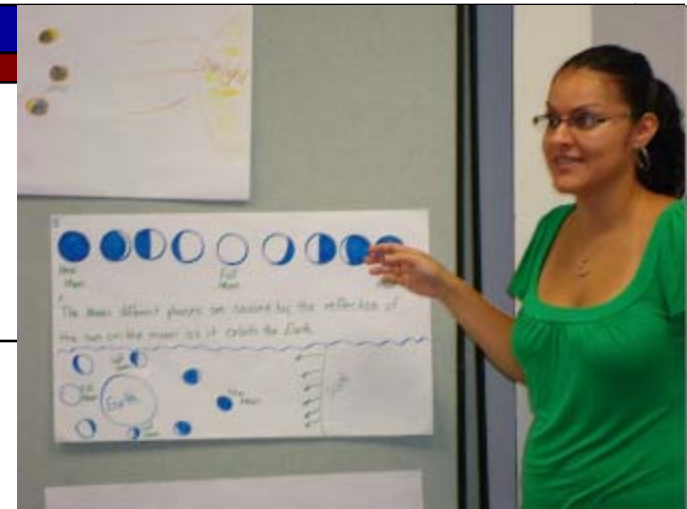
Physical Science & Math

Program Structure

- Two-week summer institute
 - Science lessons with focus on scientific inquiry
 - Engineering curricula
 - Real time data, telecollaborative projects
 - Faculty-led workshops, lab tours, & hands-on activities
- 3 PD workshops during school (f2f & online)
- Monthly classroom visits
- Project website and listserv



Teacher Evaluation



- Pre- and post- tests in treatment and comparison groups
- Questions taken from TIMSS, MOSART, NJASK & MOS (20 science, 5 engineering)
- Surveys (science inquiry and classroom implementation)
- Development of STEM Portfolio

Student Evaluation

Group	Students (N=1421)	Classes (N=72)
Treatment	737	37
Comparison	684	35

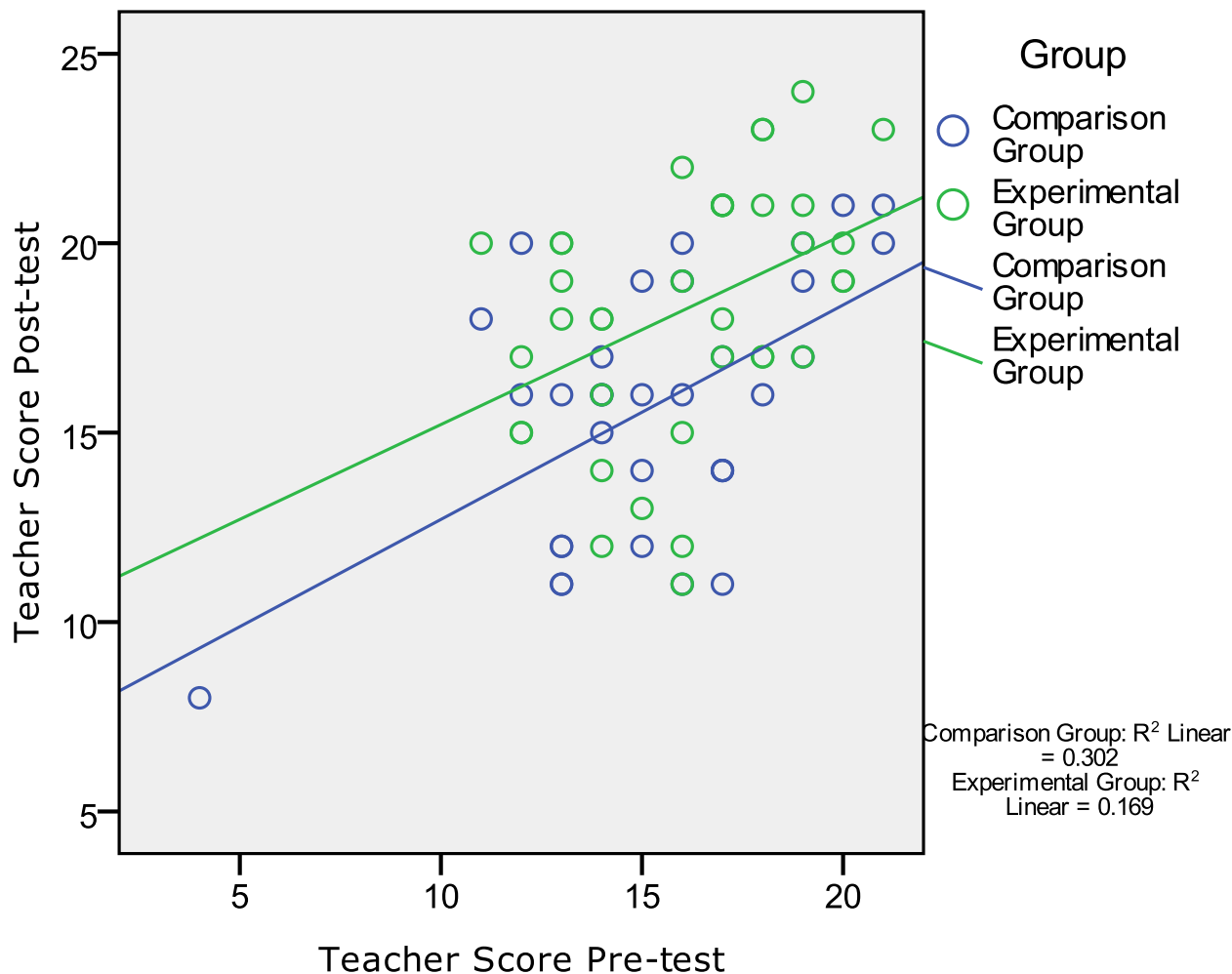
- Pre- and post- tests for treatment and comparison groups
- Teacher evaluation of student work (part of the teacher's STEM portfolio)



Designing Windmills Challenge

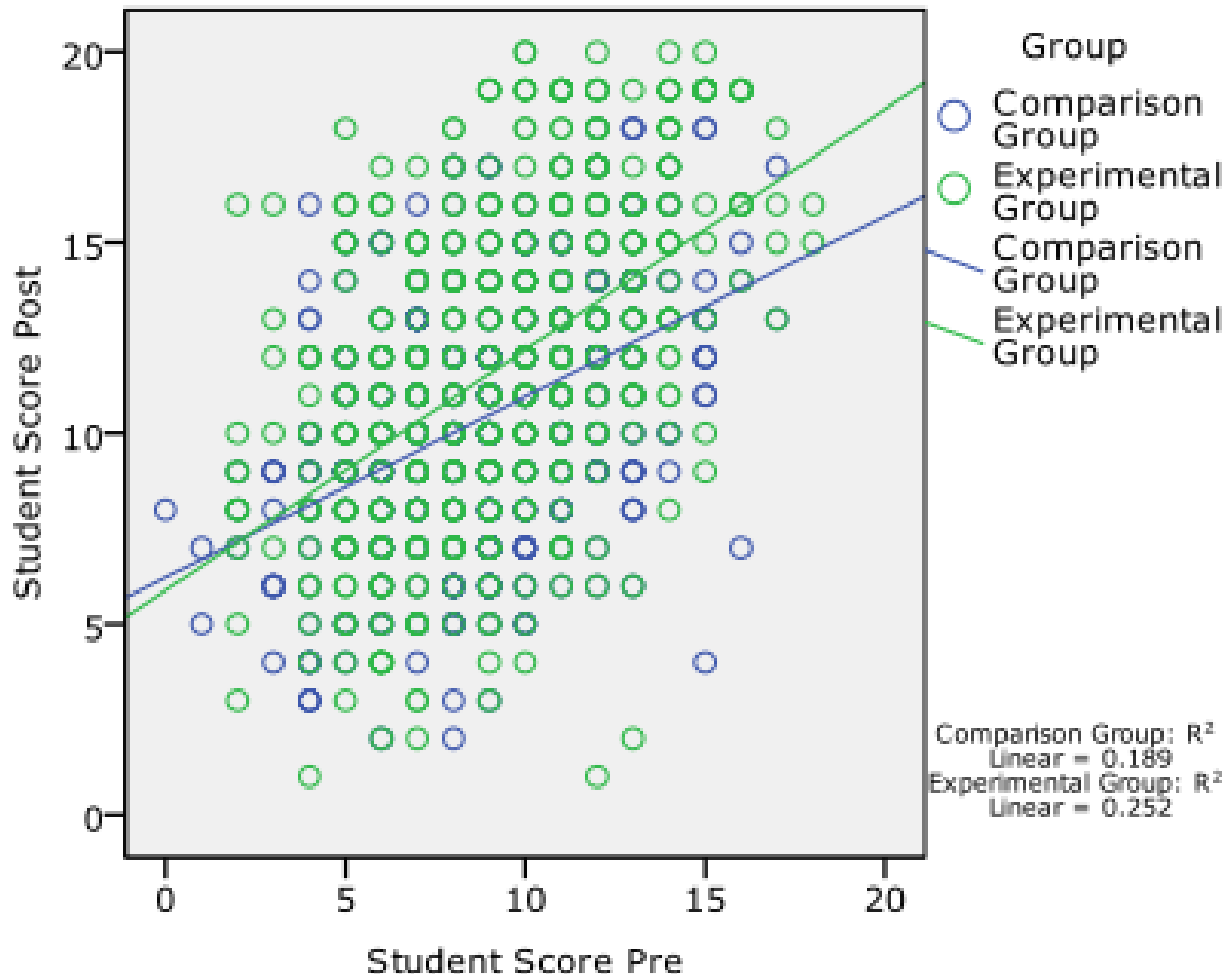


Year 2 Results- Teachers' Knowledge in Science & Engineering



Treatment teachers' post-test scores improved significantly even when their slightly higher pre-test scores are taken into account. Difference in post-test scores between the two groups is significant.

Year 2 Results- Students' Knowledge in Science & Engineering



Students of teachers in the treatment group had higher post-test scores than the comparison group.

Year 2 Results- Teacher & Students Test Scores

Teacher's post-test score is a significant predictor of students' post-test scores

- When teachers' post-test scores were added as covariate, they were a significant predictor of their students' post-test scores
- However, this correlation was statistically significant only for the treatment group.

Year 2 Results- Implementation of Activities & Students' Test Scores

- Number of activities implemented found to be a significant predictor of students' post-test scores
- When activities were conducted by teachers with greater content knowledge there was greater effect on student outcomes
- Exposure to twelve or more activities was more likely to have significant positive effect on student learning
- Number of science activities found to be a significant predictor of students post-test scores on science
- Students' post test scores on science questions were significantly correlated with the number of engineering activities that they were exposed to, suggesting that using engineering activities could positively affect science learning

Summary of Findings Yrs 1 & 2

Change in Mean Pre/Post Test Scores

YEAR 1

- Teachers
 - Treatment Group: 9%
 - Comparison Group: 3%
- Students
 - Treatment Group: 39%
 - Comparison Group: 15%
- **Science Content Only**
 - Treatment Group: 33%
 - Comparison Group: 14%

YEAR 2

- Teachers
 - Treatment Group: 13%
 - Comparison Group: 3%
- Students
 - Treatment Group: 27%
 - Comparison Group: 16%
- **Science Content Only**
 - Treatment Group: 24%
 - Comparison Group: 15%

GPRA Yrs 1 & 2

YEAR 1

- Teachers
 - % of teachers who showed significant gains in science content knowledge:
77%
- Students
 - % of students with assessment data in science scoring proficient or above:
62%

YEAR 2

- Teachers
 - % of teachers who showed significant gains in science content knowledge:
65%
- Students
 - % of students with assessment data in science scoring proficient or above:
87%



Disclaimer

The instructional practices and assessments discussed or shown in this presentation are not intended as an endorsement by the U. S. Department of Education.