
# Applying Blended Research Methods to School-based Intervention Evaluation

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# Key Questions Addressed in this Theory-Based Evaluation

1. How can a theory-based evaluation framework be used to help demonstrate the relationships between program elements?
   - The theory model helps us posit, test, and investigate which program elements seem to be:
     - Causing the desired (or undesirable) outcomes, or
     - Linking program elements to other, related factors that stimulate the ultimate outcomes of interest
2. How accurate, precise, reliable, and valid are the findings of this outcomes-based mixed method evaluation?


## Relevance of Study

- 85% of the 149 schools involved in this evaluation are classified as high poverty schools.
- 78 % of the schools serve a student population with a high percentage of minority students.
- Recent research reports indicate that the gap between high-performing teachers and low-performing students continues to increase.
- This evaluation assesses the outcome data associated with the implementing of a theoretically-based professional development service and utilization model designed to help teachers and students situated at high need, low performing schools.

# Background

- The NASA Explorer Schools (NES) project provides curriculum materials, professional development, and technology support for low performing, socioeconomically challenged, ethnically diverse schools serving grades 4-9. The focus of NASA's support is on improving teacher abilities and student achievement in science, technology, engineering, and mathematics (STEM) areas.


- This report integrates the results of five previous interim reports and provides an impact analysis of the first three years of the NASA Explorer Schools intervention.
- This study reports the results of data collected from the start of the project in 2003 through the spring 2006.


**Setting:**

- This study includes schools participating in the program between 2003 and 2006.
- Schools from all 50 states plus Puerto Rico are represented in this sample group.
- The intervention was carried out on a regional level through 10 participating NASA field centers located in:

| | |
|---|---|
| Alabama (1), | California (3), |
| Florida (1), | Maryland (1), |
| Virginia (1), | Mississippi (1), |
| Ohio (1), and | Texas (1). |


## Study Sample:

- 149 schools, 596 teachers
- 149 administrators, and
- 135,396 students

were involved in this program in the 2003 to 2006 period that is the focus of this study

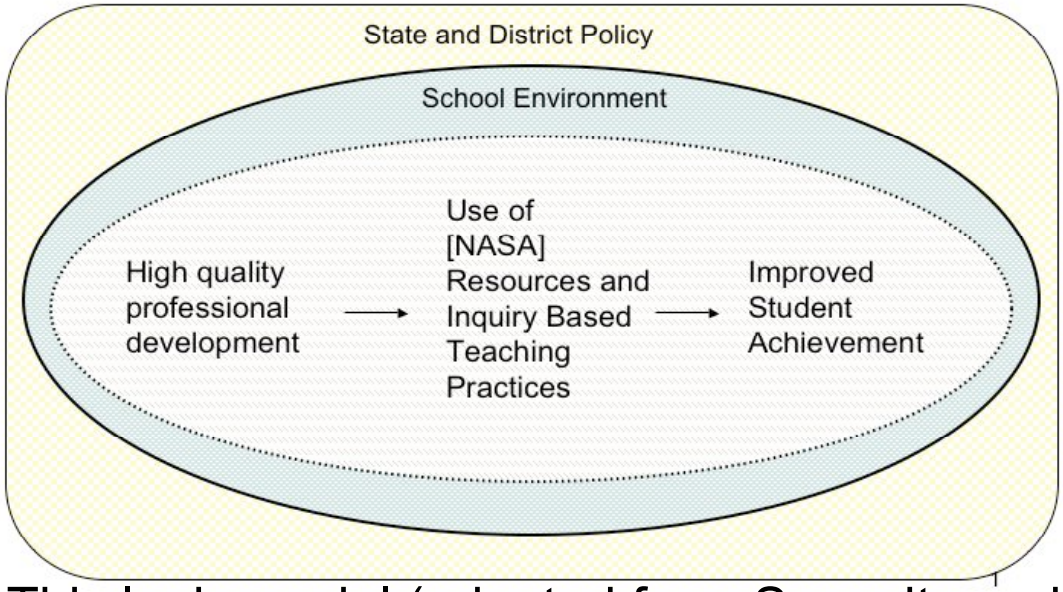
# What was the intervention being evaluated?

- The NASA Explorer Schools (NES) project provides a three-year partnership between NASA and the participating schools to offer professional development, funding for technology resources, STEM-related curriculum activities, materials, and expertise, and individual consultation to help teacher and administrator teams achieve the academic goals outlined in their NES sustainability and implementation plans.


## Research Method

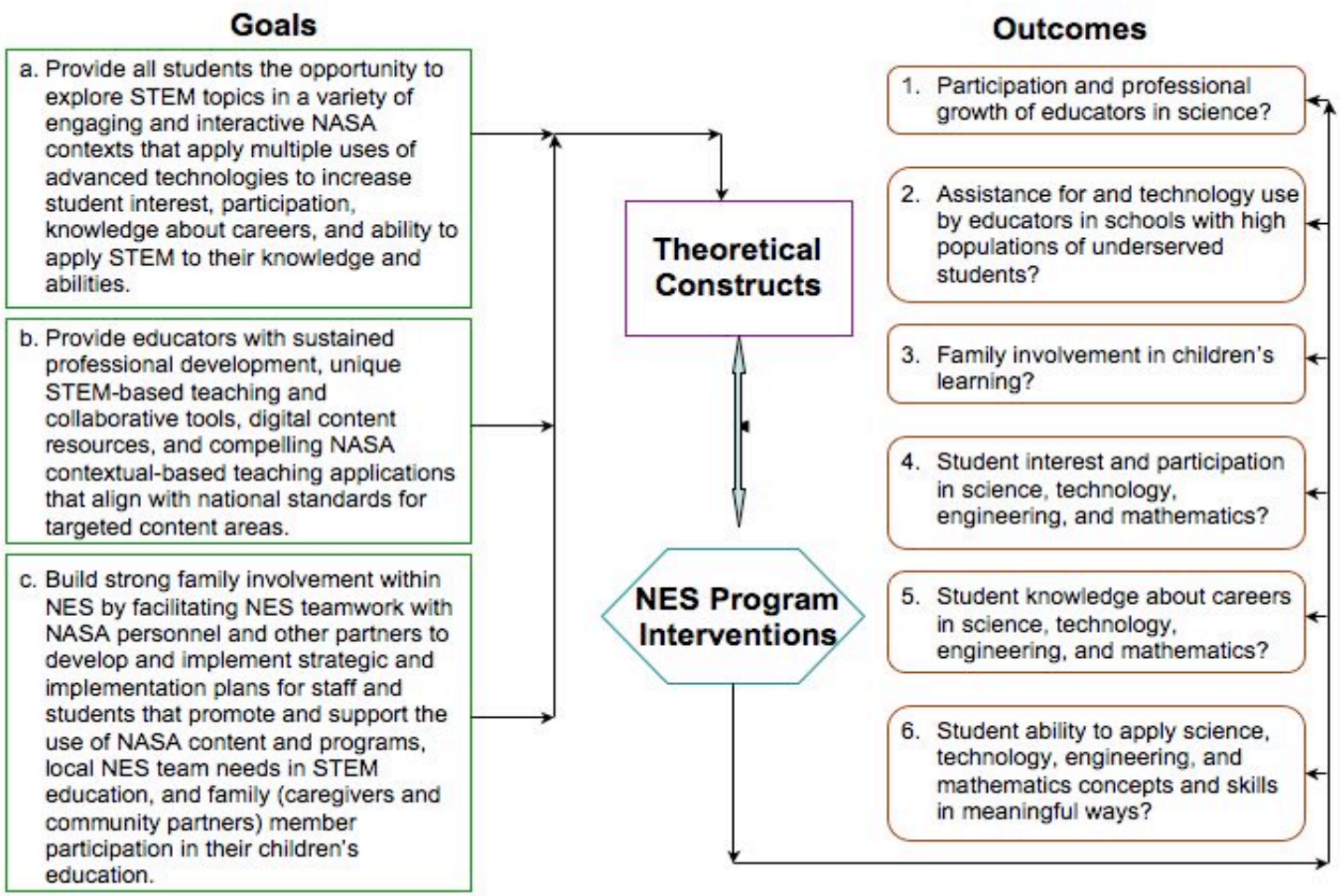
- Examines the first three years of the NASA Explorer Schools project using a blended method approach combines qualitative and quantitative methods:
- Applies a theory-based research design, a cluster-based, randomly selected sample of case study school implementations
- Compares case study school analysis to the theoretical guidelines of anticipated outcomes and practices
- Compares student achievement scores at participating schools with standing in their district and state after one, two, three, and four (one-year post completion) years of participation
- Pre-/posttests are compared to examine the impact of the STEM education intervention on school curriculum, teacher professional development, technology integration, family involvement, and student interest and achievement


*The Relationship between Professional Development and Student Learning**




This logic model (adapted from Supovitz and Turner, 2000) illustrates the theory-based framework that links high quality teacher professional development with student achievement.

# Applying Blended Research Methods to School-based Intervention Evaluation


# Integrating Data

| Assessment Instrument | Sample Population | Date Collected | Desired Outcomes/Goals |
|---|---|---|---|
| Teacher Involvement survey | 706 teachers from 143 schools | Pre/Post – fall, 2005 to spring 2006 | All 6 outcomes/goals |
| Team Lead survey | 143 teachers from 143 schools | Annually – fall 2005 and 2006 | All 6 outcomes/goals |
| Teaching, Learning and Computing (TLC) survey | 335 in spring 2005; 553 in spring 2006 | Annually | Measures teacher attitudes, beliefs, and practices regarding instruction and technology |
| School demographic profiles[1] | Student population demographics for each participating school | Upon acceptance into the program and subsequently on an annual basis | Goal 2, working with underserved and ethnically diverse student populations |
| Student Interest survey | 13,590 students (grades 4-9) from 121 schools in fall 2005; 7,447 from 87 schools | Pre/Post fall and spring annually | Outcomes 4, 5, and 6 from student perspective |
| Field Center Staff survey and interviews | 10 project coordinators, each located at one of the NASA field centers | Annually | All 6 outcomes/goals |
| Case Study report | 30 randomly selected cases representing one school per NASA regional center per year over the 3-year period | The case study reports cover the first 3-years of the program and include 10/year from each of the 3 cohort groups: 2003, 2004, and 2005 | All 6 outcomes/goals – Integrates all of the above listed data on a school case-based level |

[1] School demographic profiles are based on data posted by National Center for Education Statistics (http://nces.ed.gov), except in cases where state report card data were different and more current, and in those instances, the state-level demographic da


# Rubric

- A rubric was developed that integrated the theoretical framework, goals, and criterion of success as defined by previous research
- Applying the rubric ratings to all 29 case studies enabled a cross case analysis that followed the guidelines suggested by Yin (1994)

NASA Explorer Schools Rubric : Measuring School Success in Achieving the Six Anticipated Outcomes

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | ***Exceeds Expectations*** | ***Meets Expectations*** | ***Meets Minimum or Does Not Meet Expectations*** | ***Maximum Possible Points*** | ***Rating Scores*** |
| 2 | **Outcome 1: Participation and professional growth of educators in science** | **6-8 points** | **3-5 points** | **0-2 points** | **48** | |
| 3 | *Guideline 1 - Instructional Strategies*<br><br>*[data sources*: interview transcripts; surveys: TI, Adm, TLC; e-folio]* | Teachers meet expectations and:<br>• Immerse students in scientific inquiry, questioning, and experimentation.<br>• involve students in the process of generating and evaluating scientific evidence.<br>• Model scientific reasoning. | In regard to their classroom teaching of STEM-G topics teachers apply what they've learned about inquiry methods to create learning environments that immerse students in:<br>• Hands on investigations.<br>• Cooperative learning activities. | In regard to their classroom teaching of STEM-G topics teachers describe:<br>• Problems with not being able to implement inquiry methods in their classroom teaching.<br>• Difficulties with or restrictions in implementing cooperative learning strategies. | 8 | |
| 4 | *Guideline 2 - Time Intensive*<br><br>*[data sources: interview transcripts; surveys: TL, TI, FC; e-folio]* | Teachers meet expectations and:<br>• Present information to other NES and non-NES schools.<br>• View individual learning opportunities as part of an intensive and sustained professional development plan.<br>• Express higher satisfaction with NES professional development (rating score mean is at least 4 out of 5). | Teachers:<br>• Attend workshops and conferences.<br>• Network with the learning community.<br>• Share information with other NES and non-NES teachers.<br>• Express satisfaction with NES professional development (rating score mean is at least 3 out of 5). | Teachers attend workshops and conferences, but:<br>• Do not network with the learning community.<br>• Do not share information with other NES and non-NES teachers.<br>• Express dissatisfaction with NES professional development (rating score mean is less than 3 out of 5). | 8 | |
| 5 | *Guideline 3 - Classroom Practices*<br><br>*[data sources: interview transcripts; surveys: SI, TL, TI, FC; e-folio]* | Teachers:<br>• Integrate NASA resources and expertise (including AES) into their curriculum to increase student engagement and make learning relevant and meaningful.<br>• Aim their teaching strategies and materials to improve student performance in STEM-G areas. | Teachers:<br>• Integrate NASA resources and expertise (including AES) to encourage student engagement.<br>• Aim teaching strategies and materials toward improving English, reading, language arts, and STEM-G instruction. | Teachers:<br>• Do not use NASA resources or call upon NASA experts to encourage student engagement.<br>• Do not attempt to adapt and implement NASA content materials into their curriculum.<br>• Do not consider how they can aim their teaching to improve student performance. | 8 | |

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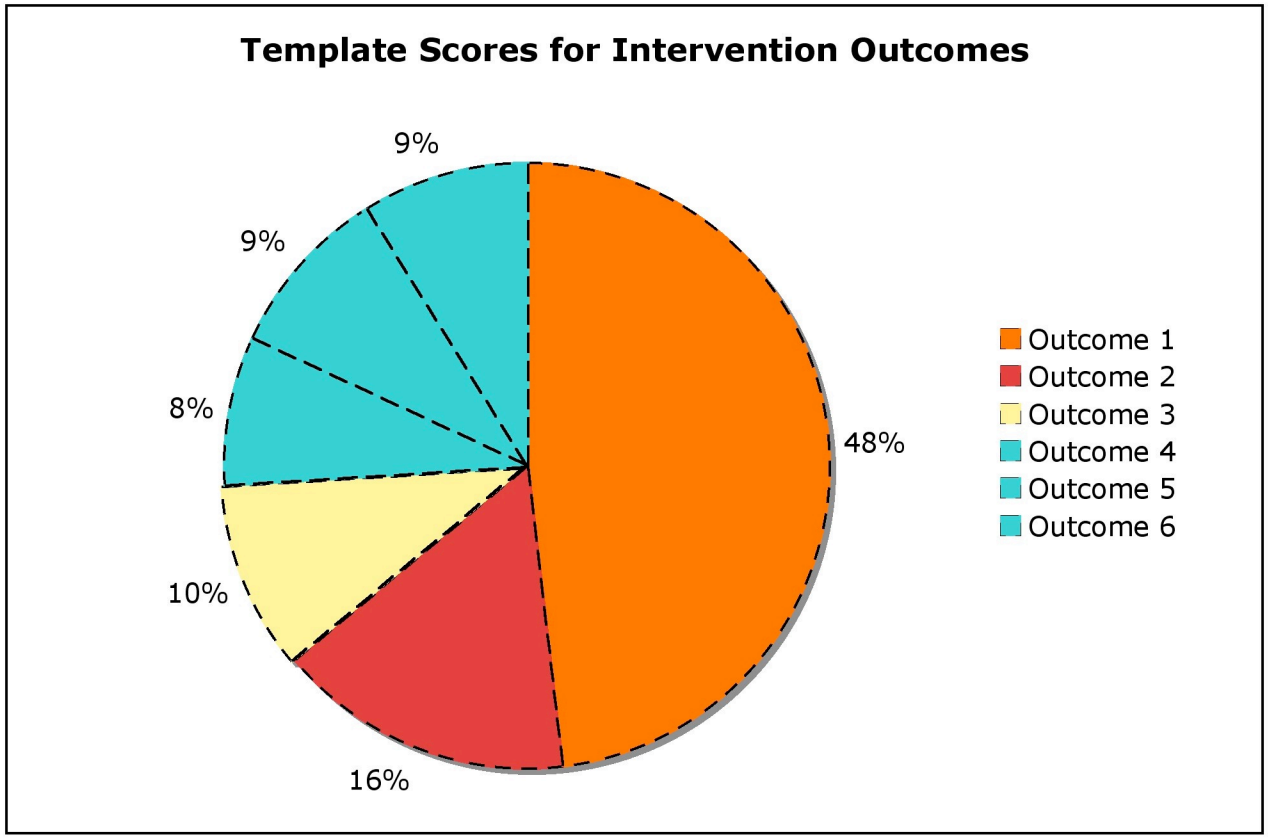
Reliability and validity of the rubric was tested and improvements were made in the criterion as needed.


# Rubric Summary Data

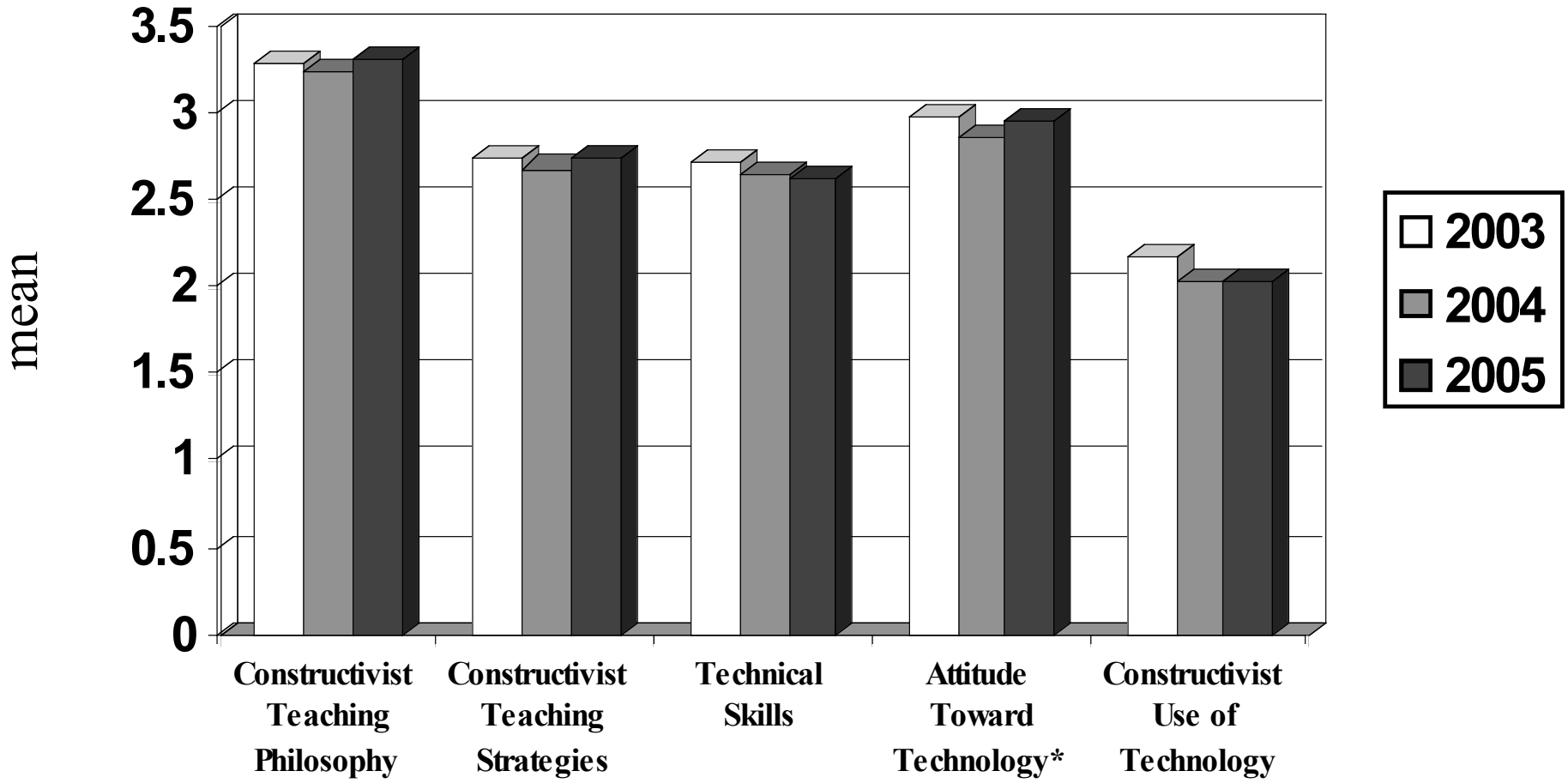



1. Teacher professional growth in STEM education
2. Teacher technology use
3. Family involvement in student learning
4. Student interest and participation in STEM
5. Student knowledge about careers in STEM
6. Student ability to apply STEM concepts and skills in meaningful ways


## Data Analysis:

- The analysis uses a blended methods research design. The quantitative research primarily conducted on survey data included descriptive statistics, mixed design analysis of variance, and regression modeling analysis.
- The qualitative data analysis followed procedures to verify interrater reliability and triangulation of data by comparing ratings to similar data questions across researchers and instruments.


- Findings: The qualitative analysis and regression modeling reinforced findings that student achievement gains were most strongly associated with evidence of applying teaching instructional strategies to:
    - support inquiry,
    - teacher knowledge gains in STEM content and pedagogy,
    - teachers integration of intervention into district/school curriculum, and
    - use of educational technologies to support classroom instruction.

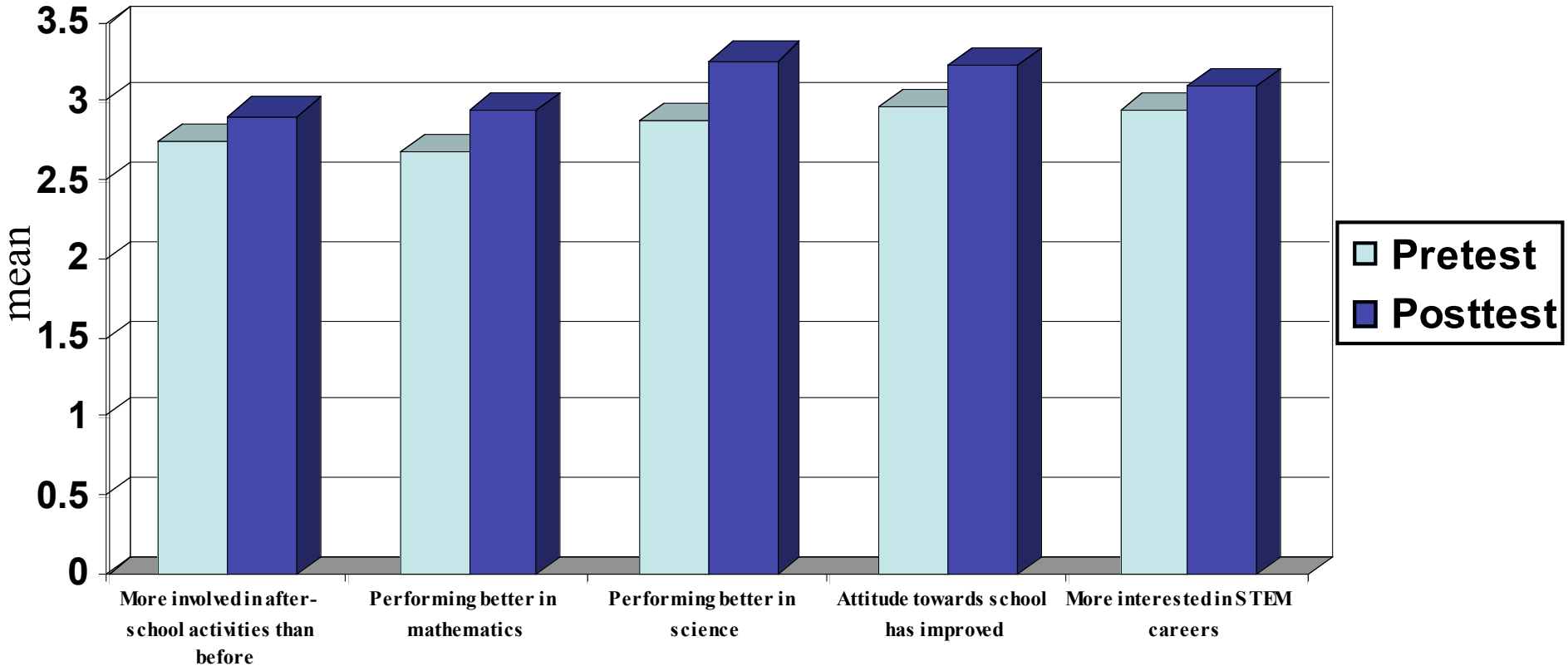

*indicates a significant difference between 2003 and 2004 cohorts with p<.05.


# Correlation of student exposure to NASA Material with other STEM-related variables

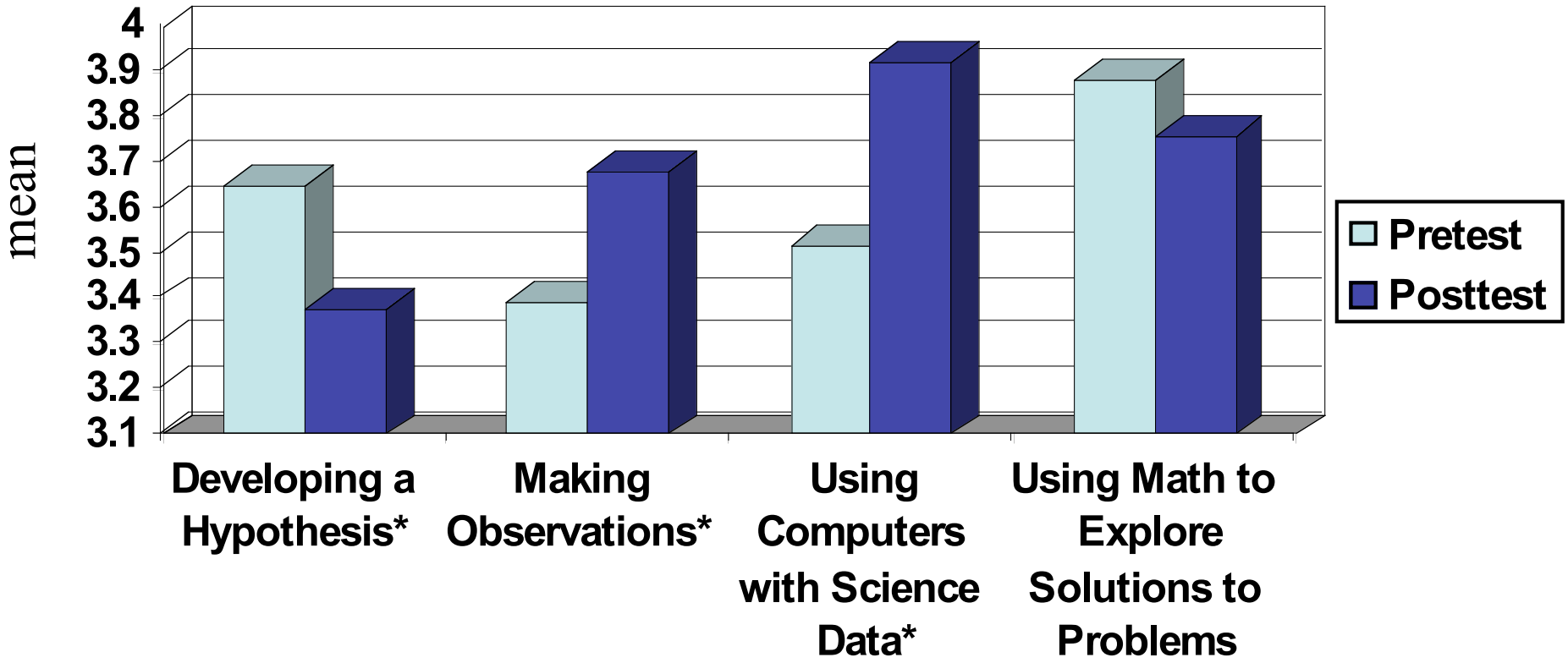
| |
|---|
| "How often do you or your teachers use NASA materials in geography?"<br><br>(.372**) How much I like math<br>(.409**) How much I like science<br>(.315*) How good I am at using computers with science data<br>(.312*) How good I am at using math to explore solutions to problems<br>(.646**) How often as an adult I think I will use science to interpret news stories (grades 7-9 only) |
| "How often do you or your teachers use NASA materials in science?"<br><br>(.369**) How much I like geography<br>(.481**) How much I like science<br>(.331*) How good I am at using computers with science data<br>(.406**) How good I am at presenting the results of an investigation or project to the class |
| "How often do you or your teachers use NASA materials in technology education?"<br><br>(.418**) How much I like geography<br>(.521**) How much I like science<br>(.426**) How much I know about technology education or engineering (grades 7-9 only)<br>(.334*) How good I am at using computers with science data<br>(.313*) How good I am at using math to explore solutions to problems<br>(.569**) How good I am at presenting the results of an investigation or project to the class |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).


***How do you think family participation in NASA activities has affected your students this year?***

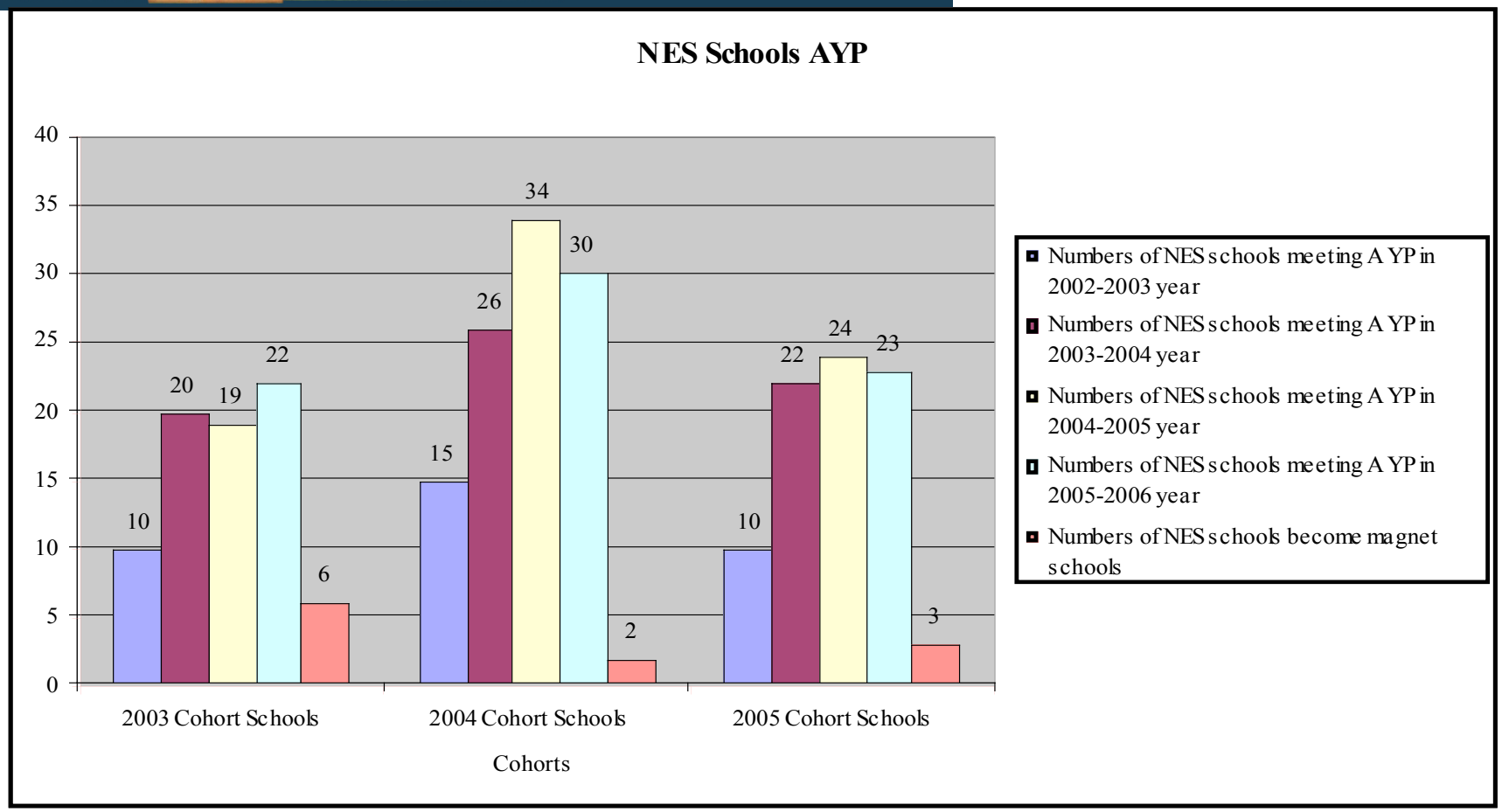



## How Good They Are at the Following STEM Related Activities




*indicates a significant difference between the pre and posttest.

*Note: The survey data is based on 580 matched 4-6th graders (representing 38 teachers)*


Schools meeting AYP before and after NES intervention


## Discussion:

- The field center implementation of the NES project was improved and made more coherent over the course of the three-year evaluation. Teachers indicated that they highly value how the NES workshops helped them grow personally and professionally.
- Schools that met NES expectations for implementation showed positive impact on teacher growth, integration of educational technology, family involvement, and student interest and achievement in STEM-related topics and careers.


- The case study analysis provides detailed school-based factors that either contribute to or impede successful implementation of NES as a comprehensive STEM-related intervention. The quantitative analysis from survey data supported and in some cases further defined the trends identified in the cross-case analysis.


# Areas to be further refined and expanded:

- Involve students in the process of generating and evaluating scientific evidence.
- Help teachers be able to model scientific reasoning for students.
- Help teachers know how to recognize and change common student misconceptions.
- Help teachers improve their pedagogical understanding of content so that they can document the impact of specific teaching strategies on student learning.
- Help teachers work as a team to plan, review, and connect NES implementation to specific standards for student achievement.
- Prepare teachers so that they can integrate student use of technology within STEM content instruction.
- Support student participation in the scientific inquiry process.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