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Recommended Citation
Marshall, Jeff C. and Alston, Daniel M., "Inquiry in Motion: Increasing the Science Achievement of All Students by Improving Teacher Inquiry-based Instruction" (2015). *Health, Education and Human Development Awards*. 17.
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# Inquiry in Motion: Increasing the Science Achievement of All Students by Improving Teacher Inquiry-based Instruction


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INQUIRY IN MOTION
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## Abstract


Student performance in science classrooms has continued to falter throughout the United States. Even though proficiency rates on national tests such as National Assessment of Educational Progress are higher for Caucasian students than African Americans and Hispanics, all groups lack achieving desired proficiency rates. Therefore, much work is needed in our classrooms to achieve the new more rigorous performance expectations found in the Next Generation Science Standards (NGSS). This five year professional development study sought to link the involvement of teachers in a sustained intervention, designed to improve the quantity and quality of guided inquiry-based instruction in middle school science classrooms, to student academic growth. Specifically we wanted to see if we could link higher quality inquiry-based instruction with the narrowing of the achievement gap between student groups. Findings show statistically significant gains for all student groups (aggregate, males, females, Caucasians, African Americans, and Hispanics) on all three science MAP tests (composite, science practices, science concepts) when compared to students of non-participating teachers.


## Introduction

According to several indicators, American students have continued to perform abysmally in science education (Lauko, Grigg, & Brockway, 2006; Martin, Mullis, Foy, & Stanco, 2012; U.S. DoEd, Institute of Education Sciences, & National Center for Education Statistics, 2011). Additionally, large achievement gaps continue to persist ( Lauko et al., 2006; US DoEd et al., 2011). Within the current condition of languishing performance, a new benchmark for learning, NGSS, has been introduced that effectively raises the performance expectations for what all students in K-12 science classes should know and be able to do (Achieve, 2013; National Research Council, 2012). For decades, inquiry-based instruction has been encouraged as a teaching strategy that provides a vehicle by which teachers can engage their students in experiences that go beyond low-level thinking (Marshall, 2013). Despite knowing this, it is evident that effective inquiry-based instruction is far from the norm in most classrooms (Marshall, Horton, Igo, & Switzer, 2009).

## Purpose

Our research builds from the need to improve student achievement for all groups of learners in science classrooms. The professional development that this research focuses on sought to transform teacher practice relative to inquiry-based instruction with the expectation that student achievement would increase for all groups of students. Specifically this study addresses three research questions:

- RQ1: Do student proficiency levels increase for those engaged in effective inquiry-based instruction?
- RQ2: Do classrooms that utilize inquiry-based instruction demonstrate a narrowing of the achievement gap for minority students?
- RQ3: Do proficiency rates for both males and females increase in classrooms where teachers utilize inquiry-based instruction?

## Results

Figure 1. Percentage Scoring Proficient on MAP vs. Intervention Year of Students' Teachers

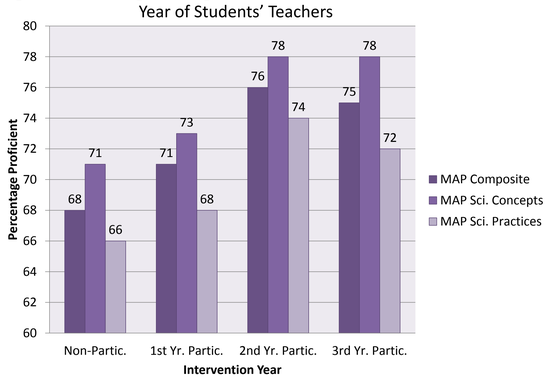
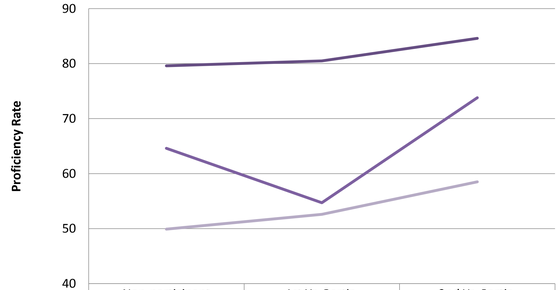



Figure 2. Percentage Scoring Proficient on MAP vs. Intervention Year of Teachers




| | Non-participant | 1st Yr. Partic. | 2nd Yr. Partic. |
|---|---|---|---|
| Caucasian | 79.6 | 80.5 | 84.6 |
| Hispanic | 64.6 | 54.7 | 73.8 |
| Afr. Amer. | 49.9 | 52.6 | 58.5 |

## Discussion and Implications

When comparing proficiency rates of students of non-participating teachers with students of second year participants, all groups (collective, male, female, Caucasian, African American, and Hispanic) showed significant growth (See Fig. 1 & 2).

Increases were noted for all groups on all three MAP tests (Science Composite, Science Practices, and Science Concepts)—see Figure 1.

The achievement gap was narrowed, but perhaps the greatest accomplishment is that all groups: male, female, Caucasian, African American, and Hispanics grew significantly.

Inquiry-based instruction can effectively increase student learning in both the Science Practices (e.g., interpreting graphs, analyzing data) and the Science Concepts (e.g., understanding concepts such as energy or genetics).

Therefore inquiry-based instruction provides a solid means to achieve the performance expectations set forth by NGSS (Achieve, 2013; National Research Council, 2012) and other state standards that emphasize having students model complex ideas, plan scientific investigations to test ideas, communicate and justify ideas, and think critically and deeply about concepts.


This material is based upon the work supported by the National Science Foundation under Grant #DRL-0952160.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.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## Methods

### Context

#### SUMMER

**Two Week Workshop**
- Engaged in modeled inquiry lessons
- Discussed inquiry lessons
- Collaboratively planned inquiry lessons

#### ACADEMIC YEAR

**Observations**
- Four Observations and Debriefs (1 per nine weeks)
- Co-teaching and co-planning lessons with PD facilitators

**Follow-up Meetings**
- Four Meetings (2 in the fall and spring)
- Teachers: Discussed and problem solved inquiry issues, engaged in modeled inquiry lessons, cooperatively worked on planning inquiry lessons

### Participants

#### TEACHERS

Year 1 involvement focused primarily on improving individual instructional practice. Year 2 and 3 participants continued to focus on improving individual practice but were also expected to design and implement a school/district initiative to further improve inquiry-based instruction in their setting.

**Breakdown of Schools and Teachers Included in the Study**

| | Total | [a]Non-Participant | 1st Year Participant | 2nd Year Participant | 3rd Year Participant |
|---|---|---|---|---|---|
| Schools | 11 | 7 | 11 | 8 | 6 |
| Teachers | 74 | 32 | 47 | 19 | 11 |

Note. 2nd and 3rd years are included in the count of 1st years, therefore the total reflects the actual numbers of teachers and schools and not their times involved in the PD.
[a] Non-participants = Year 0

#### STUDENTS

**Student Demographics**

| N=9981 | Male | Female | Caucasian | African-American | Hispanic | Other or Unknown |
|---|---|---|---|---|---|---|
| Percentage | 50.3 | 49.7 | 49.7 | 30.4 | 7.4 | 12.4 |

### Data Collection & Analysis

**Measure of Academic Progress (MAP) Science Test**

Science Processes + Science Practices → Science Composite

**Fall MAP Scores**

ANOVA
- Start scores to determine if significant differences between intervention years

**Spring MAP Scores**

ANOVA
- Determine if percentage of students earning a proficient score is a function of intervention year
- Differences between ethnicity group scores
  T-test
- See if any ethnicity groups were able to narrow the achievement gap based on intervention year