The Keys to Success in K-6 NGSS Implementation III: Learning through Scientific and Engineering Practices

A California State University, WestEd, and CSU East Bay Collaboration

March 13, 2015
Welcome and Housekeeping

- **Quick Write:**

  Type messages into chat area

- **2 Types of Polls:**
  - Quick Poll
  - Multiple Choice Poll

- **Break** for responding to chat questions/comments

- Those on just the teleconference can **email questions** to: eventhelp@wested.org.
Getting to Share with Each Other
Please type into the chat your name, role, location, and what you are most interested in learning and contributing on today’s webinar.

from Gabriela Rodriguez to All Participants
Hello! I’m a curriculum specialist at San Ejemplo Unified in Alta Luna, CA. I’d like to find out more about ____________________.

Type your comments here and press “send”.

What is your role?

Please check which role best describes you:

- Teacher/School Site Coach
- School Site Administrator
- District Administrator
- County Office or Support Provider
- Technical Assistance Provider
- Postsecondary Faculty
- Researcher/Policy Analyst
- Other (type in chat area or send to eventhelp@wested.org)
Introductions

- Joan Bissell
  - Director, Teacher Education & Public School Programs, California State University Chancellor’s Office
Today’s Presenters

- **Jeff Seitz**
  - Professor and Chair, Department of Earth and Environmental Sciences, California State University, East Bay

- **Carl Kloock**
  - Associate Professor of Biology, Faculty Expert in Science Education (Biology), California State University, Bakersfield

- **Maria Grant**
  - Associate Professor of Education, Faculty Expert in Formal and Informal Science Education California State University, Fullerton
Today’s Reflectors

• Carolyn Nelson
  - Dean, College of Education and Allied Studies, California State University, East Bay

• Danika LeDuc
  - Associate Director, Institute of STEM Education and Associate Professor, Department of Chemistry & Biochemistry, California State University, East Bay
Agenda

1. Overview (5 min.)
2. SEP's in Pre-service and In-service Teacher Programs (15 min.)
3. Next Generation Science Standards: Liberal Studies at CSU Bakersfield (15 min.)
4. NGSS at California State University Fullerton (15 min.)
5. Discussion/Reflection (3 min.)
6. Wrap-up (2 min.)

Each section followed by Reflection & Discussion (5 min.)
Exemplars of Learning through Scientific and Engineering Practices: Overview

- The NGSS: eight scientific and engineering practices
- Asking questions (in science) and defining problems (in engineering)
- Modeling, investigating, analyzing data, thinking mathematically
- Constructing explanations (science), designing solutions (engineering)
- Arguing from evidence, evaluating and communicating information
- Key to success: teaching of the practices by students engaging in them
Section 1

SEP's in Pre-service and In-service Teacher Programs

Jeffery Seitz
Integrated Middle School Science Partnership

• $11.96 million research and implementation project funded by the National Science Foundation’s Math Science Partnership.

• Studying the effectiveness of a middle school science professional development model

• We’re in the 5th year of a 5-year grant.

www.sciencepartnership.org
Integrated Middle School Science Partnership

8 School Districts in the San Francisco Bay Area
- 33 middle schools
- 45 Science Teacher Leaders
- 81 K-12 site and district administrators
- 230 middle school science teachers

California State University East Bay

Alameda County Office of Education

Other Partners
- Exploratorium
- California Science Project

www.sciencepartnership.org
Five Strands of IMSS Professional Development

**District Based PD**
Provides professional learning related to NGSS and CCSS. Provides the structure to build collaboration among teachers. Is connected to other school initiatives. Teacher leadership emerges.

**Intensive PD**
Teacher Leaders continue to deepen their content knowledge and instructional leadership skills. Engage in extended learning opportunities and productive collaborative communities.

**Lesson Study**
Teachers collaborate in lesson study teams to gain insight into their practice and their students sense making. Through and iterative process these teams plan, research, teach, reflect and revise and reteach a lesson.

**Teacher Leadership**
Teacher Leaders take on leadership roles with the support of IMSS coaches. Opportunities include: lesson study facilitation training, professional development training, curriculum design, instructional coaching

**Leadership Institute**
District leadership teams (teacher leaders, coaches, and administrators) meet quarterly to plan how to support science teaching and learning, how to implement reform measures, and align resources.
Instructional Cases

• Series of lessons focused on a key science concept

• Integrate the NGSS and CCSS

• Integrate SEP’s and writing into curriculum, instruction, and assessment

• Includes lesson plans, activities, samples of student work, and assessments
Instructional Cases

• Collaboratively developed by middle school science teachers, CSUEB science faculty, and instructional experts from ACOE

• Piloted by middle school teachers and have a research lesson that is revised through a Lesson Study process

If you are doing lesson study, click the green check button, and feel free to share your experiences in the chat.
Lava Viscosity Classroom Activity

Example of type of modeling activity common in Middle School Earth Science.

Earth Science modeling has significant boundary conditions. Teacher can guide students into developing the use of SEP’s:

- Developing and using models
- Planning and carrying out investigations
Earth Moon Scale Activity

Middle school students develop a model of the Earth and Moon using sports balls. This activity models the relative sizes of the Earth and Moon and their relative distance. First students are asked to develop a model without any data – exposes misconceptions about the structure of the solar system. Using numerical data, students are permitted to evaluate the accuracy of their model. Then students are able to revise their models.
District-based Foundational Level General Science (FLGS)

IMSS Partnership at CSUEB is offering district-based FLGS courses for cohorts of teachers from districts in the partnership.

- Lab course taught in a middle school science lab one evening a week after school.
- Lab course is co-facilitated by an IMSS middle school teacher leader – peer-teaching is an important opportunity to develop teacher leadership.
- Teacher leader is an important resource for science content in the context of middle school and integration of NGSS.
- Lab course activities based on IMSS Instructional Cases and other lessons developed through Lesson Study.

Are you familiar with the Foundational Level General Science initiative?
Modeling in Earth Science Education

Large scale in time and space of geologic processes is potential barrier to student learning and experimental classroom activities.

Instructional models often have important boundary conditions. Instructional models in Earth Science often focus on structure or morphology. NGSS requires us to focus on processes.
Synergistic Relationships

The relationship between pre-service teacher preparation and in-service teacher professional development becoming integrated.
Reflections

Participants, please share your own reflections, comments & questions about what resonates for you in your role (teacher, IHE faculty, staff development specialist, etc.)
Section 2

Next Generation Science Standards: Liberal Studies at CSU Bakersfield

Carl Kloock
Project Overview

• Goals:
  – Increase abilities of pre-service K-8 teachers in knowledge and practice of NGSS
  – Integrate and align content and practice

• 3 main components
  – EDTE 310 or 300(STEM): Early field experience in teaching
  – NEW: Summer BLAST science camp experience
  – SCI 325A: Integrated Science from a life science perspective

• Capstone science course in Liberal Studies
EDTE 310/300 (STEM): Early field experience

• Change of venue and verb
  – From in-school school observation to After school science teaching.
Summer BLAST science camp

- Select candidates teach a 3 week science camp focused on rocketry.
  - Recruited from:
    - EDTE 310/300 & SCI 325A (K-8)
    - Natural Science majors (8-12)
    - Math Science Teacher Initiative
    - Noyce Scholars and Fellows
  - Experienced classroom teachers as mentors.
Content: SCI 325A Integrated Science

• 2013:
  – Adjusted course content to align with NGSS
  – Included small-scale introduction of Engineering principles
  – Added module on Academic Literacy
  – Modified existing Science Lesson Plan assignment
Content: SCI 325A Integrated Science

• 2014
  – Added lecture on Lesson Plan as engineering.
  • & further modified lesson plan assignment
Why Lesson planning as Engineering?

- Addresses existing curricular weakness in engineering
- Puts core engineering concepts in a relevant context
- Follows Common Core/NGSS focus on application.

Diagram Stolen from BLAST Camp

Do you treat lesson plans for science as a distinct topic (i.e., different from lesson plans in other subjects), and if so, do you cover them in teacher education or in content courses for teachers?
The Activity:
“Teachers as Educational Engineers”

1. **ASK**
   - What are the Problems?
   - What are the Constraints?

2. **IMAGINE**
   - Brainstorm Ideas
   - Choose the Best One

3. **PLAN**
   - Draw a Diagram
   - Gather Needed Materials

4. **CREATE**
   - Follow the Plan
   - Test It Out!

5. **IMPROVE**
   - Discuss What Can Work Better
   - Repeat Steps 1-5 to Make Changes

Propose solutions to problems

Rewrite lesson plan based on peer comments

Write New lesson Plan

Peer Review

The Engineering Design Process
Assignment overview

• Analysis
  – Explain lesson’s relationship to specific Performance Expectations, All practices and Crosscutting concepts.

• Critique
  – Identify flaws and suggest improvements

• Academic Language; add vocabulary element

• Questioning for Science Comprehension
In-Class (lab) Peer review

• Each student reads and responds to 3 assignments from other students
  – Evaluate & Offer suggestions for improvement
  – Peer review guide-sheet.
• Revise based on feedback
  – Improves focus on lesson design
## Outcomes: Knowledge survey

<table>
<thead>
<tr>
<th>NGSS Item tested</th>
<th>% Change</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3-5 ETS 1-1:</strong> “Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost”</td>
<td>23%</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td><strong>Practice 6:</strong> “Design solutions to problems using Scientific and Engineering reasoning”</td>
<td>23%</td>
<td>46%</td>
<td></td>
</tr>
<tr>
<td><strong>Practice 8:</strong> “Obtain, evaluate and communicate information in an engineering context”</td>
<td>43%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td><strong>HS-PS3-2:</strong> Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</td>
<td>34%</td>
<td>46%</td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{% change} = \frac{(\text{Post} - \text{Pre})}{\text{Pre}} \text{ significant (p<0.05) for all pre-post comparisons within year (x^2)} \]

Between year comparisons NS (x^2)
Problems and issues

• Too much new stuff in one assignment?
• Students focus on shallow “improvements”
  • Changing materials lists, learning goals etc.
• Time & politics. SCI 325A is a content-course, not pedagogy…
Revise & redesign…

- Small group activity instead of individual?
- Use another lab period to allow hands-on exploration of activities?
  - Ideally, teach to age-appropriate audience but…
- Provide example of desired product.
Reflections

Participants, please share your own reflections, comments & questions about what resonates for you in your role (teacher, IHE faculty, staff development specialist, etc.)
Section 3

NGSS at California State University Fullerton

Maria Grant
NGSS at California State University Fullerton

- Informal Science Internships
- Informal Science Institution Conference
- Online Science Methods Course
How do you envision supporting real world learning connected to the NGSS?
INFORMAL SCIENCE INTERNSHIPS
Criteria and Expectations for Participation

- Application process
- 90 hours on site work
- Participation in online community activities
- 5-7 lesson plans based on internship experience
- Research-style poster for display at the CSUF PRISE Poster Session
Updating Handbooks at The Discovery Cube

Introduction

The Discovery Cube Orange County (formerly known as the Discovery Science Center) is an interactive children’s science museum located in Santa Ana, California. Various hands-on exhibits throughout the museum facilitate unintentional learning through natural inquiry and curious exploration. Table top demonstrations are hands-on activities where volunteers interacted with guests to teach specific content. My internship project involved rewriting volunteer handbooks to better meet the new science standards.

Abstract

A table top demonstration introduces a specific science concept by having volunteers interact with visitors to speak about and showcase examples. In order to be able to update the handbooks, I first had to familiarize myself with the tutorial and the way the actual demonstration worked. At the start of my internship, I interacted with visitors who visited my table top demonstration. I was able to identify weaknesses and strengths in order to improve the current handbook.

In the second phase of the project, I began to preseed and revise the existing handbooks. Points of focus were ensuring that all demonstrations included (1) an introduction (2) materials list (3) step-by-step procedures (4) guiding questions and (5) appropriate standard. Overall, the revised handbook contains a more standardized format for all tutorials.

Conclusion

The opportunity to work on this project at the Discovery Cube Orange County afforded me the ability to realize firsthand the importance of using manipulatives to teach abstract principles to young children. Manipulatives, when used correctly, bring life into a topic that may be abstract and incomprehensible to young children and adolescents. It can serve as an effective scaffolding tool for in-class use.

As a science educator, I plan to use manipulatives whenever possible within my lessons. It is more engaging and effective in creating meaningful connections for students. This is accurate at all stages of development.

Acknowledgements

I’d like to thank both the Education Manager, Laura Schmidt, and the Volunteer Services Leader, Juna Almon and Rosa Lee for the opportunity to collaborate with the Discovery Cube Orange County. Laura Schmidt was necessary in elucidating the requirements of table top demonstrations. Juna Almon and Rosa Lee were more than resourceful in providing guidance and feedback during my reconstruction of the demonstration handbook.

Contact Information

Jessica Lg
E-mail: jlg@lasdournam.edu
Analysis of the Effectiveness of Science Professional Development Program for Multiple Subject Teachers

Jennifer K. Wong
Advisors: Janet Yamaguchi and Laura Schimidt
Discovery Cube Orange County

INTRODUCTION
Young children have a natural inclination to explore and discover the world around them. Thus, the early years of a child's education are a crucial time to cultivate and nurture scientific inquiry. Although that responsibility falls on elementary school teachers, many of these teachers feel they have the adequate tools to teach science.

The Discovery Cube of Orange County has designed a professional development program to target this very issue. In their program, specialized science educators construct a series of lesson plans based on Next Generation Science Standards, go to elementary schools in low-socioeconomic areas with a high demographic of English Language Learners, and teach multiple subject teachers how to use and implement an inquiry-based, hands-on science lesson.

My objective was to assess the effectiveness of this program, using teacher administered pre- and post-testing. My analysis of test results has demonstrated the effectiveness of this program in developing and nurturing scientific learning and growth.

RESULTS
Results were recorded for each of the categories of conceptual knowledge, vocabulary, and modeling skills. While a score of five indicates advanced proficiency, a score of one indicates the student has many misconceptions or did not attempt a response.

CONCLUSION
The frequency of black responses or “I don’t know” (I DK) responses were also separated recorded, to distinguish between situations in which responses held many errors in thought and situations in which students did not attempt the problem at all.

ACKNOWLEDGEMENTS
This work was completed at the Discovery Cube Orange County with the support of California State University, Fullerton through the PRISE Internship. Advisors Janet Yamaguchi and Laura Schimidt oversaw the completion of this work and provided input and guidance throughout the program analysis.

METHODS
Pre-Analysis
Elementary school teachers administered a pre-test prior to the specific DCOC lesson. After instruction, teachers re-administered the same test to their students.

Analysis
To evaluate the scientific growth of students involved, test questions were dissected into three categories of knowledge: conceptual, vocabulary, and modeling. For each question and category, a five-scale rubric was constructed and used to assess each response. Reports were drawn for each lesson plan and the program as a whole.

The frequency of scores for each category and each question were tallied for both tests. Microsoft Excel aided in the conversion of raw data into analytical data that compares the pre-testing and post-testing results in terms of percent change in conceptual knowledge, vocabulary, and modeling skills. Compiling these results together, I created a comprehensive report of overall growth by category.
The 4th Annual CSU-ISI Collaborative Symposium to Promote Science Education

Dr. Linda Abraham Silver

Informal Science Education Initiatives in Abu Dhabi
Fullerton Arboretum
ONLINE Science Methods

• What’s New?
  – Teaching and Learning Events Videos
  – Guiding Questions
  – Real Time Discussions
  – Videos of Students Teaching for Analysis
  – Engineering, Design, and Inquiry
  – Argumentation
Quickwrite

• How might you work with informal science institutions to support learning of the NGSS?
Working to Support NGSS Knowledge

- Across Colleges
- Across the Campus
- Meeting with the Council of Deans
Reflections

Participants, please share your own reflections, comments & questions about what resonates for you in your role (teacher, IHE faculty, staff development specialist, etc.)
Quickwrite

Now that you have learned a bit about learning through scientific and engineering practices, share in the chat how you think it would be a valuable resource for preparing new or future teachers for the NGSS?
Quickwrite: Final Reflection

What have you learned today that you are going to act upon in the next week?
Archived Webinars

The Keys to Success in K-6 NGSS Implementation: Well-Prepared Teachers, Excellent Programs
http://teachingcommons.cdl.edu/ngss/csu_projects/index.html

The Keys to Success in K-6 NGSS Implementation: Cross-cutting Concepts and CCSS Alignment in NGSS
http://teachingcommons.cdl.edu/ngss/index.html
Teaching Commons

http://teachingcommons.cdl.edu/ngss

http://teachingcommons.cdl.edu/ngss/csu_projects/index.html

A place to
- Locate resources
- Share your own resources

Contact Danika LeDuc: danika.leduc@csueastbay.edu
Thank You
Next Steps

- Survey Feedback
  https://www.surveymonkey.com/s/csu-ngss-k6_webinar3

- Webinar Archive & Resources
  http://teachingcommons.cdl.edu/ngss/index.html