

What's the Matter?

Under Represented Middle School Students Learning about States of Matter in Informal Science Summer Camp

Heather Bankowski

Advisor: Noah D. Finkelstein

REU August 2008

Department of Physics, University of Colorado, Boulder





Why Physics Education Research?



- Established sub-discipline of Physics:
 - Study conditions of student learning
 - Backed by APS, NSF, National Academies
 - Own journal lines (e.g. Physical Review)
 - Exists in many physics departments across US
- Traditionally focused on:
 - Student conceptual understanding
 - College level
- New Areas of Interest:
 - Beyond concepts (e.g. attitudes and beliefs)
 - Upper division / graduate
 - K-12



Why Informal Science Education?



- Reach under represented populations
- Extended relationship with children
- Complement school activities
 - Some ESL students sacrifice science
 - Work with students in their cultural context

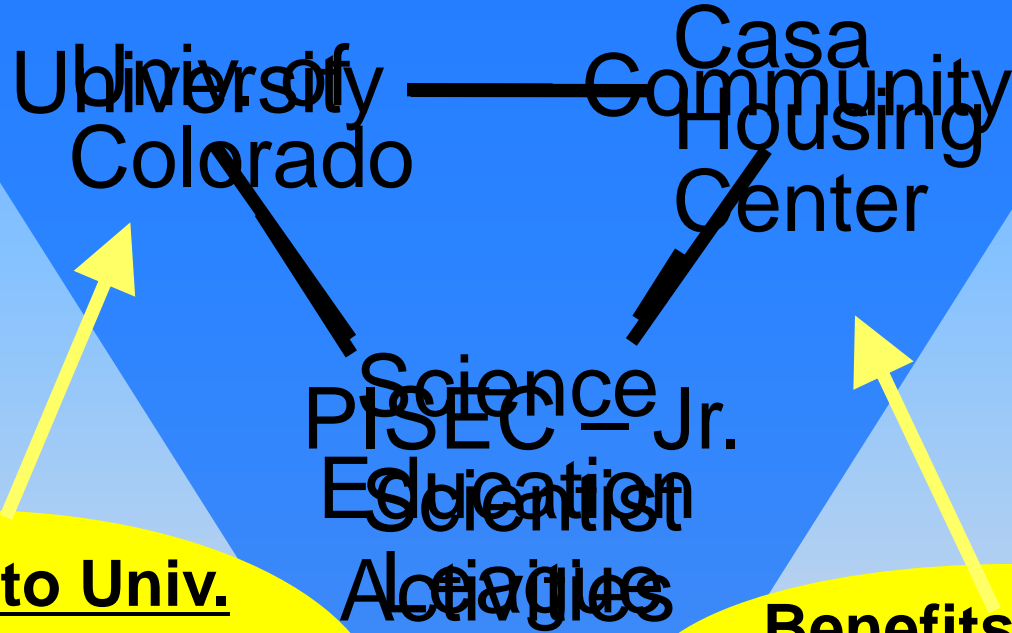


Summer Camp Demographics



- Casa de la Esperanza, Longmont, CO
- Subsidized Housing, Predominantly Hispanic
- 32 apartments
- 85 children and 70 adults
- Casa de la Esperanza Goals:
 - Promote post secondary education
 - Promote computer knowledge and skills
- 13 children, grades 5-8

Model



Benefits to Univ. of Colorado:

1. University mission of service
2. Educate grad/undergrad

Benefits to Casa:

1. Science and Education
2. Univ. resources

Camp Details



A screenshot of a video analysis software interface. The main window is titled "demo" and has menu options "new", "open", "save", and "export". The interface is split into two main viewing areas. The left area shows a video frame with a small LEGO structure (yellow base, green and blue blocks, red wheel) on a white surface. The right area shows a zoomed-in view of the same LEGO structure. Below the video frames is a control panel with a play button, a timeline showing "12/14 frames" and "00:01.10/00:01.40", and a frame rate of "10.0 fps". There are also buttons for "edit frame" and "analysis". At the bottom, there is a "Snap an image from the camera" button and a zoom slider.



Research Methods



- Methods
 - Pre/Post survey
 - Pre/Post SAM Movies
 - Lab notebooks
 - Video



Student Attitudes and



On the given scale, how would you rate the following statement?

1. I like to learn about the history of science and technology.

Strongly Dislike

2. The history of science and technology is an important part of our education.

Strongly Dislike

3. I would like to see more history of science and technology in our curriculum.

Strongly Dislike

Strongly Dislike

4. I would like to see more history of science and technology in our curriculum.

Strongly Dislike

Survey

1. I like

2. The

3. I w

ha

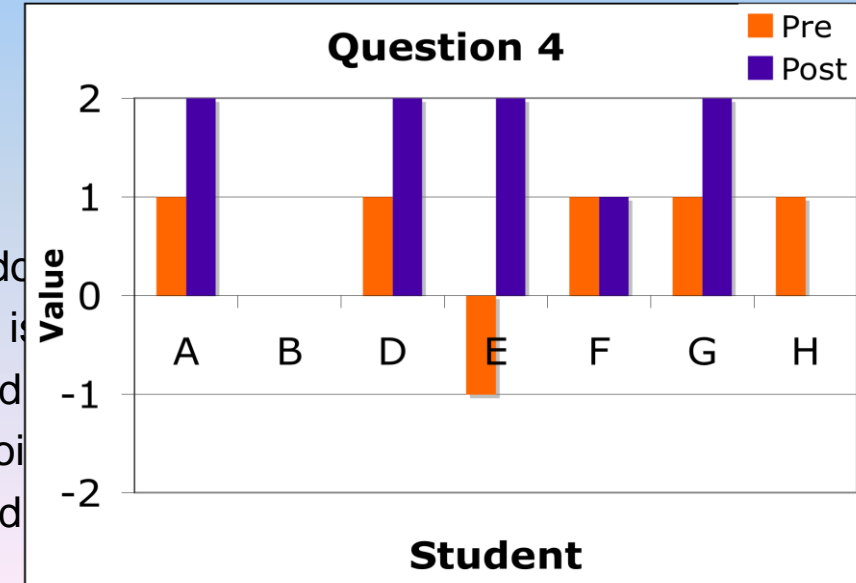
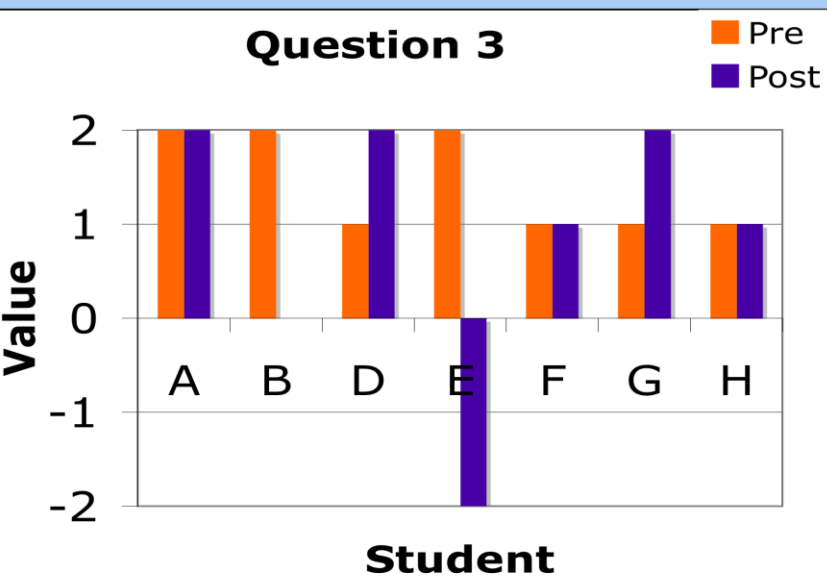
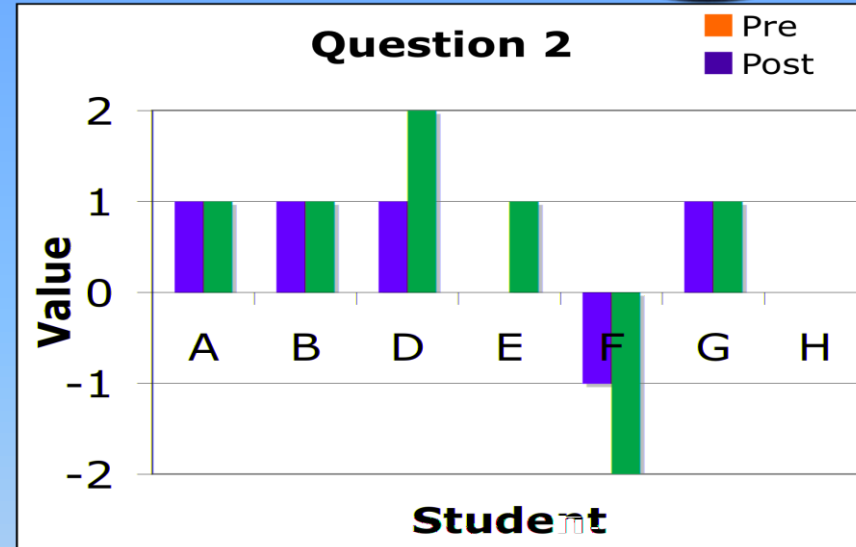
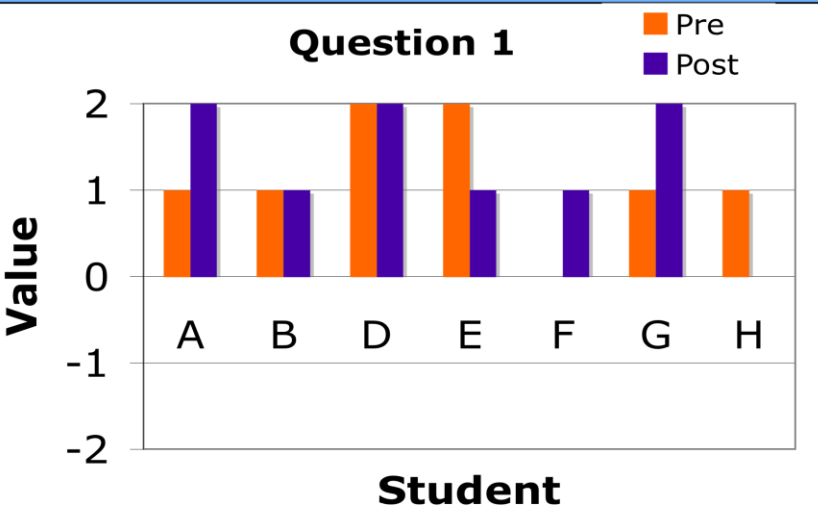
be

4. I w

my

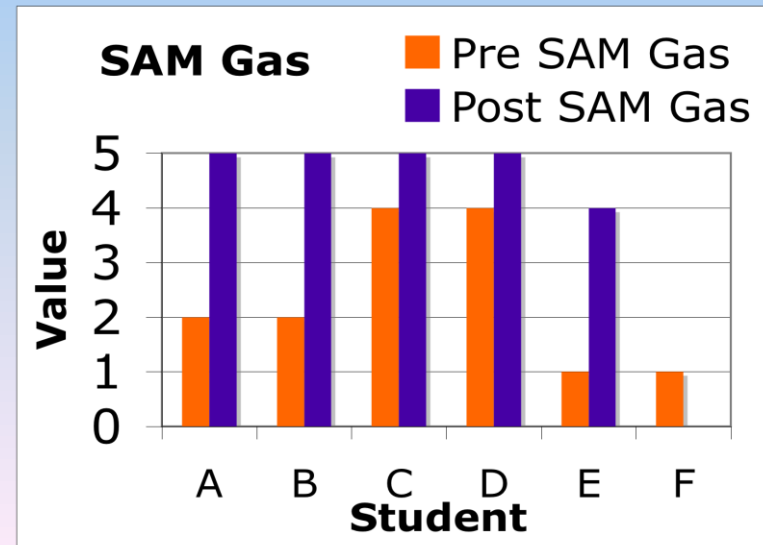
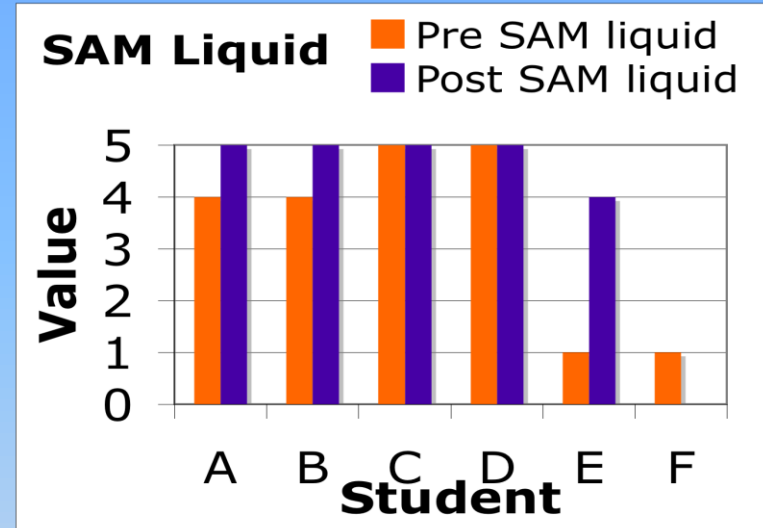
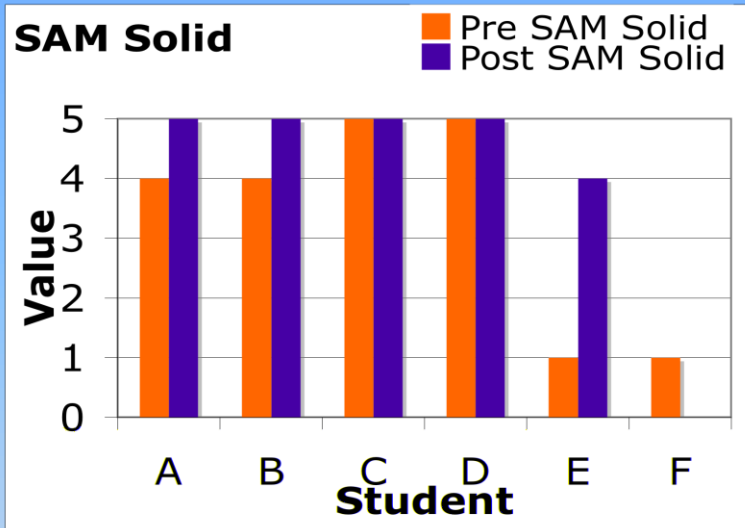
ng
by

h as



1. I like do
2. There is
3. I would
- by doi
4. I would

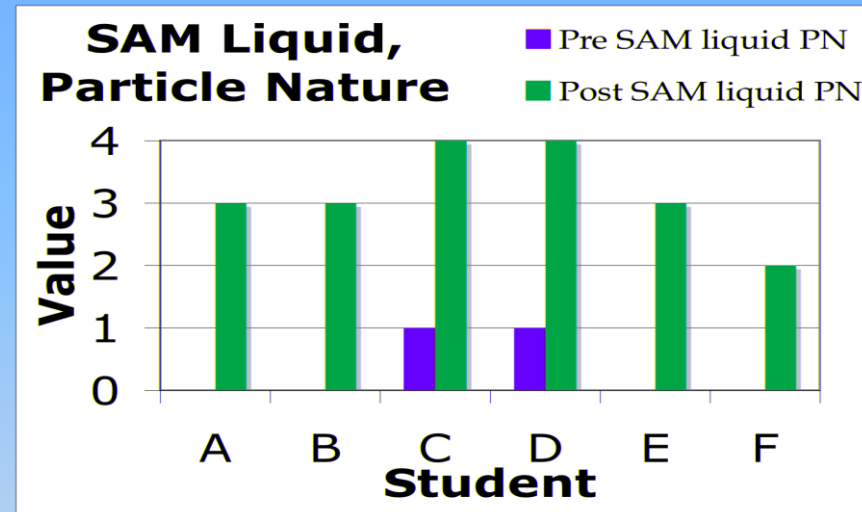
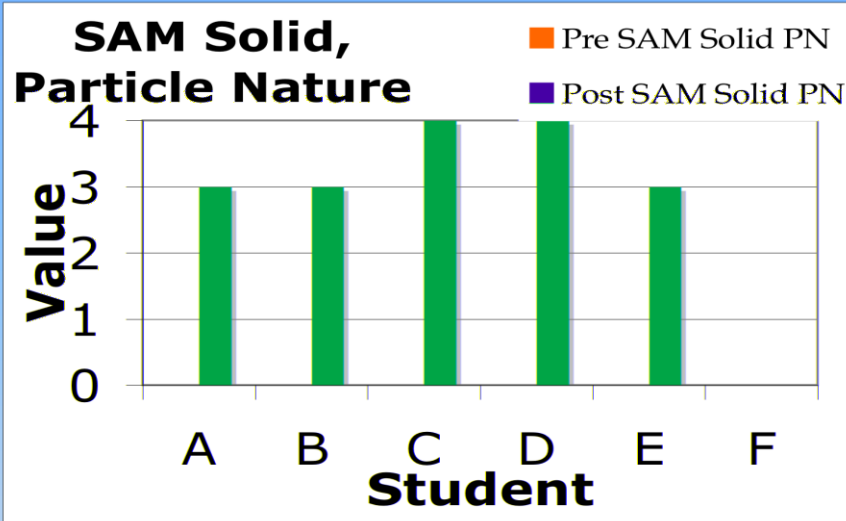
SAM Evaluation Solid, Liquid, Gas



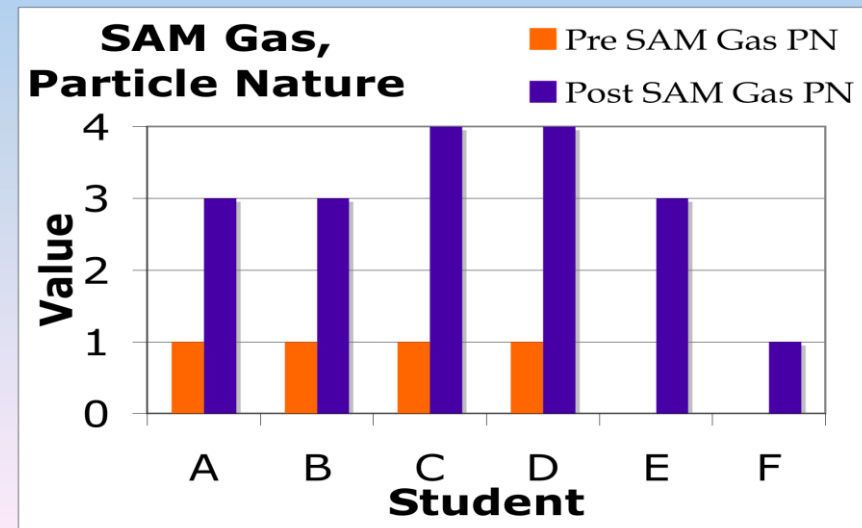
- 0 Don't know the difference between S/L/G
- 1 Identifies most S/L/G (80%)
- 2 Identifies all S/L/G
- 3 Can articulate how they know (80%)
- 4 Can articulate how they know (100%)
- 5 Able to defend how they identified



SAM Evaluation Particle Nature



Movies



- 0 No evidence of particle nature
- 1 Some evidence, not definitive
- 2 Evidence of particle nature, not clear on interaction/density
- 3 Clear on density, maybe not interaction
- 4 Clear in interaction



Conclusions



- **Observations**
 - Measuring gains in student performance is difficult
 - Engaging middle school students is difficult

- **Research Results**

- Survey:**

- Q1: (liking science) effectively no change
 - Q2/3: (nature of science) effectively no change
 - Q4: (career choice) 4/7 increased, 6/7 increased or same

- Solid, Liquid Gas: SAM**

- 4/6 could initially identify a solid and liquid, 1 learned how
 - 2/6 could initially identify a gas, 3 learned how

- Particle Nature: SAM**

- Solid: Pre: Almost no one, Post: 5/6 learned how
 - Liquid: Pre: Almost no one, Post: 6/6 learned how
 - Gas: Pre: Almost no one, Post: 6/6 improved



Acknowledgments:

- Univ. of Colorado Physics Education Research
- Ms. Jessica Bartley, CU Physics Undergrad
- Dr. Laurel Mayhew: JILA NSF Physics Frontier Center
- Ms. Carlota Loya-Hernandez: Casa de la Esperanza