

Promoting students' interest in science: Inquiry-based instruction and an authentic investigation

Maya R. Patel, Daniel K. Capps, Ayelet Baram-Tsabari,
Barbara A. Crawford

9th conference of the European Science
Education Research Association
Sept 5-10, 2011. Lyon, France



Rationale

- 70% US adults are scientifically illiterate (Miller 2008)
- High attrition, lower achievement, and limited diversity
- Waning interest in and motivation to learn science, beginning with adolescence

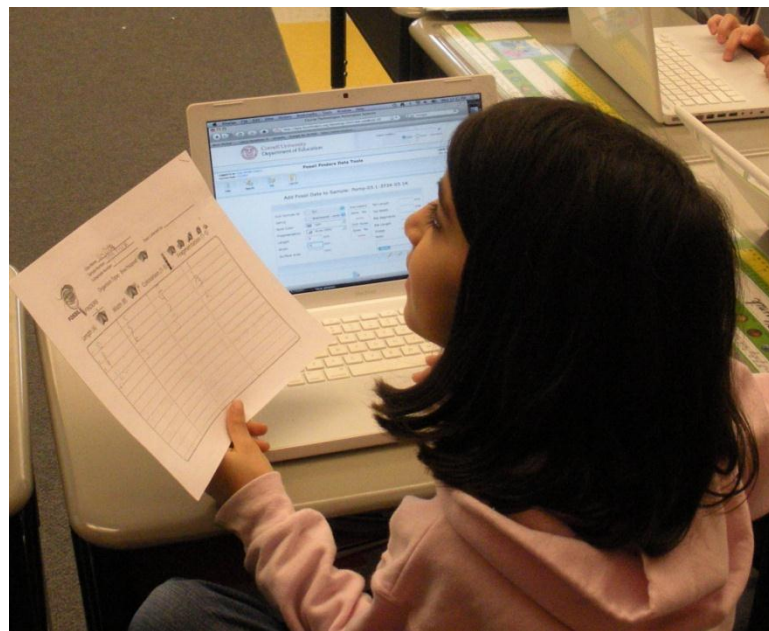
Rationale

- Interest is important to student learning (e.g. Hidi, 1990; Pintrich and Schunk, 2002)
 - Provide positive contacts with STEM at an early stage (OECD, 2008)
 - Engage students in stimulating, novel, and varied tasks that they find meaningful and interesting (Pintrich, 2003)
 - Provide ongoing, supportive teacher PD, especially for those with limited training in science and using hands-on activities (OECD, 2008)



Goals

- 1. Engender children's interest in learning more about science, including culturally and linguistically diverse groups.**
2. Create an authentic context to enhance children and teachers' understandings of the nature of science (NOS) and evolutionary concepts.
3. Develop educational materials that help teachers and children understand inquiry.



Question 1

Is there evidence that students who participated in Fossil Finders (FF) demonstrated increased interest in...?

- (a) Extracurricular science (continuing motivation)
- (b) School science in general (personal interest)
- (c) Aspects of school science related to FF (situational interest)



Definitions

- **Continuing motivation:** “the tendency to return to and continue working on tasks away from the instructional context in which they were initially confronted” (Maehr, 1976)
- **Personal interest:** “an individual’s relatively enduring disposition to be attracted to, to enjoy, or to like to be engaged in a particular activity or topic” (Pintrich, 2003)
- **Situational interest:** “being interested in a task or activity that is generated by the interestingness of the task or context” (Pintrich, 2003)

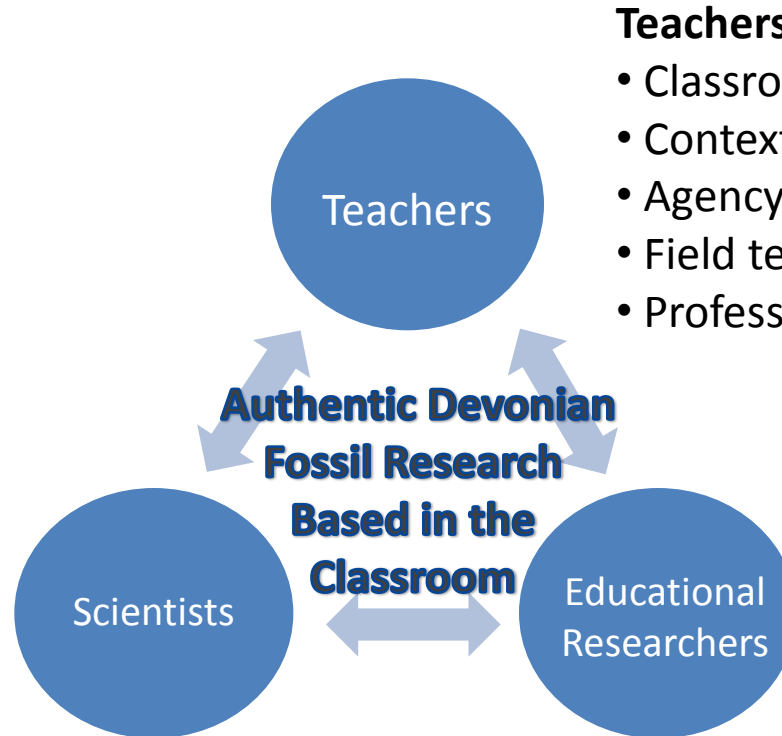
Question 2

What aspects of FF did students find most interesting?

- Authentic investigation
- Hands-on learning experience
- Collaboration/Discussion
- Independent thinking/ideas
- Communicating with scientists



What is Fossil Finders?



Teachers provide:

- Classroom experience
- Contextual knowledge
- Agency for change
- Field testing
- Professional feedback

Scientists provide:

- Research question
- Authentic research experiences
- Content knowledge and resources
- Support with science process skills

Educational Researchers provide:

- Inquiry-based teaching strategies
- Explicit NOS support
- Curriculum development
- Link between scientists and teachers
- Strategies for teaching ELL

What is Fossil Finders?

- Inquiry-based science teacher PD (grades 5-9)
- Week long summer-residential PD institute (2 summers)
 - Participants take on the role of the learner
 - Explicit instruction in inquiry-based approaches, nature of science, evolution and aspects of paleontology
 - Community of practice, on-going support from peers and experts



What is Fossil Finders?

- Paleontology and evolution curriculum and authentic investigation:
 - *How did sea life respond to changes in the environment during the Devonian Period in central New York State, US?*



What is Fossil Finders?

- Paleontology and evolution curriculum and authentic investigation:
 - *How did sea life respond to changes in the environment during the Devonian Period in central New York?*



Methods

- Mixed methods:
 - 1) Likert survey - 24 items addressing
 - Continuing motivation (Pascarella et al., 1981)
 - Personal Interest in school science (ROSE, 2004)
 - Situational Interest in aspects of school science related to FF
 - 2) Follow-up interviews with teacher-selected students (range of academic abilities, EL skills)

Methods

- Mixed methods:
 - 1) Likert survey - 24 items addressing
 - Continuing motivation (Pascarella et al., 1981)
 - Personal Interest in school science (ROSE, 2004)
 - Situational Interest in aspects of school science related to FF
 - 2) Follow-up interviews with teacher-selected students (range of academic abilities, EL skills)

Participants

- 7 Fossil Finders teachers = 468 students
- 5 Comparison teachers = 239 students



Sample Questions

- Continuing motivation (extracurricular science)

1. How interested are you in doing each of these activities on your own time (when not required for school?)

Please circle the answer that best describes how you feel.

- | | | | | |
|-------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------|--------------------|-----------------|
| a. Are you interested in reading about science or scientists (in newspapers, magazines, on the web, or in books)? | Not interested at all | Not really that interested | Sort of interested | Very interested |
|-------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------|--------------------|-----------------|

- Personal interest in school science:

2. How much do you agree with these statements about the science that you have at school? Please circle the answer that best describes how you feel.

- | | | | | |
|----------------------------------------------------------|-------------------|-------------------|----------------|----------------|
| a. School science is interesting | Strongly disagree | Somewhat disagree | Somewhat agree | Strongly agree |
| b. I like school science better than most other subjects | Strongly disagree | Somewhat disagree | Somewhat agree | Strongly agree |
| c. School science makes me curious about things | Strongly disagree | Somewhat disagree | Somewhat agree | Strongly agree |

Sample Questions

- Situational interest in aspects of FF

3. How interested are you in doing each of the following in your science class? Please circle the answer that best describes how you feel.

a. Learning about science by doing an investigation or experiment	Not interested at all	Not really that interested	Sort of interested	Very interested	I don't know because I haven't done this in class
d. Measuring and identifying samples (items) from nature	Not interested at all	Not really that interested	Sort of interested	Very interested	I don't know because I haven't done this in class
e. Working in groups with my classmates	Not interested at all	Not really that interested	Sort of interested	Very interested	I don't know because I haven't done this in class
f. Sharing my ideas about a science topic with other students	Not interested at all	Not really that interested	Sort of interested	Very interested	I don't know because I haven't done this in class
g. Collecting my own data in an investigation	Not interested at all	Not really that interested	Sort of interested	Very interested	I don't know because I haven't done this in class

Post-Survey

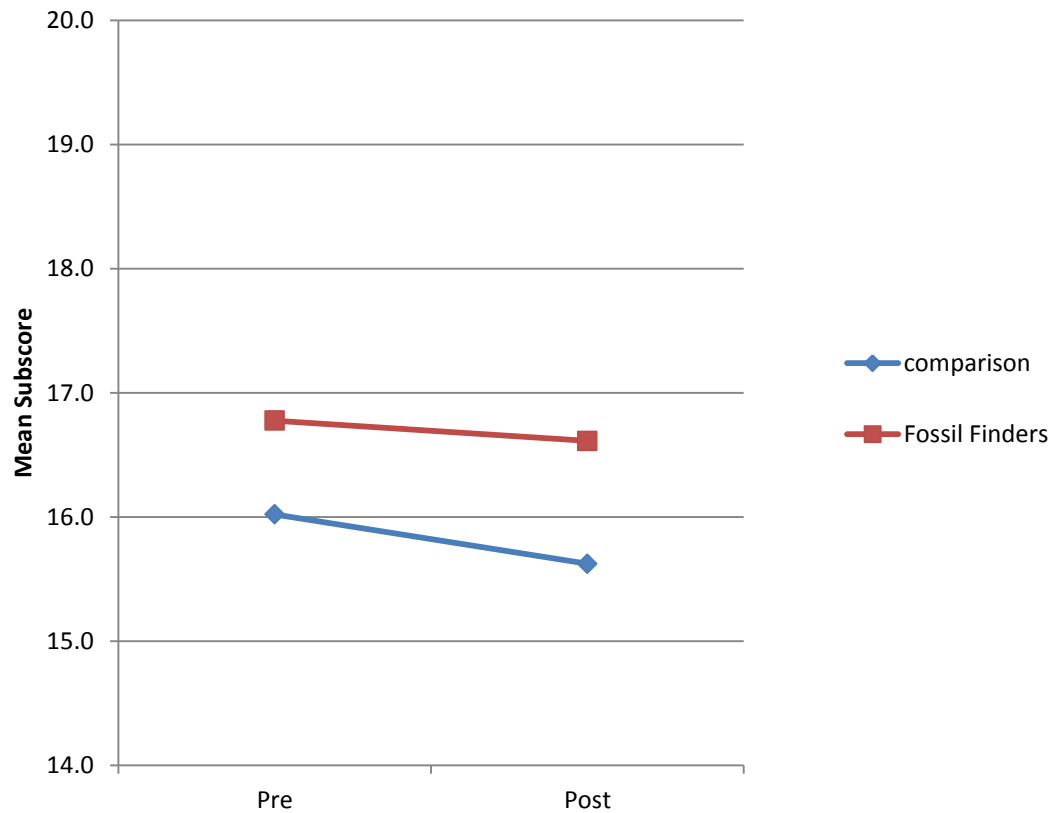
- Identical to the pre-survey
- + 2 open-ended questions:

7. What are three things you really liked about doing Fossil Finders?

8. What are three things you didn't like about doing Fossil Finders?

Q1-Findings

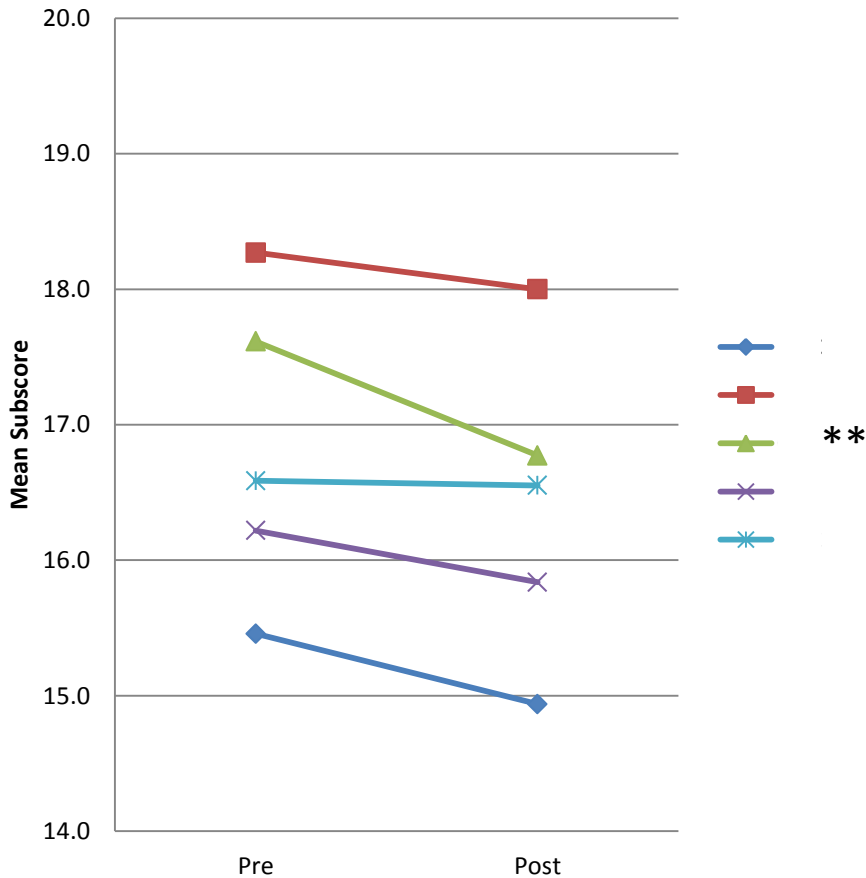
Increased interest in extracurricular science?



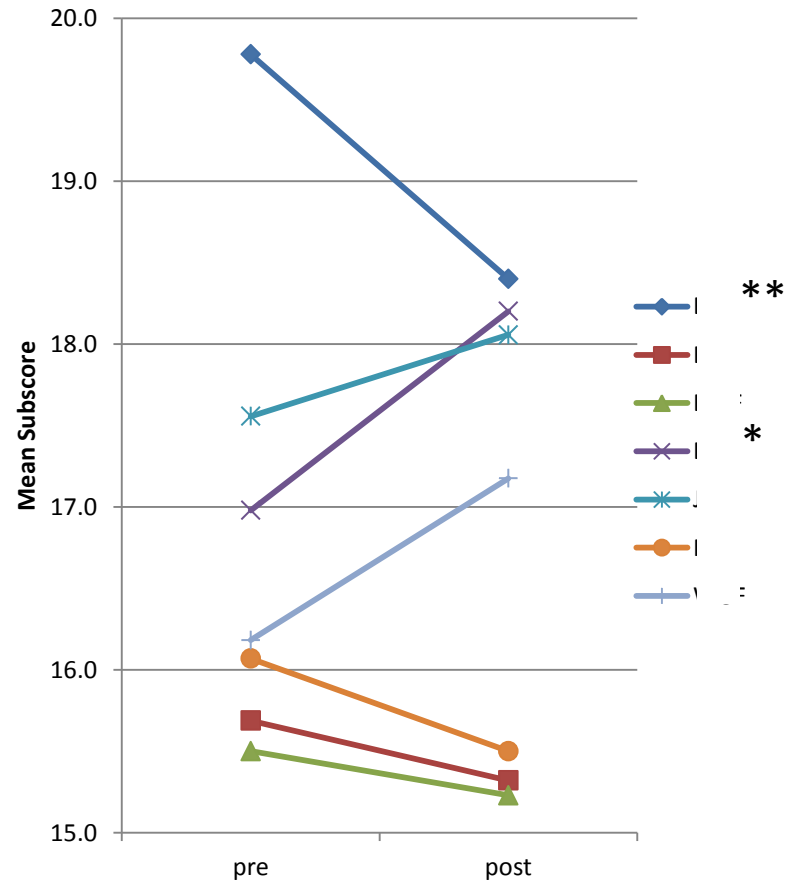
Q1-Findings

Increased interest in extracurricular science?

Comparison

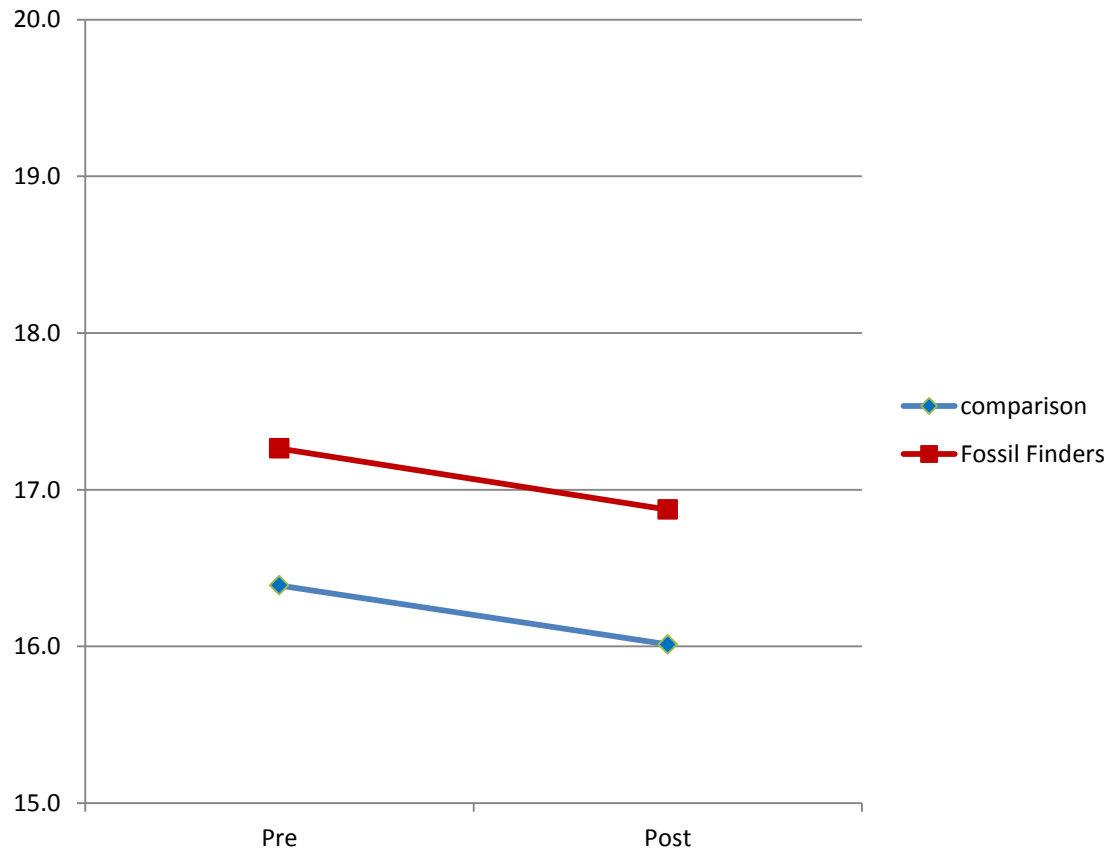


Fossil Finders



Q1-Findings

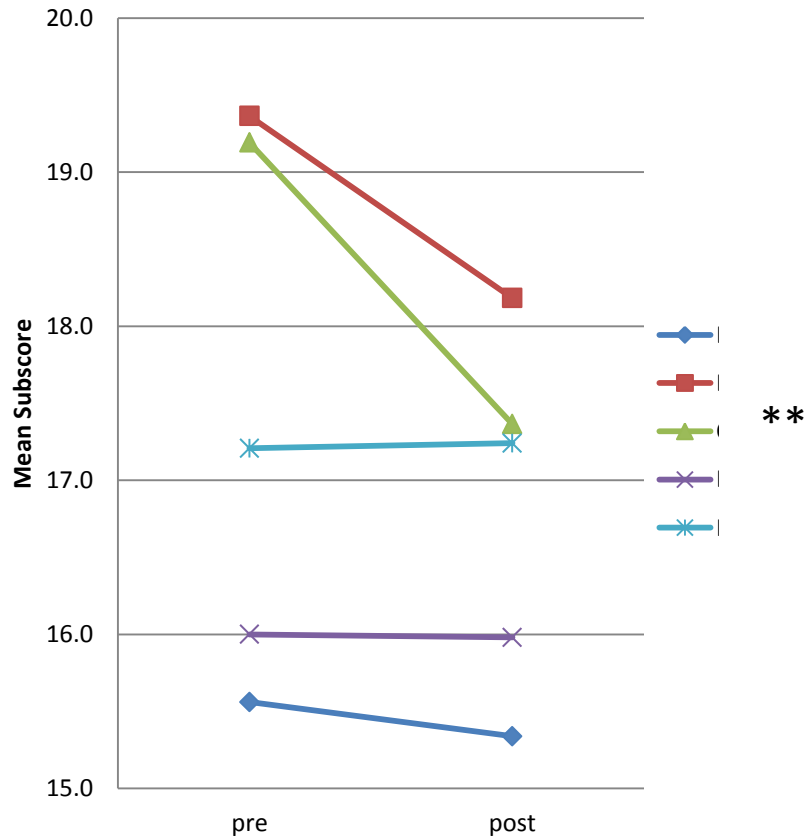
Increased interest in school science?



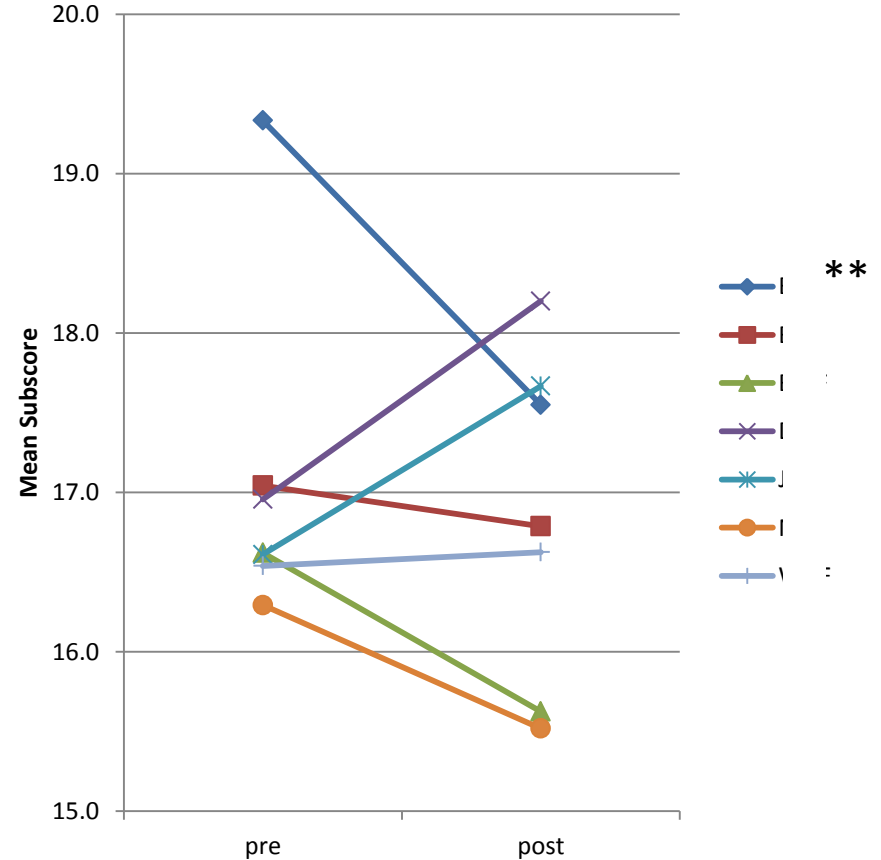
Q1-Findings

Increased interest in school science?

Comparison Teachers

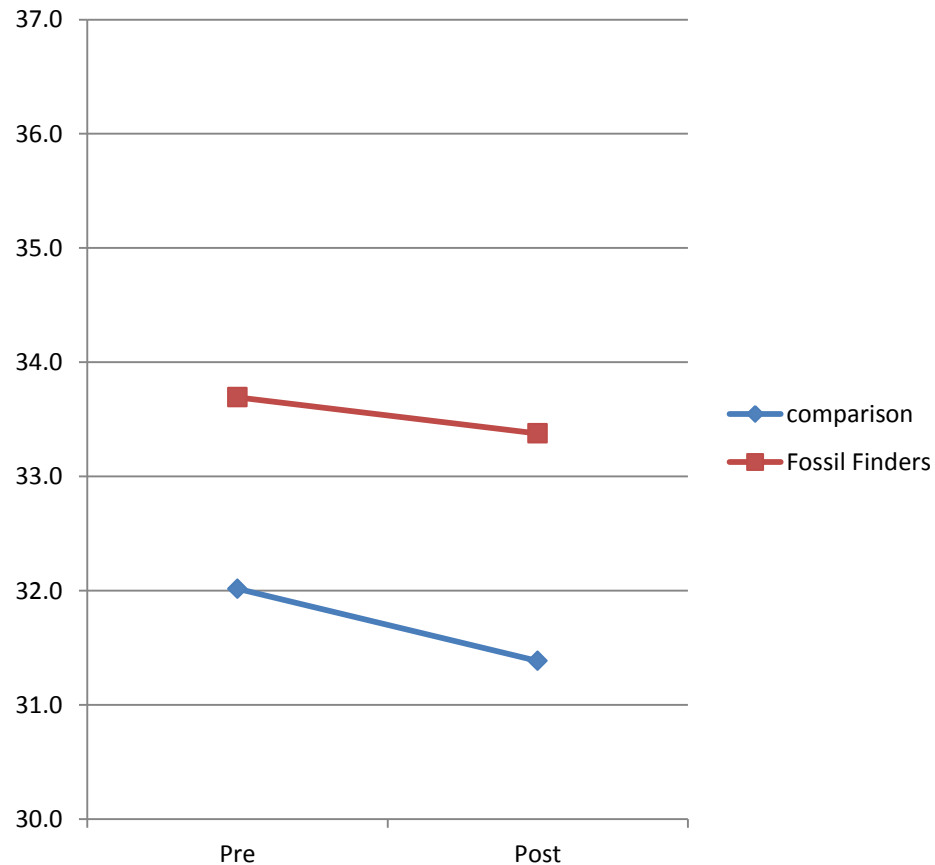


Fossil Finders



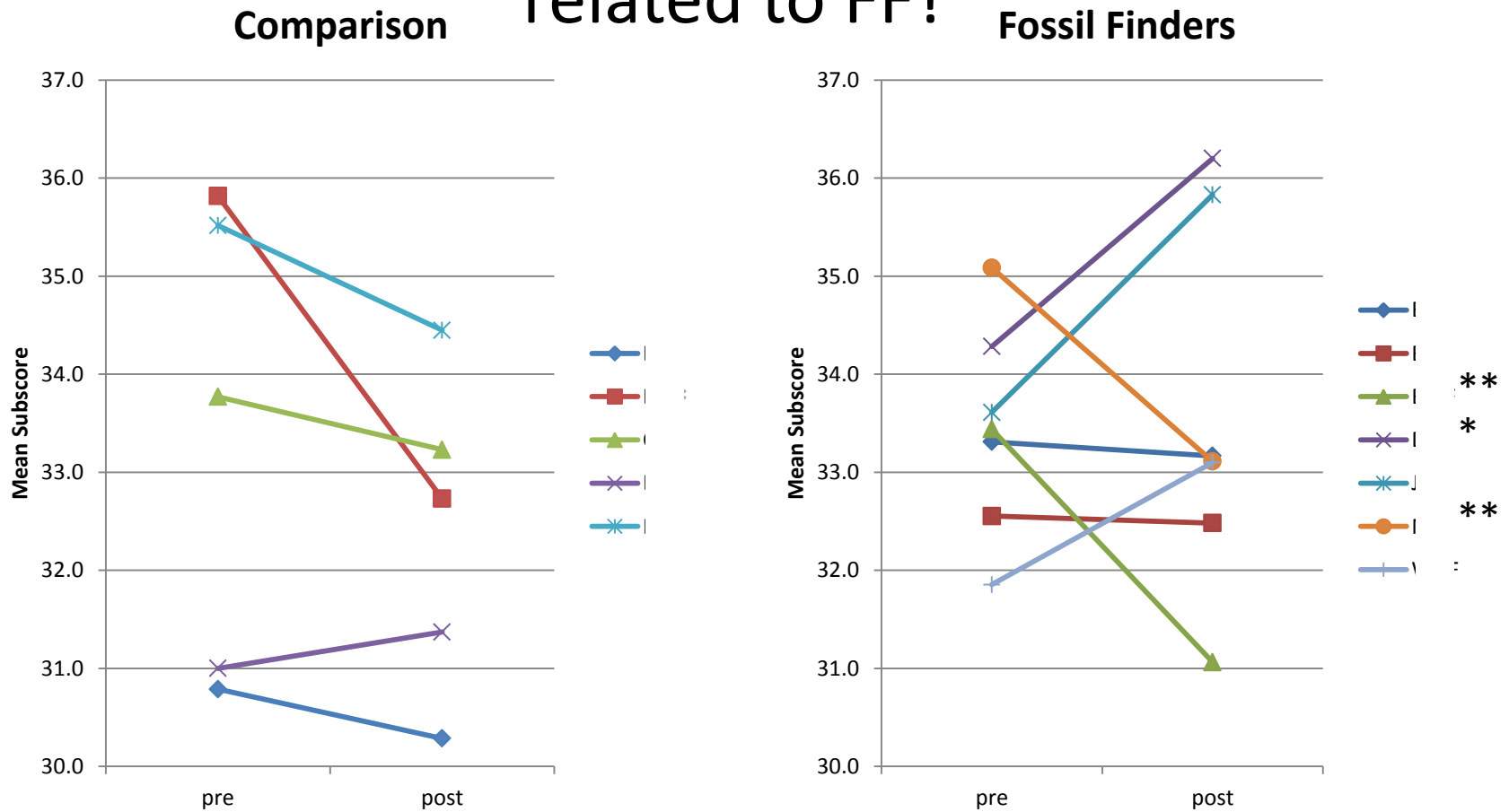
Q1-Findings

Increased interest in aspects of school science related to FF?



Q1-Findings

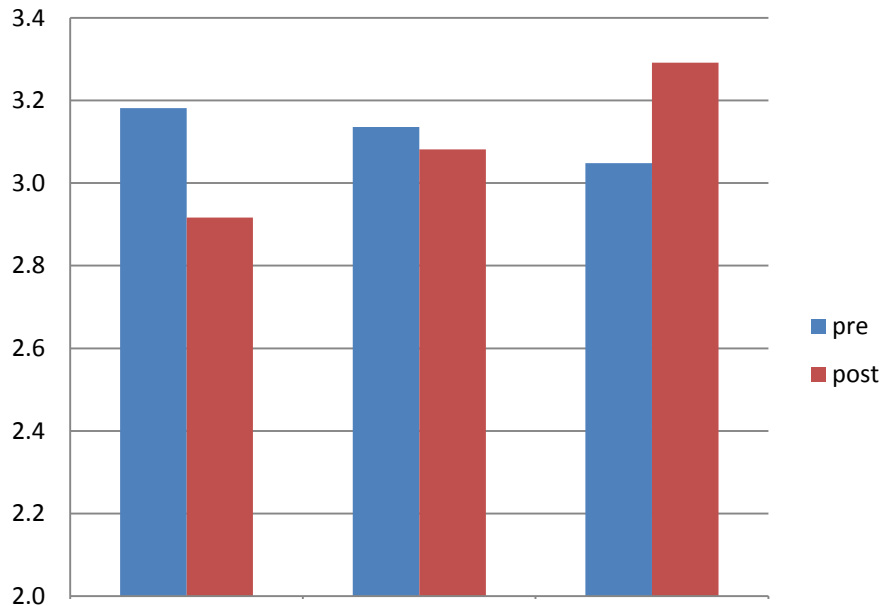
Increased interest in aspects of school science related to FF?



Q1-Findings

Increased interest in aspects of school science related to FF?

Aspect: Investigating something that nobody knows the answer to

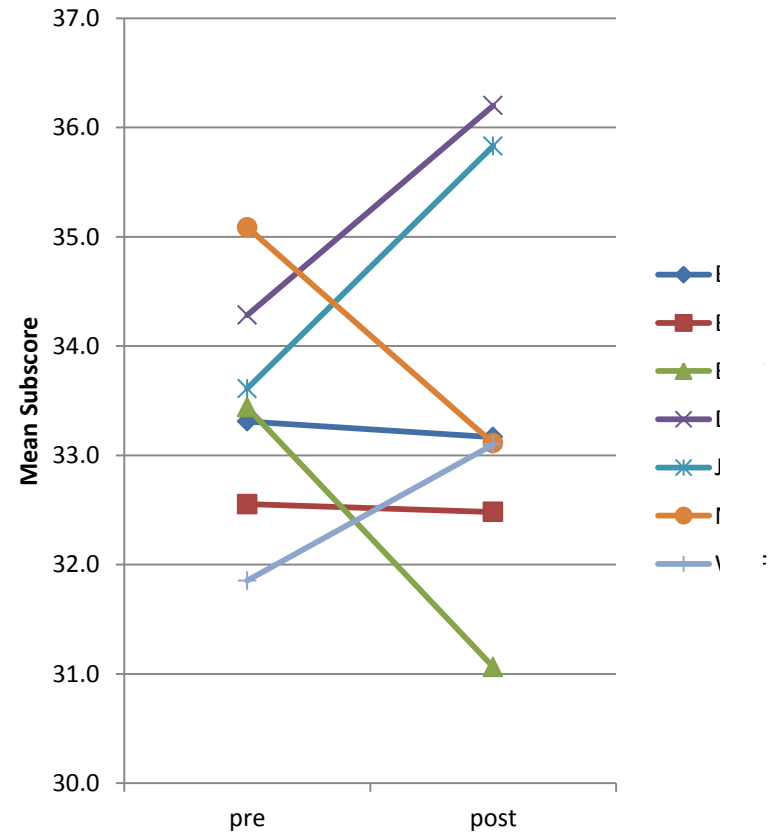


Decrease No Change Increase

Student n 183 185 100

Teacher n 2 2 3

Fossil Finders

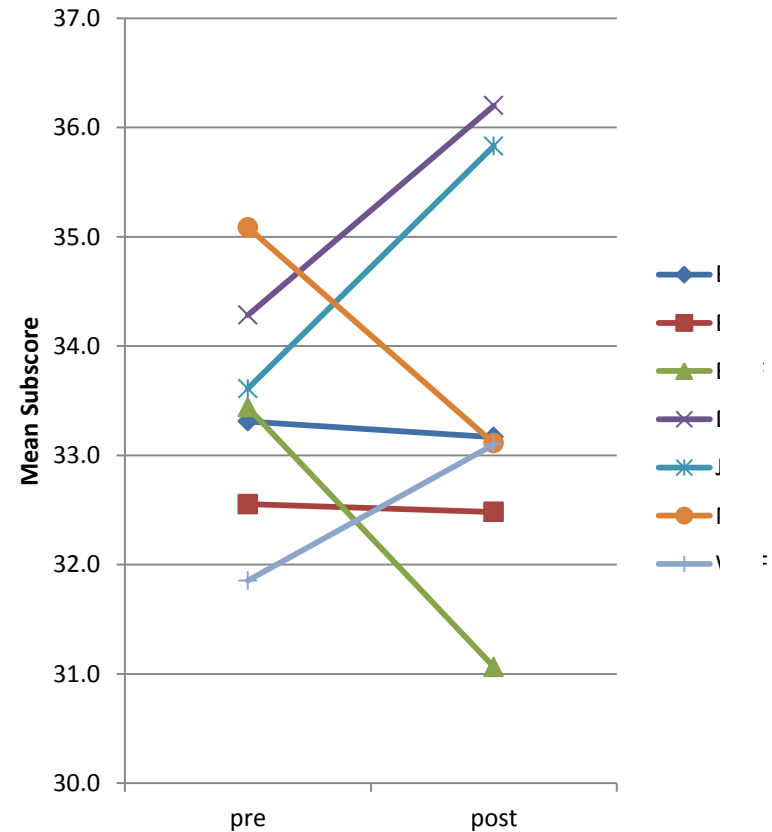
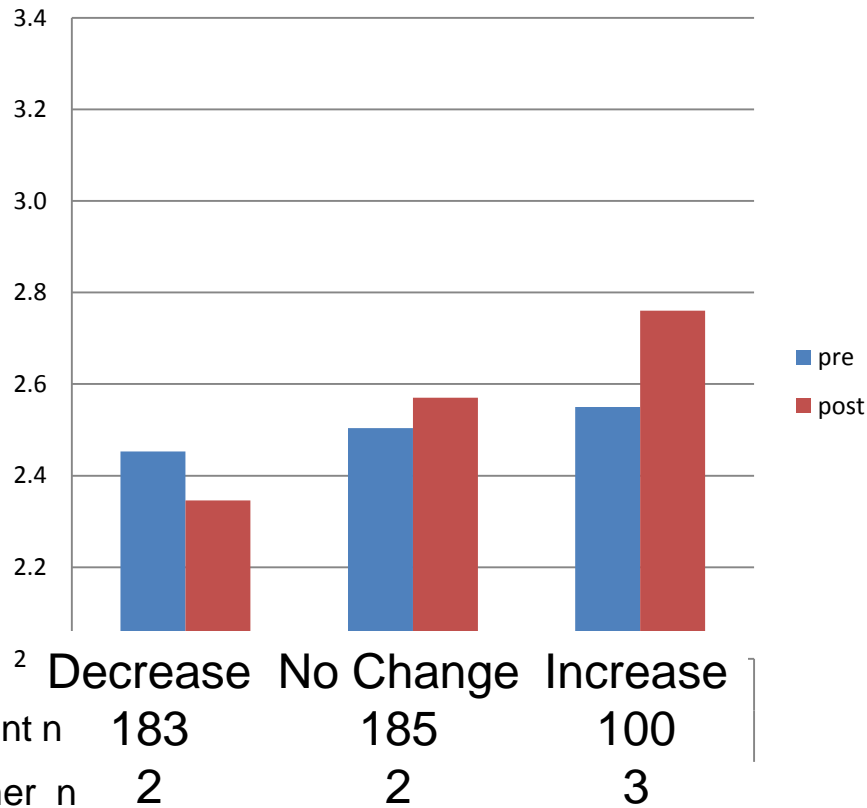


Q1-Findings

Increased interest in aspects of school science related to FF?

Aspect: Sharing ideas with classmates

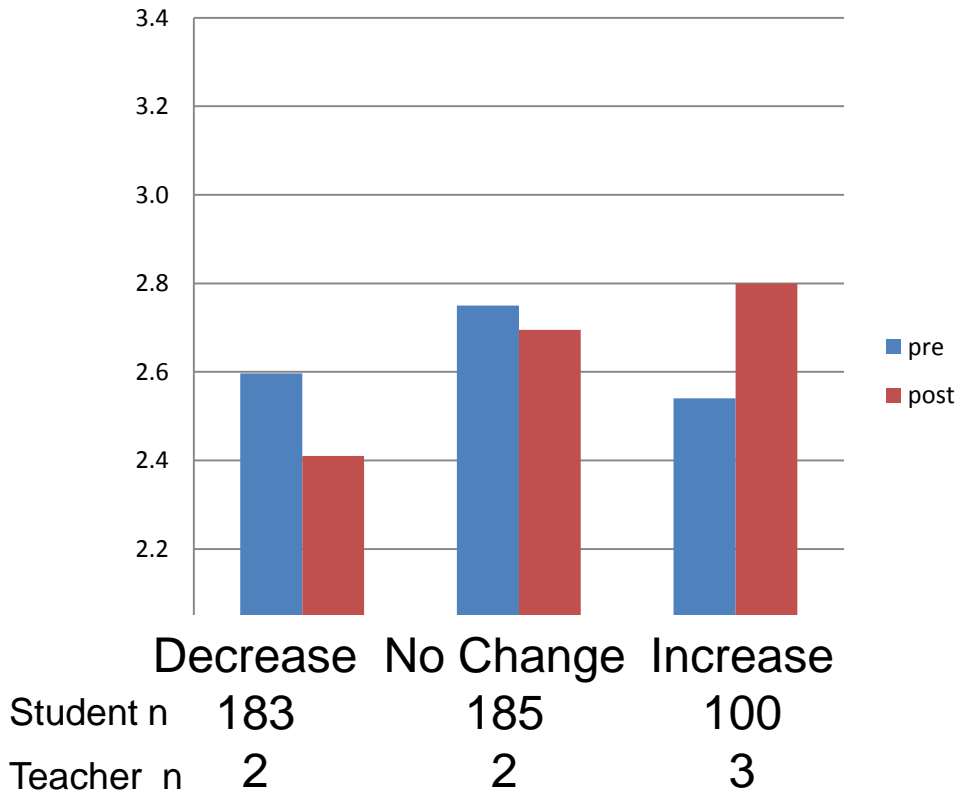
Fossil Finders



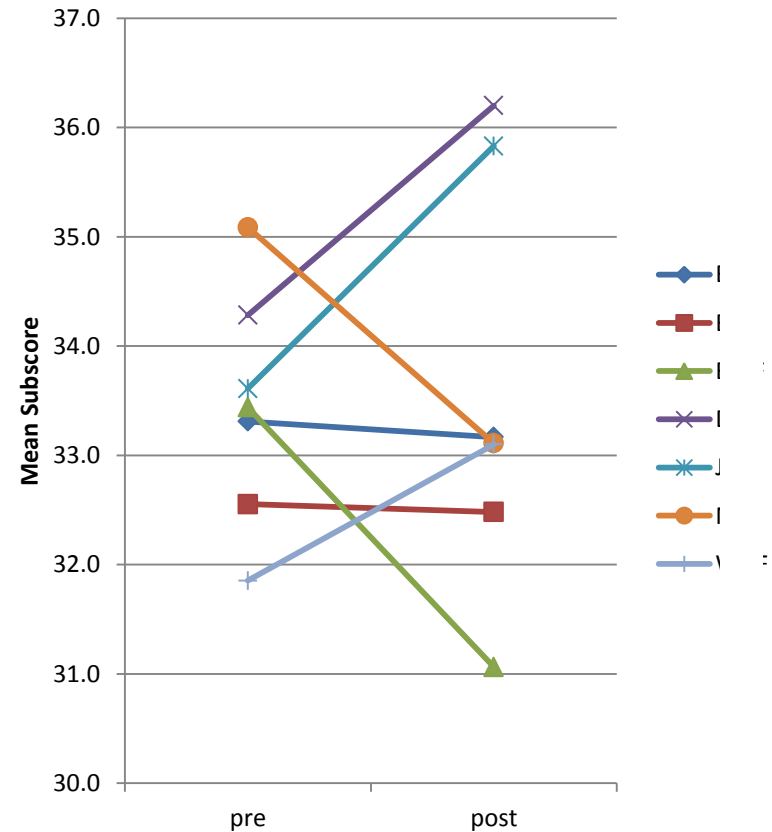
Q1-Findings

Increased interest in aspects of school science related to FF?

Aspect: Using graphs or figures to argue my point



Fossil Finders



Summary of Q1

- Participation in FF did not necessarily engender a change in students' interest.

Summary of Likert findings

- Participation in FF did not necessarily engender a change in students' interest.
- In some FF classrooms (3/7), we saw an increase in interest. In other classrooms we saw a decrease or no change in interest in all 3 areas investigated.

Summary of Likert findings

- Participation in FF did not necessarily engender a change in students' interest.
- In some FF classrooms (3/7), we saw an increase in interest. In other classrooms we saw a decrease or no change in interest in all 3 areas investigated.
- Enactment of FF (emphasizing authenticity, sharing ideas, working with data) may influence students' interest.

Q2-Findings

Open Ended: What are three things you **really liked** about doing FF?

Fossils have a “Wow! Factor”

“I got to touch something ancient without getting in trouble!”

Q2-Findings

Open Ended: What are three things you **really liked** about doing FF?

Fossils have a “Wow! Factor”

“I got to touch something ancient without getting in trouble!”

Authentic aspects of FF

“We could actually see and do the real things instead of just reading about them. It made us learn in a fun way. It felt like we were real scientists.”

“Fun looking at fossils, sent into real scientist, it got my mind thinking hard on science.”

Q2-Findings

Open Ended: What are three things you **really liked** about doing FF?

Fossils have a “Wow! Factor”

“I got to touch something ancient without getting in trouble!”

Authentic aspects of FF

“We could actually see and do the real things instead of just reading about them. It made us learn in a fun way. It felt like we were real scientists.”

“Fun looking at fossils, sent into real scientist, it got my mind thinking hard on science.”

Working with data*

Making graphs and figures, comparing data with other classes, sharing our ideas with scientists.

Q2-Findings

Open Ended: What are three things you **didn't like** about doing FF?

Truncated investigation:

"You just talk about them and we don't do anything with the ideas."

Q2-Findings

Open Ended: What are three things you **didn't like** about doing FF?

Truncated investigation:

"You just talk about them and we don't do anything with the ideas."

Quality of the Fossils/Samples:

"After a while it got boring. There was a lot of little pieces of rocks. There weren't that many fossils. I thought there would be more."

"I hated that all the rare things were really cool. I hated when we found fossil poor parts."

"Too hard to measure and identify! Too many fossils! Too small!"

Conclusions

- Authentic investigation alone did not engender students' interest in science
- Teacher-enactment made a difference
 - e.g. working with the data, emphasizing authenticity, student discussion
- Physical samples made a difference
 - Too many or too few fossils

Implications & Future Research

- Authenticity and interest in science – a two-sided coin.
 - Education Researchers and Scientist Partnerships
- What are teachers doing differently as they enact FF in their classrooms?
- What more can we learn from this data by matching students pre-post?
- What can we learn from the qualitative data?

Contact Information

mrp@ithaca.edu

bac45@cornell.edu

Paper will be posted at: www.fossilfinders.org

This research was funded by the National Science Foundation DRK12 award # 0733223. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of The National Science Foundation.

