Evaluating the Earth Science Education Lab for Student Teachers

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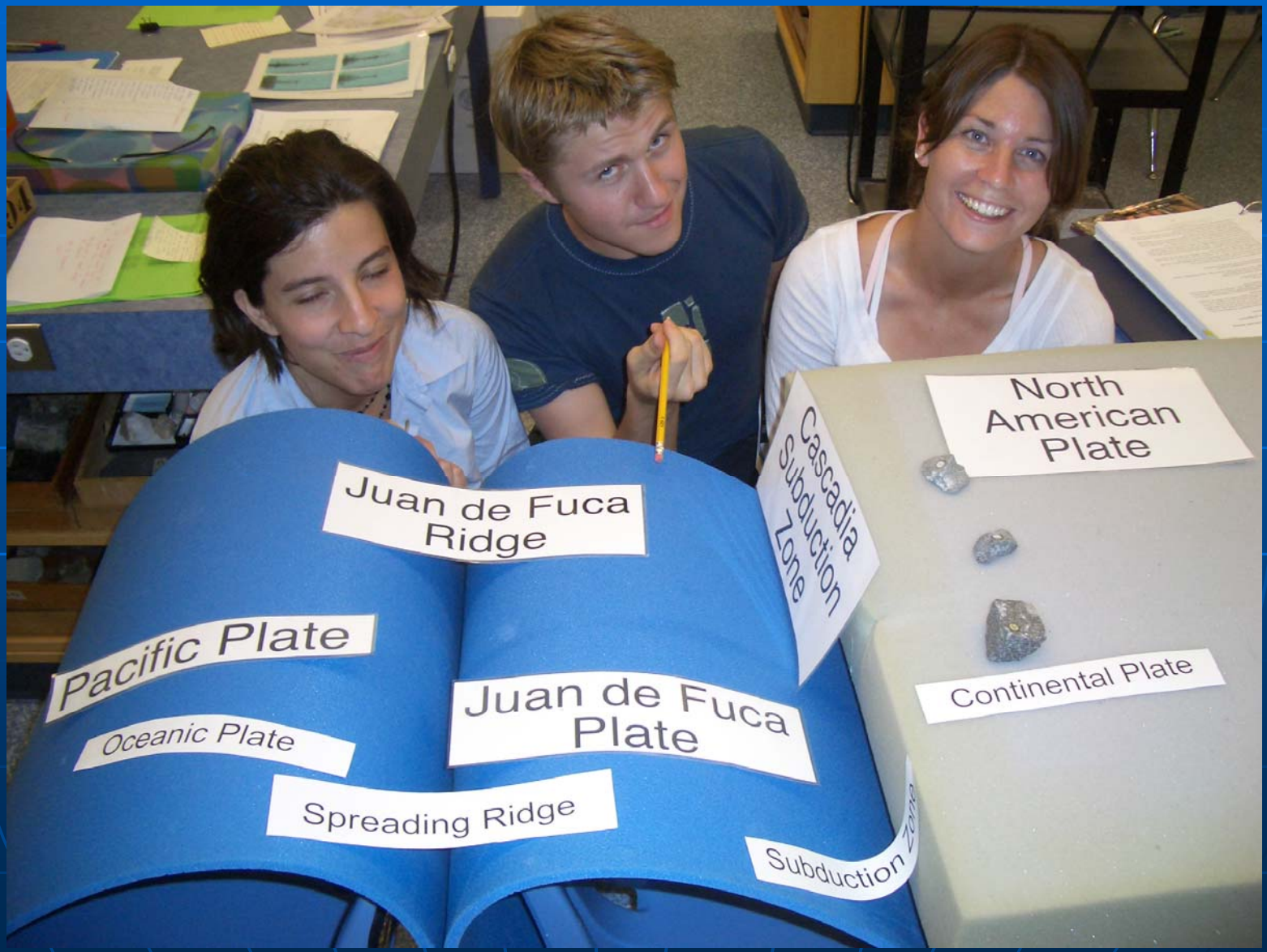
Education Lab - background

- Has been run three times, Fall 2005, 2006, 2007, with twenty students per year, in EOS 120 "Introduction to the Earth System II"
- Science content the same as peer labs, but we use hands-on activities and demonstrations transferable to the K-12 teaching environment
- Education Lab had one additional introductory education tutorial
- A new lab manual was developed specifically for the Education Lab
- Labs are built on a constructivist model for science education (EDU)
- Goals are to

  - Increase student teacher confidence in, and enthusiasm for, earth science (and therefore their willingness to teach this science)
  - Increase earth science knowledge and address misconceptions
  - Provide earth science resources and activities that the students will use in their future classrooms

The next generation of Teachers!



Evaluating our impact

Using our goals to guide the process

Goals for our student teachers

1. Confidence in, and enthusiasm for, Earth science
2. Increased Earth science knowledge, misconceptions addressed, experience of 'doing' science
3. Hands-on and field based activities, and teaching resources, that students will use in their future classrooms

Evaluating the impact of the Education Lab

Human Subjects, so Step 1- Ethics Approval
Step 2 - Participant Consent

Our Evaluation Approaches

- Pre and Post lab surveys
- Student group interviews (wrap up at end of course) and comparison to a Regular Lab section 05 (same TA)
- Lab evaluations
- EdGEO evaluations – EdGEO helped fund the teacher resources
- Student marks – course work and lab work (e.g. Lab grade, final exam and midterm exam)
- Researcher observations (incl. video of teaching lab)
- Student reflections
- Longitudinal survey to examine longer term impact

Making Research Ethical

- *All* research involving humans (questionnaires, interviews, etc.)must be approved by Human Research Ethics at UVic, which is governed by national standards.
- There are two key issues to consider:

  A. Could this research lead to harm?
  - Physical harm (usually not an issue)
  - Psychological stress, such as resultant teasing, trauma from realizations, etc.

  B. Does this research involve "power over" situations that limit equity? (e.g., in evaluation) *There must not be any influence this way, which makes doing social research in education very difficult but not impossible (challenges creativity!)*

Key considerations

Research must not disadvantage participants in any way.

Good ethical research in education conforms to the principles of:

- Informed consent (issues with younger)
- Right to words and ideas
- Anonymity (issue in group meetings)

1. The Pre and Post Lab Surveys

Designed to test changes in attitude to Earth science, were misconceptions addressed, and the high school Earth science experience

Surveys given without prior warning – results therefore represent long-term 'deep' knowledge not last minute cramming

- DATA COLLECTED
  - Prelab - demographic info, high school earth science background, enjoyment and interest in earth science, relevance to society, and knowledge questions
  - Postlab - motivation for taking the course, relevance to society, how much they thought they had learned, interest in earth science and the same set of knowledge questions as the Prelab survey

The Pre Lab Survey

The purpose of this questionnaire is to inform the development of the EOS120/Geog 120 course. Your participation is entirely voluntary; please answer any or all of the questions below. Your student number is for research purposes only and your responses will be kept anonymous; *in no way will your answers to the questions below be involved in your grades for this course.* Thank you for taking the time to respond to these questions.

PART 1

Demographic information. This information will be used for data analysis, and your student identification number and all of the information you provide will be kept strictly confidential.

Student # _____ Male __ / Female __

Age: [ ]16-20 [ ] 21-25 [ ] 26-30 [ ] 31-35 [ ] 36-40 [ ] 41 and over

Please circle the correct response!

In the BC school system, the study of earth science (e.g. plate tectonics, volcanoes, rock types, earthquakes, age dating) is a curriculum requirement.

a) Did you attend high school in BC? Yes No

b) Did you study earth science in Grade 10? Yes No

c) Estimate the amount of time spent on earth science compared to other science topics

_____%.

d) Did you do lab work (practical hands-on) in earth science in school?

None Rarely Occasionally Often

e) Did you go on earth science field trips? None Rarely Occasionally Often

f) Were you interested in earth science in school? On a scale of 0 (no interest whatsoever) to 10 (the most interesting topic you studied in school)

_____

Please explain your answer

g) Did you enjoy learning earth science in school? On a scale of 0 to 10

_____

Please explain your answer

h) The study of earth science is relevant to society. 1 2 3 4 5

where 5 is strongly agree and 1 is strongly disagree

Please explain your answer

Part 2 example questions – same for both pre and post surveys

1. The age of planet Earth is approximately
   a)4.6 billion years
   b)1.0 billion years
   c)65 million years
   d) 4500 years

3. Life originated
   a) on land
   b) in the oceans
   c) in lakes on continents
   d) in all environments at once

5. Humans and dinosaurs have co-existed in the past. T or F

7. Earthquakes we experience in B.C. are related to the
   a) San Andreas Fault
   b) The Queen Charlotte Fault
   c) The Cascadia Subduction zone
   d) The East Pacific Rise

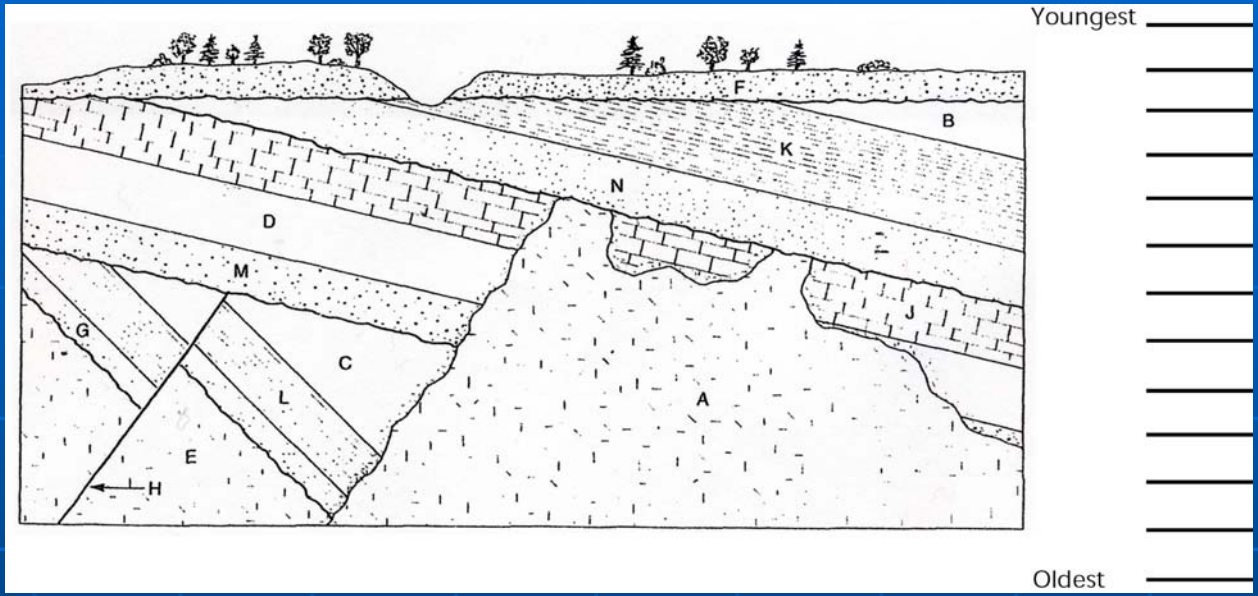
8. Vancouver Island is part of the
   a) Pacific Plate
   b) North America Plate
   c) Juan de Fuca Plate
   d) Western Canada Plate

9. B.C. has not experienced volcanic activity in the last 5000 years. T or F

10. Heat that drives earth surface processes (e.g. erosion) comes from
    a) Geothermal energy
    b) Solar energy
    c) Hotspots
    d) Mantle convection

12. Groundwater (e.g. aquifers) and surface water (e.g. rivers and lakes) are part of the same interconnected system. T or F

Use the following cross section to answer the next questions



17. Which is the oldest unit or event in the geological section shown?
    a) H
    b) E
    c) A
    d) M
18. If units C and L are 90 million years old, units D and J are approximately 30 million years old, and units N and K are approximately 10 million years old, the best 'guess' for the age of unit A is?

The Post Lab Survey

PART 1

This information will be used for data analysis, and your student identification number and all of the information you provide will be kept strictly confidential.

Student # _____

Please circle the correct response!

1) Please respond to the following statement, where 5 is strongly agree and 1 is strongly disagree:

The study of earth science is relevant to society. 1 2 3 4 5

Please explain your choice for **h** above:

2) Why did you enroll in EOS/GEOG 120?

a) Science elective
b) Intend to study earth science
c) Required for my intended program
d) General interest
e) Recommended by advisors

3) Do you plan to take a higher level EOS course?

a) Yes, because I like EOS
b) Yes, because additional courses are required for my program
c) Yes, because I need science electives
d) No, because it doesn't interest me
e) No, because it is not required

5) Did this course increase your interest in EOS/GEOG?

a) Yes, greatly
b) Yes, a little bit
c) Not much
d) No, not at all
e) No, now I dislike the subject very much

6) How much do you think you learned in this course?

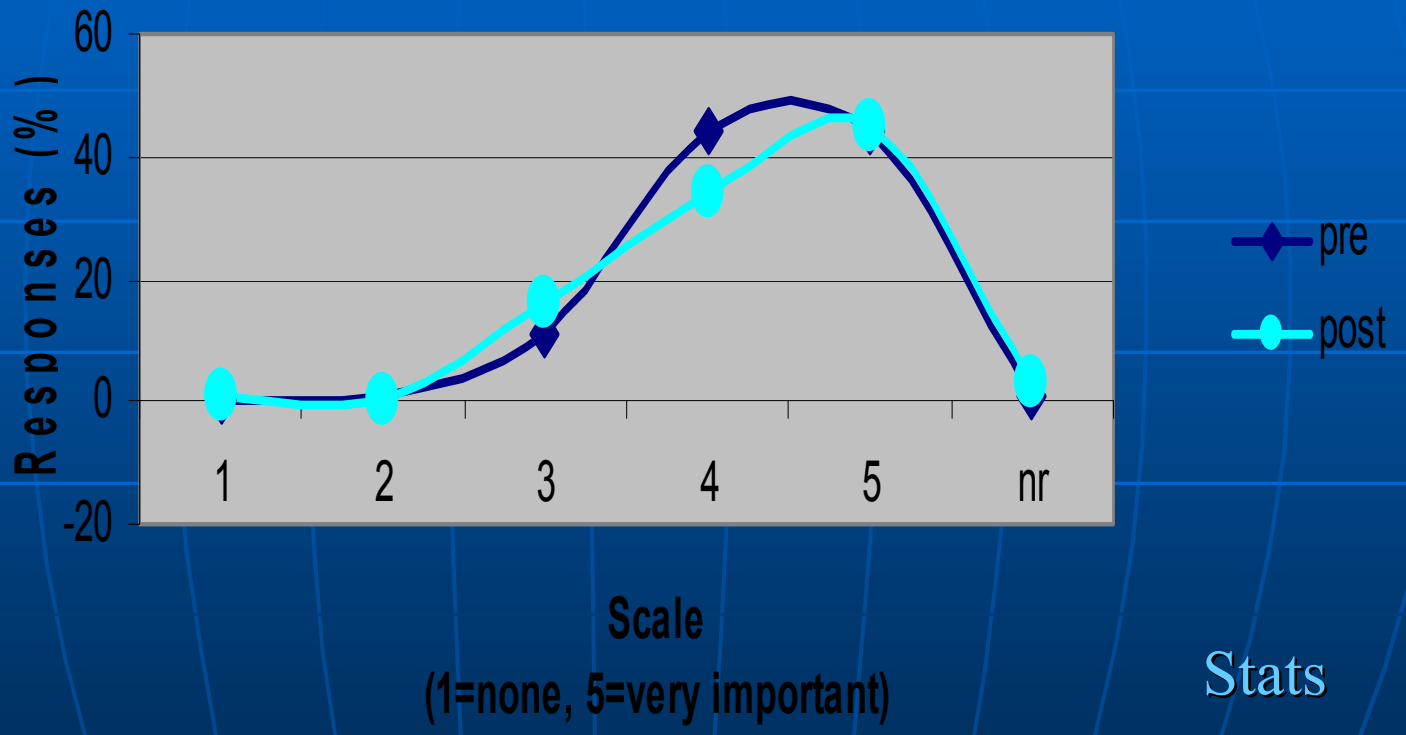
a) a great deal
b) more than I expected
c) about what I expected
d) very little, but I expect to pass
e) very little and I'm worried about passing

PART 2 **The same as on the Pre Lab Survey**

Analysis of the Survey Data

- So far have looked at the 2005, 2006 cohorts of 20 students (in relation to their class peers in EOS 120)
- Now putting the entire data set together
- Todd Milford and Julie Giasson will be analysing the dataset

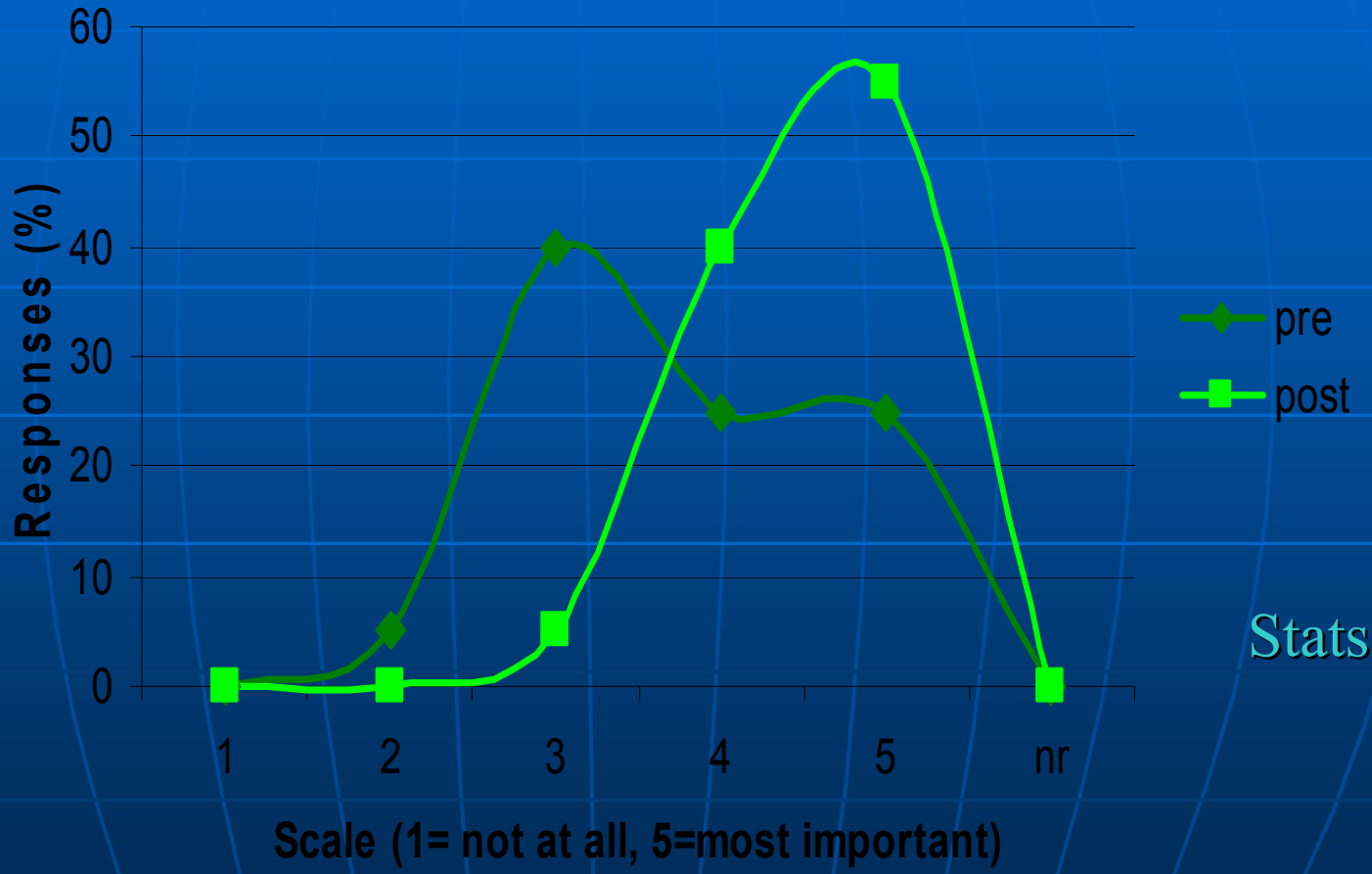
Changes in Attitude for Earth Science Being Socially Relevant for Regular Students



Stats

N=90, two tailed, alpha @ 0.05, tobs, 0.773< tcrit 1.97 , therefore no statistically significant difference between pre and post test views on social relevance.

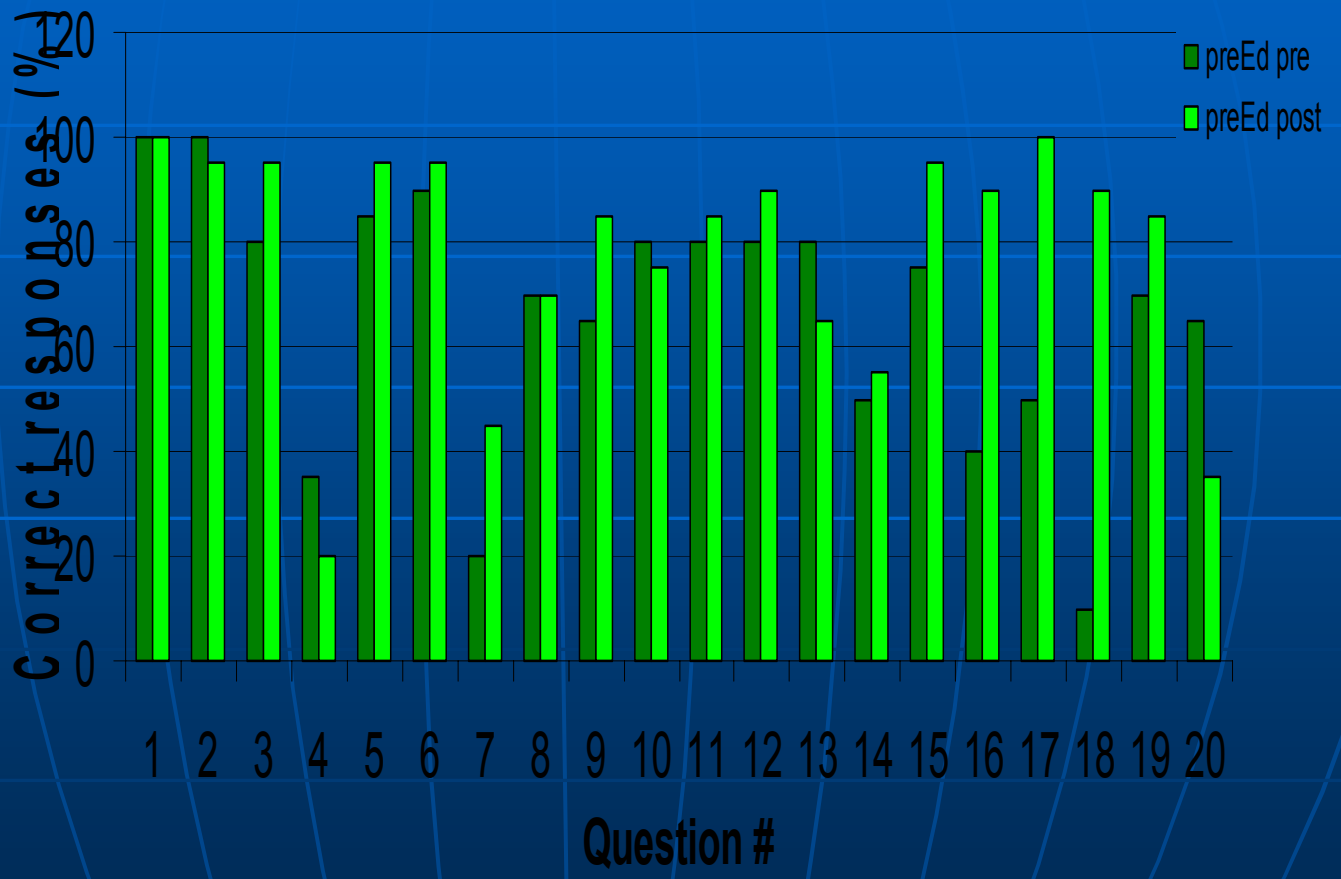
Changes in Attitude Towards Earth Science Being Socially Relevant for Pre-Ed Students.



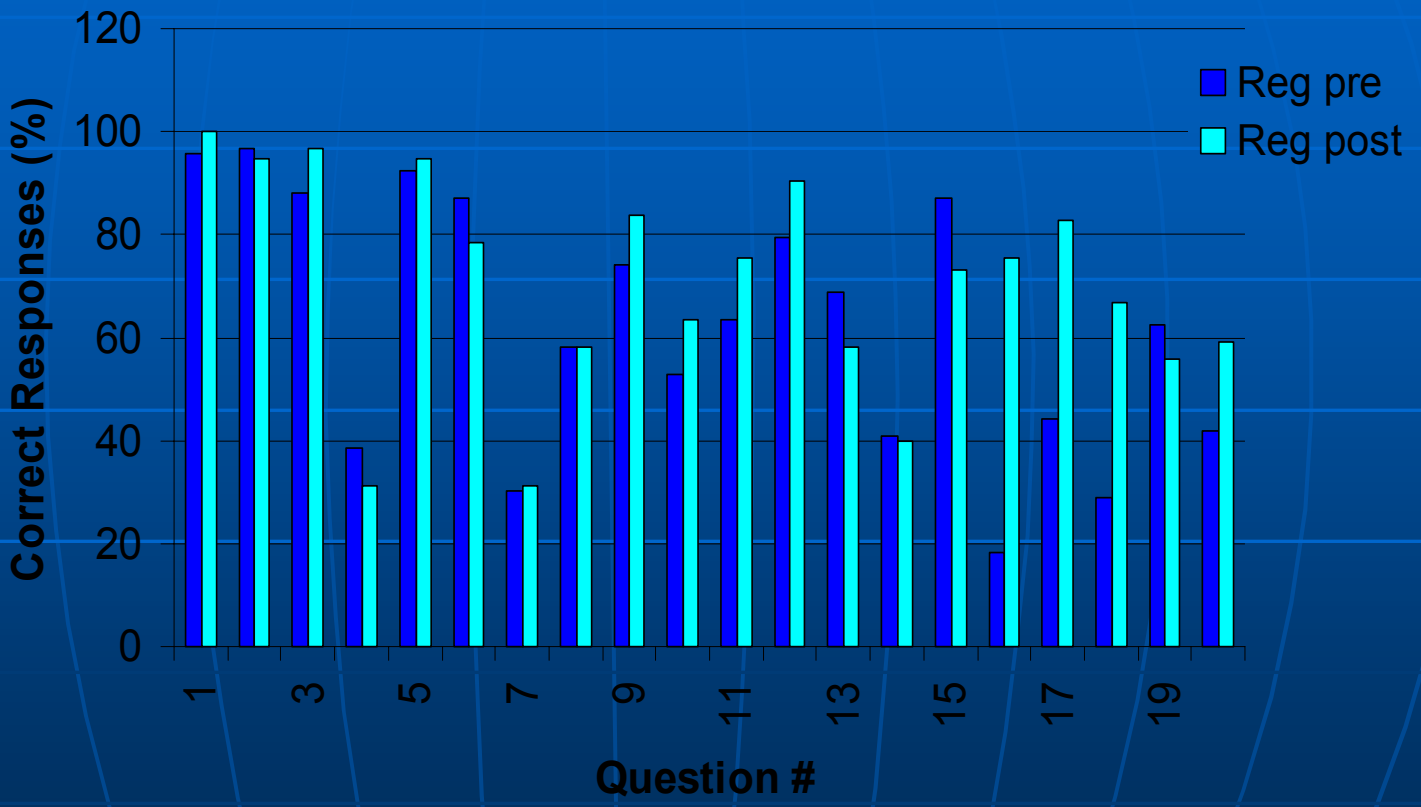
Stats

N=20, $p = 0.001$, two tailed, alpha @ 0.05, tobs, 3.907< tcrit, 2.093 , there is a statistically significant difference between pre and post test views on social relevance in the Pre-Ed group.

Correct Responses Between the Pre EOS/GEOG and Post EOS/GEOG surveys for Pre-Ed Students



Correct responses Between PreEOS/GEOG and Post EOS/GEOG survey of Regular Students.



2. Student Group Interviews

Questions around which discussion was based

The 2006, 2007 interviews were recorded or vidoetaped

1. Why did you enroll in the Education Lab?
   Do you intend to go into elementary, middle or high school teaching?
   How long from now do you intend to apply to the Faculty of Education, if at all?
2. What was your attitude towards the subject of geology/earth science coming into this course?
   Has this attitude changed at all?
   If so, what was the role of your lab section in changing this attitude?
3. How does your experience in this lab section compare to other lab sections you have experienced?
   Did the lab meet your expectations?
   Is there anything you would change?
   Knowing that you are responsible for the same material as the other lab sections, would you organize the lab any differently?
4. This lab section features teaching strategies promoted in the Faculty of Education and was designed to give some advance preparation for a teaching career -
   Did this approach help you learn the geology content of this course?
   Did it have any influence on your decision to become a teacher?
   How useful (for your career aspirations or for learning the course content) was the activity to engage in peer teaching? What did you like/dislike about this activity?
   How useful was the lab manual? Do you have any suggestions for improvement?
5. Which lab activities were specially useful for learning course content?
6. What thought/impressions do you have about the resources you were given in this lab section?
7. Do you feel confident that you will be able to teach the geology/earth science section of the school, science curriculum?

Some examples of student comments

- “A fabulous way to present science to people who are interested in teaching”
- “It provided me with many good ideas and resources that will benefit me in my career”
- “I’ve never had more fun in a lab science class before”
- “I wish more programs would adopt this idea”
- “Let’s make good teachers now as opposed to fixing them later”

5. FINAL Course Marks (e.g.2005)

Group	Pre Lab Qs (%)	Post Lab Qs (%)	Lab % (out of 50)	**Final % on the course (includes midterm and final exam mark)**
Regular N=84	62.75	69.60	40.31	69.70
Pre-Ed Hopefuls N=9	51.65	66.10	41.48	70.50
Pre-Ed N=20	66.25	78.25	43.38	75.80

6. Researcher Observations

- In 2005 David and I sat in on many of the labs. In 2006 and 2007 we did this less as we felt that our presence may have introduced a bias compared with the other labs
- The TA's recorded their impressions and regularly met with us
- We presented the Education Tutorial at the start of the course and met with the group again for the Final interview or discussion

7. Student Reflections

- Five reflections were required, after Lab 1, Lab 3, Lab 5, Lab 7 and Lab 9
- An opportunity for students to document their own learning experiences and perspectives

e.g. What are the most important items you have learned or feel you will remember about the lab in 2 months or two years?

e.g. When you think about teaching this material, reflect on the teaching methods and activities used in the lab

e.g. Have you had any 'lightbulb' moments or misconceptions corrected?

8. Longitudinal Survey

To evaluate whether students do, in fact, use the Education Lab activities, resources and pedagogical approaches in their future classrooms and practise teaching.

- Survey/interview for students who agreed to participate
- Takes time for Education Lab students to enter an Education Program, get a practise teaching assignment, and finally have a classroom of their own
- We would like to maintain a dialogue with them as they follow this journey
- Response rates are low
- Issue of losing track of them
- Need incentives for them to take time out of their busy schedules

Other CRYSTAL Resources

Pei Ling Hsu Ph.D. student – conversation analysis and discourse analysis (classroom observations and videotaping)

phsu@uvic.ca

Mary Holmes Teacher and Masters Student – permission forms for students

David Zandvliet (Simon Fraser) – PLACES and SMILES

We hope to post presentations and other evaluation resources, on our website, to facilitate sharing of evaluation tools and expertise