A New Tool for Investigating Undergraduate Attitudes about Earth Science

Jolley, Alison[1] and Lane, Erin[2]. Department of Earth and Ocean Sciences, University of British Columbia (Vancouver).
6339 Stores Road, Vancouver, BC, Canada V6T 1Z4
[1]ajolley@eos.ubc.ca, [2]elane@eos.ubc.ca

Introduction

One of the main goals of an undergraduate education is moving students from novice-like thinking towards expert-like thinking. On top of gaining conceptual knowledge, we must train students to perceive disciplines and how they are used and learned in an expert manner. We have designed a survey to measure student attitudes about the field of earth and ocean science.

The Student Attitudes about Earth Science Survey (SAESS) is based on The Colorado Learning Attitudes About Science Survey (CLASS) developed in the Physics Department at the University of Colorado – Boulder (CU) (Adams et al., 2006). The CLASS showed that students were becoming approximately 5-10% more novice-like after taking a course. After making specifically directed course changes in the Physics Department at CU, the drop was reduced to no change. Results from SAESS have allowed us to take a look at the effects of our courses on student attitudes. Our results do not show the negative shift seen in physics, and yet they do not show strongly positive shifts either.

Why Use an Attitude Survey?

- Students' attitudes influence their learning behavior in 3 main ways (Gal, 1997):
  - Approach to teaching/learning
  - Translation of learning to everyday situations
  - Direction of future studies
- Attitudes positively correlate with conceptual learning gains (Perkins, 2005)
- With an attitude survey you can:
  - See a snapshot of your class at the beginning
  - Get baseline data for future pedagogical changes
  - Inform curricular improvement
  - Track individual course innovation
  - Track students or cohorts on longer timescales

Goals of SAESS

1. To establish students' beliefs about the nature and relevance of earth and ocean science.
2. To determine whether students perceive earth and ocean science the same way that scientists do.
3. To reveal the effects of course innovations on student attitudes and interest.

Administration

- Online, outside of class time
- Takes approximately 10 minutes to complete
- 1% bonus credit given for completing both the pre- and post-survey
- As of May 2009, taken by over 6000 students at 3 institutions

Methods

- Validated statements with eighteen student interviews to ensure that they are clear to people with varying degrees of knowledge and disciplinary backgrounds
- Expert responses from thirty-eight PhD holders in the department
- Factor analysis and individual assessment of correlation coefficients between statements resulted in seven categories

Categories

1. **Memorization**, e.g. "Understanding Earth and Ocean Sciences basically means being able to recall something you've read or been shown."
2. **Science and Society**, e.g. "If an Earth and Ocean finding is in the news, it means that it has been proven to be true."
3. **Problem Solving**, e.g. "I do not expect equations to help my understanding of Earth and Ocean Science ideas; they are just for doing calculations."
4. **Personal Interest**, e.g. "Things that I see around me in nature often lead me to think about how the Earth works."
5. **Skeptical Reasoning**, e.g. "I investigate the source of the information on the web before I use it for an assignment."
6. **Sense Making**, e.g. "I often don't really understand the underlying ideas behind how the Earth works."
7. **Human-Science Interaction**, e.g. "Knowing about how the Earth works is useful in making some decisions in life."

Overall Results

Table 1: Fall 2008: Results for All Students at UBC (n=925)

Category	Pre Favorable	Standard Deviation	Post Favorable	Standard Deviation	Shift
Overall	62.6	16.5	64.5	18.3	1.9
Memorization	76.2	24.7	72.8	27.1	-3.4
Science and Society	40.0	31.8	40.6	31.5	0.6
Problem Solving	53.4	31.1	56.3	31.7	2.9
Personal Interest	73.4	26.8	73.7	27.9	0.3
Skeptical Reasoning	53.8	27.5	55.0	29.2	1.2
Sense Making	48.0	33.5	63.0	33.6	15.0
Human-Science Interaction	86.3	22.2	86.8	23.5	0.5

Good News: not a negative shift as seen with the Phys-CLASS (Adams et al., 2006)
Bad News: not a significant positive shift

More students believe that earth and ocean science is about memorizing facts and formulae

Students' initial preconception about the role of earth science in society is low and does not change much over a course.

More students see value in equations, mathematics, and statistics

More students have confidence in their understanding of concepts

Course Comparison on an Individual Statement

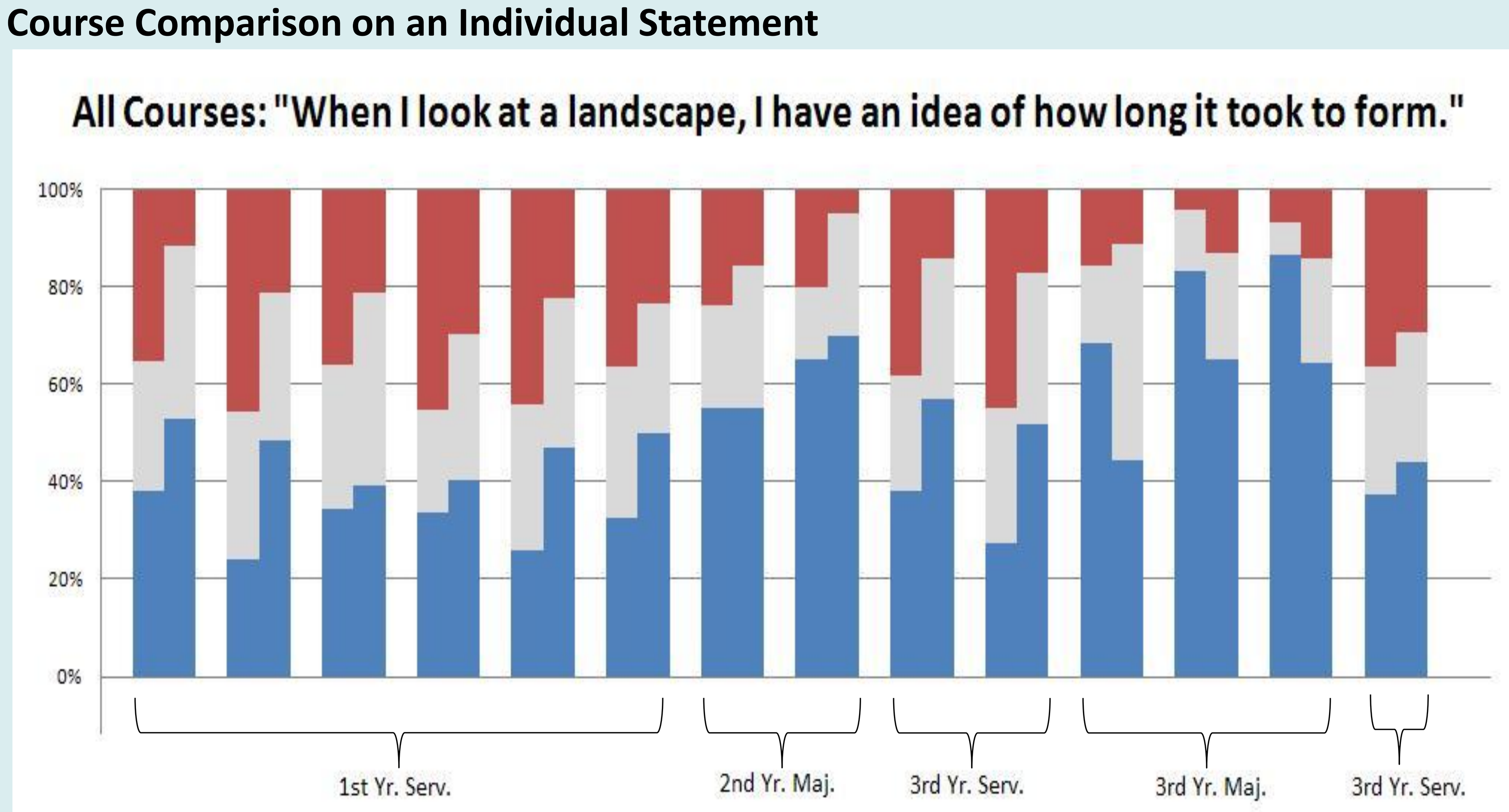

Figure 1: On average, students in third year majors courses shift away from the expert on the statement "When I look at a landscape, I have an idea of how long it took to form." Students in service courses shift towards the expert.

Instructors can view the graph and compare results of interest with the specific survey question

Good result, further investigate question 6

Bad result, further investigate question 13

Course Specific Results

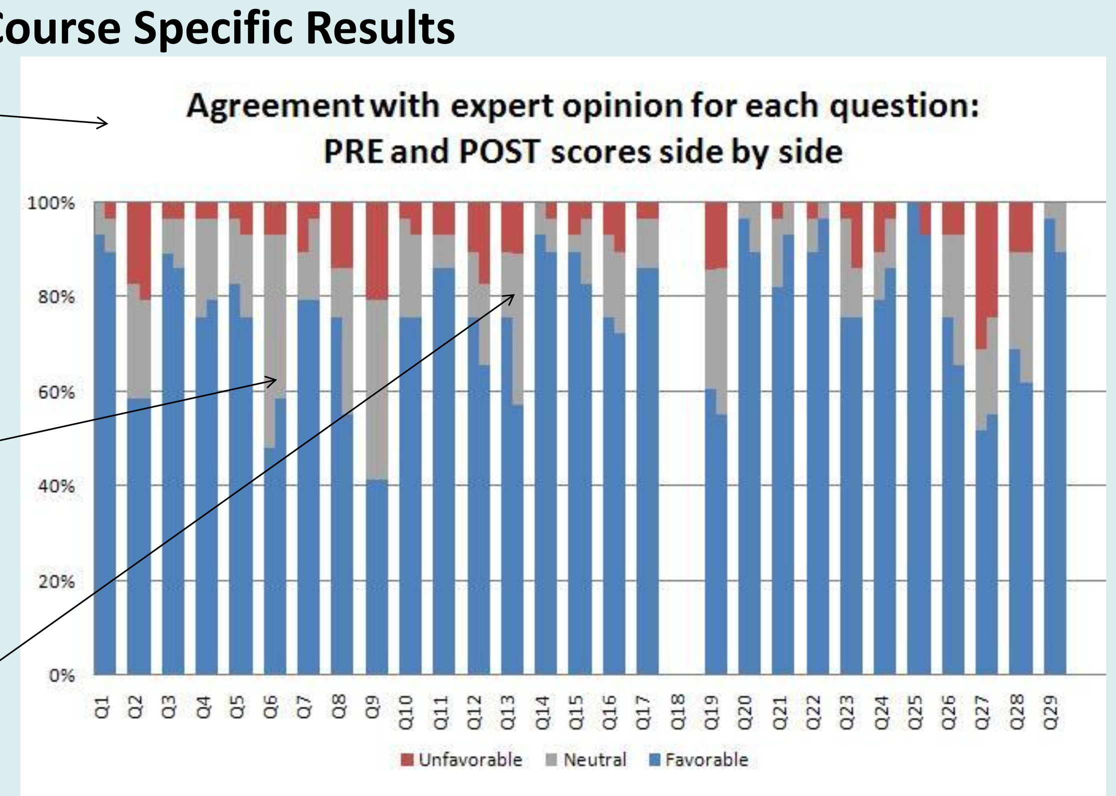

Figure 2: What an instructor would see as part of the summary for a class.

Interest Level in Earth and Ocean Science

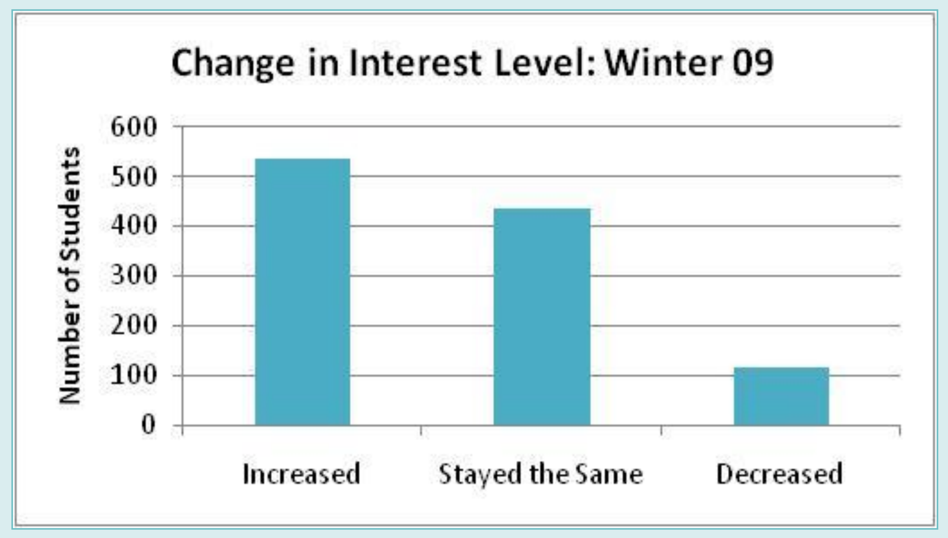

Figure 3: Change in interest level at the end of the semester.

Class Size Comparison

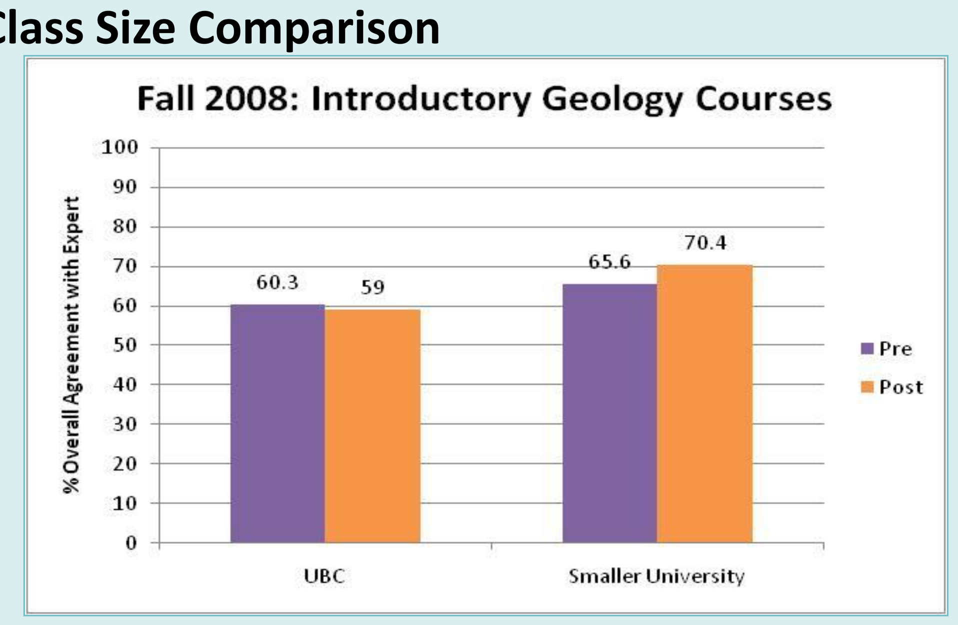

Figure 4: Students in a similar course with a much smaller class size at another Canadian university shift more positively than students at UBC.

References

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Future Studies

- Experiential learning programs (SEA and BUMP)
- In-depth investigation of the decrease in the Sense Making category for upper-level majors, including correlations of conceptual knowledge with perceptions and confidence
- Further participation from community colleges and universities with smaller class sizes