A CURRICULUM EXPERIMENT IN CLIMATE CHANGE EDUCATION USING AN INTEGRATED APPROACH OF CONTENT KNOWLEDGE INSTRUCTION AND STUDENT-DRIVEN RESEARCH, YEAR 2

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THE PRESENTATION

A two tier presentation

A course that was developed to improve undergraduate education at the Freshman level

A process of reforming an undergraduate course through instructor driven action research

CONTEXT

Target audience – regional comprehensive; Freshman level course for science and engineering students

Motivation for the course – passion for the topics – climate change and data-driven decision making (scientific argumentation)

Faculty partnership/co-teaching on prior projects

Course structure based on NSF DUE-0088818

No funding for the project – faculty choosing to conduct the action research as a standard operating procedure

COURSE

The objectives of this course are to

(a) acquaint students with the current state of knowledge regarding climate change and

(b) provide students with the skills required to do university-level scientific research.

Course was split between

50% content instruction (inquiry, collaborative groups, directed reading, scientific argumentation)

50% development of research skills and undertaking a research project as an individual

ACTION RESEARCH QUESTIONS

1. **Does the course content improve student understanding of climate change issues, specifically the greenhouse effect?**
2. **Is the course effective in developing positive attitudes towards science?**
3. **Does the course enhance student ability to conduct research?**

NOTE: The research presented here is comparative between 2009 to 2010.

METHODS

***1. Greenhouse Effect Concept Inventory* (GECI) (Keller, 2008). The purpose of this measure was to determine if we were improving student content knowledge relative to climate change issues surrounding global climate change.**

***2. Test of Science-Related Attitude* (TOSRA) (Fraser, 1981). The purpose for this measure was to determine if we were having a positive or negative impact on student attitude towards science.**

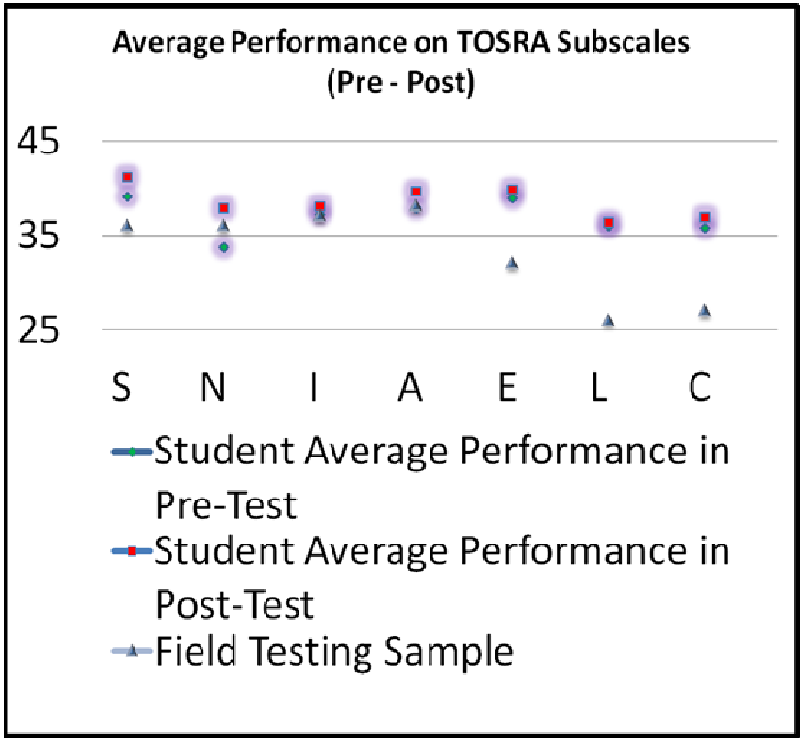
***3. Climate-Related Scientific Project Proposals Evaluation* using an internally developed rubric. Though climate change is the focus, developing research skill is the critical for the curriculum of the students in the class.**

FINDINGS - GREENHOUSE EFFECT CONCEPT INVENTORY

The students showed a significant gain using a t-test ($p<0.001$) from the pre- to post-test in both 2009 and 2010. The importance of the GECI is determining where students are having difficulty to improve instruction.

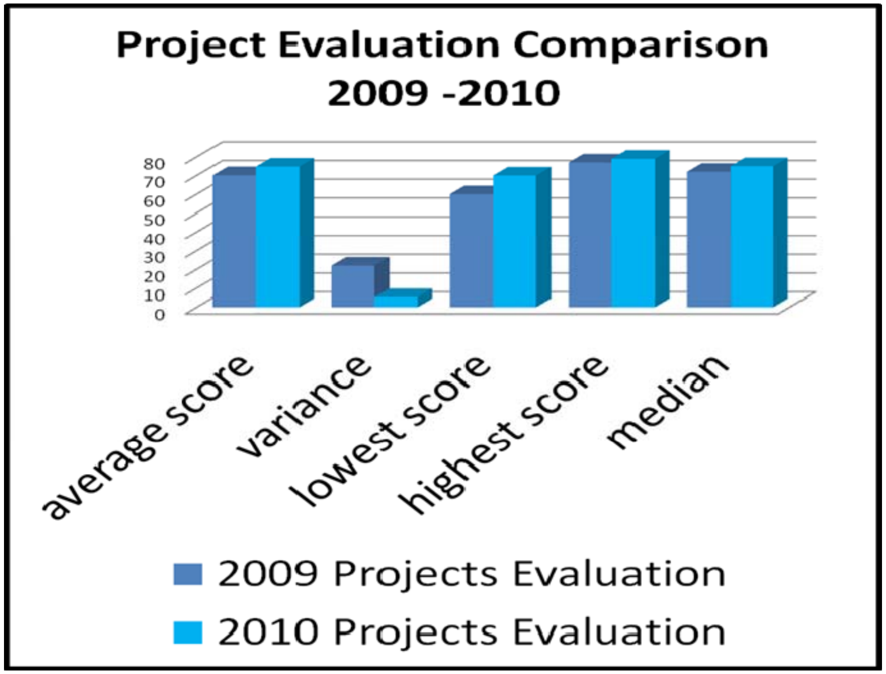
While there was no significant differences in the post-test score, there was a significant difference between the pre-test scores. The student learning gain was greater in 2010.

FINDINGS - TEST OF SCIENCE-RELATED ATTITUDES (TOSRA)



There was a gain in attitude on all seven dimensions. Overall the gain was not significant (p= 0.052), yet a gain over a period of three months indicates the potential for the course to influence attitudes.

FINDINGS - PROJECT PROPOSAL EVALUATION



Comparing 2010's project proposals to 2009's proposals, there was significant improvement in the scores ($p<.001$).

DISCUSSION

There were three major changes from the first to second offering of the course to improve project proposals.

1. Requiring completion the proposed research;

2. Emphasis on developing a research question early in the semester;

3. Altering from the proposal peer review to a formal proposal presentation with feedback provided by the faculty.

While these changes appear to correlate with improvement in proposal scores, there may have been a tradeoff as there was no improvement in GECI post-scores between the years.

The use of formalized rubrics is extremely important in a course of this type. It provided a context for students to look at and discuss each other's work. For the instructors the rubrics used during group work provided formative assessment information that allowed them to make improvements in the course while it was occurring thus improving the students' learning experience in the course.

The data was used to restructure the course for the year three offering. Content knowledge gains were improved and student research was increased with students receiving awards at the undergraduate research competition.

IMPLICATIONS – THE META-COGNITIVE MOMENT

Action research, even at a simple level of measuring critical elements, can help improve a course over time

Purposefully identify critical elements in the course that we want to improve and measure those items

Continuous quality improvement – Failure is not an option!

A support system is essential – partnership between geoscientist and a physics/education professor

Where we are –

redesigning the course to move the research options across earth & space science;

greater focus on statistics and core research tools