

Reform of Introductory Science Courses ACS/Keck Mini-Grant Final Report

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Title of Project: *Assessment of Conceptest Questioning and Electronic Student Response Technology in the Small School Introductory Geosciences Classroom: Do these Methods Really Help Non-Science Students Learn?*

Project Funding Period: June 1, 2006 to June 1, 2007

Amount Awarded: \$10,000

Original Goals and Objectives:

This proposal requested funding to support an assessment of the effectiveness of Student Response Technology (SRT) in a non-science major introductory Earth Science course at Washington and Lee University (Geology 100: General Geology). The key objective of this work will be to assess whether SRT Conceptest questioning helps non-science majors; 1) master and retain basic scientific concepts and principles, 2) distinguish between 'good' and 'bad' science, and 3) understand the importance of science in multiple real-world contexts. The primary focus of this work will be to *quantitatively assess* whether SRT Conceptest pedagogy truly helps non-science students learn and retain scientific concepts and principles.

Changes to Original Objectives:

There were no major changes to the plan outlined in the original proposal.

Goal/Objective Completion:

The specific goals outlined in the ACS/Keck proposal have been met in the following ways:

Summer and Fall 2006

- ***Development and refinement of assessment protocol and format***

Two Washington and Lee students (Kelly Hishta (07) and Matthew Paulino (08)) began working with me in fall 2006 on this project. Together, we developed a detailed plan for accomplishing the goals of the proposal. We performed a literature search related to assessment protocol and determined a course of action and implementation of SRT in Geology 100.

- ***Identification of all focus areas and question categories***

Specific focus areas critical to course curricula have been identified. Each focus area highlights a particular concept-driven aspect of the geosciences. Focus areas include:

- *Plate Tectonics, Earth Materials, Igneous Processes, Sedimentary Processes, Metamorphic Processes, Geologic Time, Whole Earth Processes, Structural Geology, Geochemistry, Hydrology, Ocean Processes, Current and Future Problems*

- ***Compilation/creation of Conceptest questions for each focus area and question category***

With help from students, I have compiled a database of over 300 multiple choice questions that can be used during the course. Approximately half of these questions may

not be sufficiently 'concept-driven' for this experiment (they are more 'fact-based'). A subset of 30 questions has been selected and refined for the standardized post-course assessment exam that will be given each of the next three years to test the effectiveness of the three concept delivery methods outlined in the proposal (lecture only, multiple choice with SRT, and multiple choice without SRT).

- ***Development of 3 year map of focus area delivery by presentation method***

I mapped a three year plan for what focus areas will be taught by each method as outlined in the proposal.

- ***Consultation with SRT users from diverse academic environments***

In addition to an extensive literature search, I consulted with colleagues at Penn State University and Trinity University about appropriate methods for SRT use.

Spring 2007

- SRT technology was integrated into Geology 100 at Washington and Lee University.
- SRT data were compiled during the course (including correlation of correct and incorrect responses by student profile) and will be analyzed in summer 2007.
- Student perception of SRT (as outlined in Greer and Heaney, 2004) was assessed (Appendix 1). Results of the survey will be tabulated in summer 2007.
- Fellow ACS faculty member Kathleen Surpluss (Trinity University) visited Washington and Lee to evaluate SRT use and provide feedback and suggestions for SRT use.
- An end of term standardized examination of all focus areas and question categories (to be applied in all subsequent years) was developed in the form of a subset of quiz questions.

Summer and Fall 2007

- SRT data analysis by student (Regina Mills). This will be ongoing.
- Purchase of additional SRT receivers to fully equip 3 additional classrooms (all of which are used by Greer).

Evaluation/Assessment:

Evaluation of the project is multi-faceted and on-going. Appendix 1 is a copy of the anonymous survey given to all students during the course. Students were also given a subset of short answer questions during a series of quizzes that will be given to all students in subsequent sections of the course over the next three years. The response data will be compared at the termination of the 3 year project period. In addition, I plan on serving students with an optional standard multiple choice question set 6-12 months after the end of classes to test retention of concepts. Kathleen Surpluss (Trinity University) visited Washington and Lee during the project period and provided an extremely valuable evaluation of my in-class SRT use. The feedback received will be utilized in subsequent terms.

Lessons Learned:

The primary lesson learned was that the semester in which each compared section is taught may influence the data recorded during the 3 year project period. Our spring term is taught in 6 weeks while the fall term is 12 weeks. While the total contact hours are the same, the nature of the Geo 100 course is different between the terms. To address this potential difference,

**Appendix 1: Assessment of the Classroom Performance System
Geo 100: Intro Geology Spring 2007**

Please respond to the following statements (1-12) using the rating system below:

- 1** *Strongly agree*
- 2** *Agree*
- 3** *Neutral*
- 4** *Disagree*
- 5** *Strongly disagree*

The Class Participation System (i.e., the 'clicker' system)

- 1)** The CPS system helps me to gauge my level of understanding of course material.
- 2)** The CPS system helps me prepare for the quizzes.
- 3)** The CPS system reinforces important concepts presented in lecture.
- 4)** The CPS system improves my problem solving skills.
- 5)** The CPS system increases my desire to come to class.
- 6)** The CPS system is fun to use.
- 7)** I like the CPS system because it breaks up the lecture.
- 8)** The CPS system increases my interaction with other students.
- 9)** The CPS system is an effective teaching and learning tool.
- 10)** I feel I learned more on days when we used CPS than when we didn't.
- 11)** Multiple choice questions during lecture *without* the CPS are effective.

Please respond to the following statements (13-19) using the rating system below:

How often do the following technical aspects of the CPS system frustrate you?

- 1** *Never*
- 2** *Rarely*
- 3** *Sometimes*
- 4** *Often*
- 3** *Constantly*

- 12)** The CPS registration process on the web.
- 13)** The time it takes to register my response in class.
- 14)** The time it takes to wait for all student responses to register.
- 15)** The time it takes to switch from lecture (PowerPoint) to the CPS program.
- 16)** The reliability of the CPS system to register my intended response.
- 17)** Describe your level of satisfaction with the course.
- 18)** Rate your satisfaction with the instructor.
- 19)** Rate your overall level of satisfaction with the CPS system.

Use the yes/no rating system below to answer the following questions (21-25)

- 1 Yes*
2 No

- 20) Does the CPS system increase your willingness to ask questions in class?
21) Would you recommend the use of CPS technology in this class next year?
22) Would you recommend the use of CPS technology in other courses?
24) Do you feel that CPS technology helps you learn?

Please respond to the following statements (26-28) by circling your chosen response

25) I believe the number of CPS questions asked in a single lecture should be:

- 1 6 or more*
2 4-5
3 2-3
4 1
5 0

26) What is a reasonable price for the CPS remotes?

- 1 Cost is not a factor*
2 \$30-40
3 \$20-30
4 \$10-20
5 They are not worth paying for

27) Do you find the class more/less enjoyable than expected?

- 1 Significantly more enjoyable*
2 More enjoyable
3 About what I expected
4 Less enjoyable
5 Significantly less enjoyable

Please provide a short answer to the following questions:

What do you like best about the CPS System?

What do you like least about the CPS System?

What suggestions do you have for increasing the effectiveness of CPS (*what types of questions do you like/dislike, logistical concerns, etc.*)?