

Evaluating the effectiveness of teaching climate change as a general education undergraduate course using a traditional lecture format and a hybrid online-traditional lecture approach



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Abstract

During the 2009-10 academic year, we established a new CSULA course, "Climate Change and the Developing World." The course was developed for inclusion in an Upper Division General Education Theme entitled "The Challenge of Change in the Developing World." CSULA students are required to complete a theme comprised of three interrelated courses distributed among three areas including Natural Sciences and Mathematics, Social Sciences, and Humanities. Our climate change course comprised the natural sciences component of the theme. We used varying instructional approaches to teach the course which allowed us to make preliminary observations about the effectiveness of each in improving student learning. In the fall quarter (10-week session) the course, which enrolled over 30 non-majors, was presented in a traditional four hour/week lecture format. Students attended lectures, read the text, *Global Warming & Climate Change Demystified*, took two exams and completed group research projects. In the spring quarter, we used more online instruction and followed the American Meteorological Society's undergraduate *Climate Studies* course format including use of the AMS *Climate Studies* text, *Investigations* (laboratory) manual, and online exercises. An online course management system was also used in the spring when enrollment reached the 43 student capacity, with others on a waiting list. Students also completed group projects. Contents for the textbooks used were thin in the area of the impacts of climate change on developing nations. To meet theme and course objectives, the assigned group projects led students to investigate the effects of climate change on a developing country. Each group of four or five students presented their report both in written and oral form (all groups had PowerPoint presentations). Overall, the presentations were quite good and showed good collaborative learning. In the spring course, pre- and post-course surveys were used to assess student learning. Generally the surveys showed an increase in climate change knowledge. However, in some areas students did not master basic concepts/information such as the role of ozone in climate change, the composition of greenhouse gases, and defining El Niño and identifying its role in natural climate variability. Anecdotally, students taught through the traditional lecture format also showed improvement in climate change knowledge and demonstrated a greater appreciation for the impacts of global warming on developing nations. As with the spring course, concepts such as El Niño, the Pacific Decadal Oscillation, and orbital climate forcing proved more difficult to grasp. According to evaluations, students more greatly appreciated the online

Background

California State University, Los Angeles (Figure 1) is a culturally diverse school that mirrors the region from which its students come. 60% of students live within a 10-mile radius from the school with the majority from East Los Angeles.

- University: 21000 students, just 5 miles from downtown Los Angeles in East Los Angeles
- Ethnicity: 52% Latino, 22% Asian, 16% white, 9% African American
- Gender 61% female, 39% male



Figure 1. California State University, Los Angeles located just 5 miles from downtown Los Angeles in East Los Angeles

Introduction

Students at Cal State LA are required to complete a 12-unit upper division theme as part of the General Education program. A theme consists of three interrelated courses on the same topic, designed to help students acquire knowledge of topics that are current, enduring, and of significant importance for humanity. Topics are designed to promote: an understanding of oneself and one's fellow human beings, the social and physical environment, and a wide range of cultural achievements; an understanding of the shared concerns of all people as well as diverse cultural heritages; and an awareness of ethical and social concerns and a cultivation of moral responsibility. Courses in each theme are distributed among three areas including: Natural Sciences and Mathematics, Social Sciences and Humanities. Students must select one course from each area. We developed a course entitled Climate Change in the Developing Nations for inclusion as part of the Natural Science block in one of the themes. Typically, the courses enroll between 20-35 students, are 4 units each and are taught in a 10-week quarter format. The course is cross-listed with Geology and Geography.

Students must choose theme courses outside of their major department/division/school unless a waiver has been approved by the General Education Subcommittee. One course from three areas: Natural Sciences and Mathematics; Social Sciences and Humanities (12 units required) must be completed. The courses in this theme are listed below.

Natural Sciences and Mathematics area: [GEOG/GEOL 312](#), [GEOG 333](#), [GEOL 351](#), [HS 356](#)

Social Sciences area: [COMM/LBS 395](#), [ECON 360](#), [HIST 360](#), [\(d\)LAS/PAS/POLS 360](#)

Humanities area: [\(d\)LAS/PAS 342](#), [\(d\) MUS 358](#), [PHIL 334](#), [TVF 324](#)

(d) denotes diversity courses which will satisfy both the upper division and diversity requirements

Figure 2. Example of courses in our theme area. Geol/Geog 312 is the climate change course we developed.

Course Teaching Strategies

In an attempt to determine a more effective teaching strategy, we used both online and traditional lecture methods.

Traditional Lecture Format

- Approximately 30 students enrolled
- Students met 4 hours/week for lecture
- Lectures centered on PowerPoint presentations
- Two exams consisting of multiple choice, fill-in-the-blanks, and essay questions were given
- Readings from *Global Warming & Climate Change Demystified*
 - Book is very basic, best for non-science majors, & easy to follow.
- Students were assigned group projects on impacts of climate change on a developing nation or nations in a particular geographic region of the globe. Groups consisted of 4 students each and were instructed to develop oral and written presentations on their topics
- One field trip to the coast to examine evidence of sea level change tied to global warming was scheduled

Hybrid Lecture-Online Format

- Approximately 43 students enrolled
- Lectures centered on PowerPoint presentations
- Students met 4 hours/week for lecture
- Used American Meteorological Society's Climate Studies Text
- Used American Meteorological Society's Investigation's Manual
- Assigned American Meteorological Society's online exercises
- Students assigned group projects on impacts of climate change on a developing nation or nations in a particular geographic region of the globe. Groups consisted of 4 students each and were instructed to develop oral (powerpoint) and written presentations on their topics
- The use of AMS materials for our climate change course was driven by our affiliation with the AMS education office. LaDochy and Ramirez have been involved with AMS online oceanography and meteorology courses for teachers. We were selected to help pilot the climate change course for undergraduates.

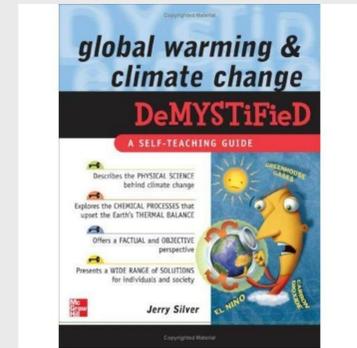


Figure 3. Textbook used for traditional lecture format course. Image from Amazon.com



Figure 4. Students and instructor examining sediment retrieved from the ocean floor during the ocean cruise required for the laboratory component of the oceanography course.

Results

Anecdotal and Pre and post-test surveys indicate the following

- Student learning increased through the use of both of the instructional formats
- Pre-and post-test survey for the hybrid method show improved student learning (Table 1)
 - Overall, average class improvement from pre to post-test was 17%
- Evaluations indicate students enjoyed the access to online materials
- Textbooks were an issue
 - The textbook for the traditional class contained some serious scientific errors and may have to be replaced
 - Both textbooks used were thin in the area of impacts of climate change on developing nations
- We are encouraged by the modest improvement in student learning. We will likely use a hybrid instructional method in the course.
- For both instructional methods used, students still had difficulties with the role of greenhouse gases in climate change, El Niño/La Niña climate variability, and how ozone is tied to climate change

Percent Improvement on Post-Test

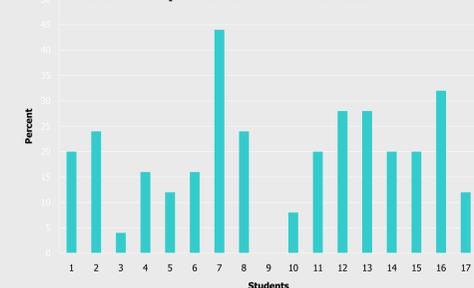


Table 1. Percent improvement in post-test surveys. 17 students took the exam. Percent improvement ranges just over 40% to 0%.

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