ED43B-3466 Implementation of InTeGrate Modules into Introductory Courses in the El Paso Higher Education Community

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ABSTRACT

InTeGrate (Interdisciplinary Teaching about Earth for a Sustainable Future) has developed teaching modules that focus on Earth sustainability and Earth-centered societal issues. We have begun to implement modules on climate change, earth materials and fresh water/environmental justice into our introductory geology and environmental science courses taught at the University of Texas at El Paso (UTEP), El Paso Community College (EPCC) and local early college high schools (ECHS) for classes ranging in size from 20 to 220 students. Our eventual goal is to insure that students taking introductory classes at any local institution will be exposed to comparable content and be similarly prepared for advanced courses. Our initial results suggest that the modules' use of case studies and analysis of authentic data sets are very appealing to our student body (over 70% Hispanic). Since many students do not speak English at home, they were sometimes challenged by the vocabulary presented in some modules. Modules containing glossaries and extensive background material (such as concept maps and annotated figures) proved very helpful to these students. The use of pre-activity quizzes insured that the students had mastered basic concepts needed for the in-class activities. Modifications required to teach these modules in larger classes included condensing materials and reducing the amount of color figures to save paper and printer costs, streamlining dissemination/collection of in-class group assignments, and adapting assignments such as jigsaw activities and gallery walks to the confines of a large lecture hall with fixed seating. Student reflections indicated students were able to make connections to societal issues and retain these ideas through the end of the courses.

INTRODUCTION

This poster focuses on the results of teaching selected units within the "Climate of Change: Interactions and Feedbacks between water, air and ice", an InTeGrate module that is publically available at :
http://serc.carleton.edu/integrate/teaching_materials/climate_change/index.html
Six units have been developed for this module, and if all are taught, they should take 2-3 weeks to cover.

In September we agreed to cover Unit 1 (Forecasting Climate Variability), Unit 2 (Deciphering Short-Term Climate Variability) and Unit 3 (Anomalous Behavior). Unit 1 focuses on how the Inca, Maya and Greenland Vikings adapted/failed to adapt to climate change and includes a pre-class reading/quiz and a gallery walk activity. Unit 2 has two case studies that involve reading and interpreting sea surface temperature, wind direction, precipitation and pressure maps for the equatorial Pacific and north Atlantic. Unit 3 has two case studies that focus on ENSO and NAO. In October we selected multiple choice questions related to these units that we would use to assess student learning, as well as collecting student reflections. In November, however, it became clear that some instructors would be unable to cover the entire 3 units, but all covered unit 1 and over half covered units 2 and 3.

The modules were taught by 4 different instructors in the following introductory classes: Introduction to Environmental Science (UTEP class, 130 students, 15 majors), Historical Geology (UTEP class, 40 students, 2 majors), Historical Geology (EPCC class, 8 students, 5 majors), and Blue Planet (UTEP class, 41 students, no majors). As a control, we administered some of the same multiple choice assessment questions to 3 other classes at UTEP that covered climate change but did not use the InTeGrate modules. These included 2 sections of Physical Geography (210 students, no majors) and 1 section of Introduction to Environmental Science (110 students, 2 majors). All classes contained at least 60% Hispanic students and most were 50-60% female. None of the classes have prerequisites.

TEACHING AND MODIFYING THE UNITS:

Unit 1 – This module involved a short pre-class reading followed by an in-class gallery walk activity on how the Inca, Maya and Greenland Viking civilizations coped with climate change. Several instructors required the students to turn in questions related to the reading as a homework assignment. In all but the largest class the instructors were able to conduct a true gallery walk with questions to answer posted on the walls around the classroom (Figure 1) and large spaces to write their answers. Students worked in groups and spent about 5 minutes at each station (Figure 2), following up with a final class discussion. The students enjoyed the open style discussions and participated actively. In the largest classroom large sheets of paper were placed on tables in the classroom so that students could gather around the tables for discussions since wall space along the sides of the classroom was limited. In 2013 a test of the module in a large (~220 students) with fixed seating the students passed around 11"x17" sheets of paper to answer questions.

Unit 2 – Only two of the instructors were able to complete case study 2.1 of this unit. The case study requires use of numerous color figures so students worked on the activity in groups to cut down on the reproduction costs. In the larger class the entire class practiced reading maps projected on a screen prior to breaking into groups.

Unit 3 – Only two of the instructors completed case study 3.1 of this unit. Although the unit had color figures, the figures could be modified using labels so that they could be read in black and white versions. The color figures were posted on Blackboard for the students to access during class as well as projected on a screen.

Figure 1 – Student groups discussing questions as part of a gallery walk activity. Groups spend ~5 minutes answering a posted question before moving to the next question.

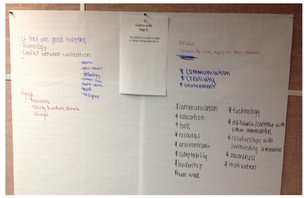

Figure 2 – Example of question (top middle) and student answers. Once all groups complete questions, a group discussion of the answers is held.

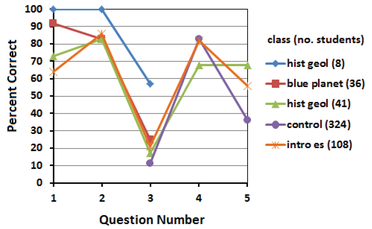

Figure 3 – Comparison of questions answered correctly by the 4 classes where InTeGrate materials were used versus a control group. Number is parenthesis is number of students in group. Question numbers correspond to numbers given in upper right hand panel of poster.

Acknowledgements

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ASSESSMENT RESULTS:

Most assessments were conducted at the end of the fall 2014 semester (week of December 8), so we have only begun to analyze the data. We focused first on the following assessment questions were administered on exams or given as out of class extra credit assignments:

Questions specific to Unit 1:

Q1: The collapse of the Mayan civilization was likely due to:
A) floods B) droughts C) extremely cold temperatures D) hurricanes E) glaciers

Q2: The Vikings may have abandoned civilizations in Greenland because:
A) they ran out of trees B) all their animals died C) they could not adapt to the harsh winters D) they fought with the native population E) it got too wet

Q3: An example of negative feedback is:
A) fresh snow reflecting more sun, causing cooling B) burning more fossil fuels to run air conditioners when it gets hot
C) dark ice absorbs sun, causing heating and melting D) greenhouse gases warm the atmosphere, causing warming of the ocean, releasing more CO_2

Unit 2 and Unit 3 related questions:

Q4: ENSO can become part of the geologic record through:
A) flooding that leaves behind sediment B) flooding that scours away sediment C) drought induced fires that leave behind burnt soils and sediment
D) A and C E) no known means

Q5: In a La Niña year we would expect to see _____ sea surface temperatures off _____.
A) higher, South America B) lower, South America C) higher Antarctica D) lower, Europe

Q1, Q2 and Q3 were given on exams in the 4 classes where InTeGrate units were taught. Q4 and Q5 were given on exams in the two classes where InTeGrate units 2 and 3. Q3, Q4 and Q5 were given as part of an extra credit assignment in the classes did not use InTeGrate materials. Figure 3 shows the percentage of students who answered these questions correctly.

In addition to the multiple choice questions, two open ended questions were asked in an exam given to the Introduction to Environmental Science class where units 1-3 were taught. These questions were:

Q6: (given as a bonus question): Give an example of a negative feedback loop that is involved in climate change. Making a drawing of the actual loop would be helpful.

Q7: Identify and describe a global challenge that society will likely face in the next 50 years. Explain how the science related to that challenge informs economic, social, and/or political decision making related to the global challenge you described.

DISCUSSION

(Figure 3 indicates that 65% of more of the students in classes where Unit 1 of the InTeGrate module was taught correctly answered Q1 and Q2 that were related to the reading and gallery walk acitvity on how civilizations adapted/did not adapt to climate change. All groups, including the control group, had difficulties with Q3 related to negative feedback. The control group scored the lowest (11% correct) with other classes ranging from 17 to 57% correct. Students tend to confuse the ideas of positive and negative feedback as related to natural cycles with psychological/behavioral concepts of positive and negative reinforcement (e.g. positive reinforcement diminishes unwanted behaviors in children), even though positive and negative feedback is introduced and reviewed several times in the InTeGrate units and other curricular materials. Students appeared to understand the association of the ENSO with flooding and droughts and how these phenomena could leave traces in the geologic record (Q4), but the control group appeared to grasp the concept as well as those classes using the InTeGrate Units 2 and 3. Classes using InTeGrate materials appeared to understand the effects of La Niña (Q5) better than the control group (56-68% correct versus 36% for the control group). Since Unit 3 strongly emphasizes predicting the effects of El Niño and La Niña, it is reassuring to observe that the students retained the information related to these effects.

Not only did the students in the section of Introduction to Environmental Science using InTeGrate materials do poorly on the multiple choice question related to negative feedback (Q3) (21% correct), students also found it very difficult to provide a detailed example of negative feedback for Q6. Only 12% responded correctly. Another 12% provided an example of positive feedback, rather than negative feedback, indicating their continued confusion. The student, however, readily identified global challenges (Q7) and 90% were able to elaborate on how they informed economic, social and political decision making. The top 3 challenges mentioned were global warming (40%), depletion of fossil fuels (10%) and availability of fresh water (7%).

FUTURE WORK

We have collected detailed student responses to questions imbedded in the InTeGrate units, as well as other reflection materials that we have only begun to review. We hope these materials will provide better insights into what portions of the units the students found most appealing and easiest to grasp, as well as what additional modifications may need to be made for our student population. We hope that the positive outcomes we have seen in our courses will persuade other faculty to adopt InTeGrate materials in our efforts to standardize curricular content across the El Paso high education community.