ABSTRACT

InTeGrate (Integrating Teaching about Earth for a Sustainable Future) has developed teaching modules that focus on Earth sustainability and Earth-centered socioscientific issues. We have begun to implement modules on climate change, Earth’s environments, and fresh water and 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 15-50 students. Our overall goal was to ensure that students taking introductory classes at any local institution will be exposed to comparable content and be similarly prepared for the advanced courses. Our initial results suggest that the module’s use of case studies and analysis of authentic data sets are very appealing to our study body (over 75% Hispanic). Since many students do not cope well with English, it is sometimes challenging to apply the instruction to some cases. Modules containing compelling and extensive background material and case studies were particularly useful to these students.

Some modules also included condensing materials and reducing the amount of text. However, materials (such as concept maps and annotated figures) proved very helpful to these students. The use of case studies ensured that the students had mastered basic concepts needed for the class assignment. Modifications required to teach these modules in larger classes included changing materials and reducing the amount of text. Small changes to a module will affect the outcome for all class sizes, and the development of modules must take into account of all class groups, assignments, and adapting assignments such as group activities and gallery walks to address the needs of a larger section of the classes.

TEACHING AND MODIFYING THE UNITS:

UNIT 1 - This unit involved a short class project reading followed by an in-class gallery walk activity on the topic of the two fats, Maize and Greenland Ice Margin changes and how climate change impacts them. Students were taught that maps and annotated figures are very helpful in teaching students to read a reading in class. A group discussion of the answers is held. Students were particularly interested in understanding the effects of La Niña. Since Unit 3 strongly emphasizes predicting the effects of La Niña as well as El Niño (Figure 3 indicates that 65% 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 activity on the two fats, Maize and Greenland Ice Margin changes and how climate change impacts them. All groups agreed that the control group has diffusions with ENSO-related (Q1) related to negative feedback. The control group scored the lowest (11% correct) with other classes ranging from 19% to 37% correct. Students tended to confuse the ideas of positive and negative feedback in relation to El Niño and La Niña cycles with psychological or behavioral concepts of positive and negative reinforcement (positive reinforcement = diffusion, negative reinforcement = change). Although both 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 (Figure 4). We also found that on the multiple choice question related to negative feedback, the control group got the questions correct (11% correct) with other classes ranging from 19% to 37% correct. Students tended to confuse the ideas of positive and negative feedback. Students also found it very difficult to provide a detailed example of negative feedback. Only 12% responded correctly. Another 90% were able to elaborate on how they informed economic, social and/or political decision making. The top 3 challenges mentioned were global warming (Q7) and 90% were able to elaborate on how they informed economic, social, and/or political decision making related to the global challenge you described. 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.

ASSESSMENT RESULTS:

Most assessments were conducted at the end of the Fall 2014 semester (week of December 1) 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:

Q1: The collapse of the Mayan civilization was likely due to A) higher, South America B) lower, South America C) higher Antarctica D) lower, Europe

Q2: The Vikings may have occupied Greenland because A) it got too cold B) they ran out of trees C) all their animals died D) they fought with the native population

Q3: An example of negative feedback in 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

Q4: Dark carbon uses A) more fossil fuels to cool air conditions when it gets hot B) dark adsorbs less energy, causing heating and melting C) greenhouse gases warm the atmosphere, causing warming of the surface, releasing methane D) lower, Europe

Q5: Which maps are more likely to be used in the future? A) black and white B) color C) lower, South America D) higher Antarctica

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: Interview the teacher and determine if any changes would be made to the module. A) higher, South America B) lower, South America C) higher Antarctica D) lower, Europe

Q8: Did you see any area where your class performed poorly on the module? 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

Q9: What are some of the same multiple choice assessment questions to 3 other classes at UTEP that were given as out of class extra credit assignments in the classes did not cover literature materials. In addition to the multiple choice questions asked, an extra credit was given to the Introduction to Environmental Science class where only 2 classes were taught. These questions were:

Q4: Light and darkness creates a feedback loop that is involved in climate change. Making a drawing of the actual loop would be helpful.

Q5: Describe how global sustainability should likely vary 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.

FUTURE WORK

We have collected detailed student responses to questions intended to elicit the InTeGrate units, as well as other reflection materials that we have just begun to review. We hope that the data and materials will provide better insights into what portions of the module the students were engaging with and what did not appeal to students, as well as what additional instructional features may need to be added for our student populations. We hope that the positive outcomes we have seen in our classes will persuade other faculty to adopt InTeGrate materials in our efforts to standardize curricular content across the El Paso higher education community.