**Abstract**

The goal of the Climate Change Narrative Game Education (CHANGE) project, funded by NSF (DRL-1316782), is to help high school students learn complex GCC science by making it personally relevant and understandable. The CHANGE prototype curriculum, including standardized tests and surveys, was integrated into three high schools’ elective Marine Science courses as a pilot during AY 2014-15. Following the continuous improvement model suggested by Imai, the student outcomes were analyzed, and two major areas for improvement were evident. (1) Student learning in specific topic areas was lower than expected and (2) student learning was inconsistent between instructors. Root-cause analysis of these shortcomings revealed that the first issue was due to gaps in the instruction and lab material provided to teachers. In the second case, the material was sufficient, however the material was outside the area of expertise of some teachers, resulting in inconsistent outcomes among student populations. In order to address these shortfalls, major portions of the classroom and laboratory curriculum were revised, along with the creation of sample class discussions and notes, which provide guidance to teachers on difficult topics.

**Objectives**

- Identify areas of CHANGE curriculum that need improvement.
- Recommend & obtain approval for realistic plan to overcome any major shortcomings before full implementation in is AY 2016-17.
- Upon approval of stakeholders, update curriculum as needed.

**Approach**

Teach

Develop Curriculum

Evaluate Outcomes

Plan

Continuous Improvement

Continuous Improvement of Teaching

**Analysis**

Students rank-order GCC causes, highlighting typical teacher misconceptions

<table>
<thead>
<tr>
<th>Issue</th>
<th>Correct order</th>
<th>Pre (N=243)</th>
<th>Post (N=218)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning Fossil Fuels</td>
<td>1</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Automobiles</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Farming/Agriculture</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Deforestation</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Nuclear Energy</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ozone Depletion</td>
<td>6</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Pre - Marine Science student responses at beginning of AY
Post - Marine Science student responses at end of AY

**Planning**

- Must be complete before start of AY 2016-17.
- Rework instruction and lab material to address shortfalls.
- Create sample lessons and notes for teachers.

**Curriculum Development**

- Redesigned 6 slide decks
  - 73 slides encompassing 5 chapters
  - Addresses identified shortfalls
  - Emphasizes GCC science & effects in Tampa Bay region
- Authored 5 sample lessons (72 pages of text)
  - Teaches the teacher on difficult topics
  - Each slide highlighted for quick reference
  - Poses questions for students along with answers

**Conclusions**

- AY 14/15 pilot incorrectly assumed teachers already possessed technical knowledge about GCC
  - Misinformation presented to students, or
  - Lack of instruction for some topics
- Student knowledge of scientific concepts were overestimated
  - Better background information is needed
- Path ahead:
  - Pilot updated curriculum in AY 15/16
  - If successful, fully implement in AY 16/17

**References**


For more information about the program visit: http://bit.ly/RISE-USF. The Robert Noyce USF Scholarship Program for Science Majors is funded by the National Science Foundation under award DUE-1439776.