Learning Outcome 1 – Unit Conversion

Methods

We assessed students’ ability to properly implement unit conversions using samples of work from 17 students enrolled in GEL 3100 (Environmental Systems Analysis) during the Fall 2015 semester and 21 students enrolled in GEL 5510 (Environmental Fate and Transport of Pollutants) during the Winter 2016 semester. GEL 3100 is an intermediate course in which students develop quantitative analysis skills. GEL 5510 is a capstone course requiring students to apply knowledge and skills developed earlier in the Env Sci course sequence.

The GEL 3100 assessment included a quiz question requiring three unit conversion steps and one exam question requiring two unit conversion steps. Thus, student performance on a total of five unit conversions was assessed.

For each problem, the total number of correct unit conversions was counted and divided by the total number of unit conversions attempted. Problems or portions of problems not attempted by students were not included. In addition, the number of unit conversions that were documented (i.e., the student showed his/her work) and the number of unit conversions with correct problem setups were also counted and divided by the total number of unit conversions attempted. In this way, two performance metrics were generated: percentage of correct unit conversions and percentage of documented unit conversions.

Results

In the GEL 3100 sample set, students completed 70% of unit conversions correctly. In the same sample set, students provided documentation of their work for 96% of their unit conversions. 70% successful unit conversion meets our stated goal of 70% correct and 96% of unit conversions documented exceeds our stated goal of 80%.

In addition, an analysis was undertaken to determine what types of errors were most commonly made by our students. We found that the majority of errors occurred during setup of the problem to be solved (commonly missing or inverted components) followed by error propagation (carry through of earlier errors in multistep problems).
In the more advanced GEL 5510 sample set, students completed 79% of unit conversions correctly. In the same sample set, students provided documentation of their work for 85% of their unit conversions. These levels represent tangible improvement over the performance of students in the 2014-2015 assessment (70% correct and 62% documentation of unit conversions). However, a 79% successful unit conversion falls below our stated goal of 85% correct; although, 85% of unit conversions documented meets our stated goal.

2015-16 B.S. Environmental Science Learning Outcome Assessment - Unit Conversions

<table>
<thead>
<tr>
<th>GEL 5510 - Winter 2016</th>
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<tbody>
<tr>
<td>Student 1 2 3 ... Attempted 286</td>
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<tr>
<td>Total Conversions Documented 244 85%</td>
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<tr>
<td>Total Setups Correct 243 85%</td>
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<tr>
<td>Total Conversions Correct 226 79%</td>
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Learning Outcome 2 – Ecological Writing

Methods

We assessed students’ ability to convey ecological concepts effectively in written form using samples of work from 13 Environmental Science majors enrolled in BIO 4130 (Ecology) during the Winter 2016 semester and 7 Environmental Science majors enrolled in BIO 5100 (Aquatic Ecology) during the Fall 2015 semester. BIO 4130 is a formative intermediate course in which students solidify their understanding of ecological concepts. It is also the Environmental Science Program Writing Intensive course. GEL 5510 is a capstone course requiring students to apply ecological knowledge and analysis skills developed earlier in the Env Sci course sequence to situations encountered in a field setting.

Assessment of student work in both courses involved the application of rubrics intended to measure both the students’ understanding of ecological concepts as well as their ability to communicate that understanding in written form. The BIO 4130 assessment involved the term paper (culmination of the Writing Intensive experience). The BIO 5100 involved two open-ended essay questions delivered as part of the course final exam.

Results

In the BIO 4130 sample set, 77% of student responses met or exceeded expectations for understanding of ecological concepts and written communication of ecological concepts. This exceeded our stated goal that 70% of students would meet or exceed expectations. Writing mechanics was flagged as an area for future skill development among environmental science majors.

In the BIO 5100 sample set, 89% of student responses met or exceeded expectations for understanding of ecological concepts and written communication of ecological concepts. Two areas stood out for future attention: correct usage of terminology associated with environmental concepts as well as basic writing mechanics.
2016-17 Action Plan

As a consequence of the 2015-16 assessment results, four actions are planned for the 2016-17 academic year:

1. Continued emphasis on unit conversions will be placed in courses where unit conversion skills are developed and practiced including GEL 2130 (Mineralogy), GEL 3100 (Env Systems Analysis), GEL 5150 (Soils), BIO 5100 (Aquatic Ecology), and BIO 5440 (Terrestrial Ecology).

2. Continued emphasis on ecological writing, and in particular articulation of ecological concepts and practice with writing mechanics, will be stressed in BIO 3500 (Ecology and the Environment), BIO 4130 (Ecology), and BIO 5440 (Terrestrial Ecology).

3. A new learning outcome, focusing on the interpretation of environmental data and relationships among environmental variables displayed in figures and charts, will be assessed.

4. An additional new learning outcome, focusing on the quantification of uncertainty and propagation of error in environmental calculations, will also be assessed.