Biology M200 Assessment – Summer 2013  
Principle 2 – Focus on Knowledge and Interpretation of Scientific Method

Introduction

Effective education begins with a plan and is evaluated by assessment of learning. Principle 2 at Indiana University Northwest has several learning outcomes. Of interest here are those related to the section on the sciences where students are expected to

- recognize and understand how scientific theories are formulated, tested, and validated.
- approach problems using scientific methods, which include: defining parameters of problem, seeking relevant information, subjecting proposed solutions to rigorous testing, and drawing conclusions based on the process.

In general education science courses, one can teach and assess these outcomes most readily in laboratory sections.

Methods

To assess the level of student achievement of these outcomes in two Biol M200 labs, a general education biology course for pre-Nursing and other students, we identified questions on the lab final practical exam that related to general biological knowledge and others that related to understanding and application of the scientific method. For the lab final of summer 2013, we chose two lab sections and designated questions 1-59 as general biological knowledge and questions 60-66 as related to the scientific method. For the latter, questions involved general application of the scientific methods (e.g. asking if a scientist can “prove” a hypothesis correct) as well as application to specific lab research they performed (e.g. do the data collected “prove” the hypothesis).

The sample size of students was 22 and 17 in the two labs. We determined the percentage of students getting each question right and calculated mean and standard deviation of percentage correct for questions 1-59 and the same for questions 60-66. For each class, we then compared the statistical significance of any difference in means by a two-tailed t-test (two-tailed because we had no a priori prediction of how well we were teaching general content vs. scientific method material).

Sometimes statistical tests on percentages can be misleading if data values are consistently near 100% (certainly desired!) but that was not the case here. Also, there has been a tradition of data transformation of percentage data, specifically \( \text{arcsin} \sqrt{\text{proportion}} \); however, recent theoretical analyses suggest this transformation is not valid. Therefore, we used untransformed data (percentage of students getting a question correct).

Results

The mean correct for questions 1-59 was 70.3% (sd=10.7) for one section and for the other was 69.5%(sd=8.3) and the mean correct for questions 60-66 was 79.8% (sd=18.3) and 81.2%(sd=19.9) for the same, respective sections. For the first pair of means (70.3 and 79.8)
the t-test p value~0.05 and for the other pair of means P<0.05. Together, these results suggest that M200 learned the scientific method (questions 60-66) better than general questions.

**Interpretation**

It appears that M200 students do answer questions on the scientific method better than they do questions of general content. We did not find this trend for Biol L100 students.

**Implications for Assessment**

Biol M200 students actively seek a career in science (mostly in Nursing). The data presented here suggest that such students readily learn the scientific method. In our assessment of Biol L100, students did not more readily learn the scientific method. Perhaps one can surmise that students not planning a career in science (L100) do not see learning the scientific method as vitally important, while those that do plan a career in science (M200) do see learning the scientific method as important.