Assessment Findings Bulletin One Spring 2010 – Natural Sciences

Introduction

This new Assessment Findings Bulletin presents key findings and recommendations from our fall 2009 Assessment Report for the Natural Science General Education Objectives. The purpose is to disseminate data more widely, stimulate dialogue and create greater utilization by faculty, administrators, staff and students. The bulletin contents will coordinate with classroom posters designed to engage students and faculty in conversations about how we can all improve student learning outcomes.

Research Methodology

The HWC Natural Sciences Assessment Tool was a hybrid indirect measure comprised of two distinct sections. The first concentrated on important demographic data about our student respondents and specifically identified the amount and source of their successful completion of previous natural science college courses.

The analytical student categories were as follows:

- No previous natural science courses
- 1 or 2 natural science courses taken at HWC
- 1 or 2 natural science courses taken at other colleges
- 3 or more natural science courses taken at HWC
- 3 or more natural science courses taken at other colleges

The second section of our assessment tool utilized the general science version of the Epistemological Beliefs Assessment for Physical Sciences (EBAPS), created by Dr. Andrew Elby from the Department of Physics at the University of Maryland.

EBAPS contains 30 statements that assess students' views along five non-orthogonal epistemological axes:

1. Structure of scientific knowledge
2. Nature of knowing and learning
3. Real-life applicability
4. Evolving knowledge
5. Source of ability to learn

HWC Assessment Committee adapted this tool to ensure we collected data which was appropriate to our specific urban student context and which spoke directly to our approved student learning outcomes. More details of adaptations are contained within the full report.

HWC General Education Student Learning Outcomes for the Natural Sciences

The following SLOs were approved by the Assessment Committee on October 31st, 2007. "The student will be able to:

1. Formulate reasonable explanations of natural phenomena based on thorough observations;

2. Interpret and articulate scientific results that are presented in verbal, graphic and/or tabular form;
3. Critically evaluate scientific resources and scientific claims presented in the media; and,
4. Apply steps of the scientific method to solve problems."

Implementation and Analytical Framework

Data were gathered during the October Assessment Week of the fall semester 2008.

- 36 faculty accompanied their students to complete the questionnaire
- Faculty from 8 academic departments contributed to data collection
- We used 46 faculty volunteered class sections
- This voluntary faculty-driven activity resulted in an initial 845 completed surveys

Taking the credit student enrollment figure to be 7,748, this represented a sample size of 10.9% of our students. This was above the required 10% for the accuracy of the sample. There was some imbalance between level 100 and level 200 volunteered sections that we were not able to even out. Completed surveys came from 512 students in 27 level 100 classes and 369 students in 19 level 200 classes. The average response rate from selected sections was 19 completed student surveys, across both level 100 and 200 courses.

There were 831 usable surveys on which the analysis was based. Item analysis, cross tabulations and ANOVA statistics were utilized to analyze data and generate results.

The general framework for grading EBAPS answers was premised on uncovering student capability to identify 'expert' response choices. Common patterns of 'knowing' and 'being' shift in complexity and relatedness as student responses move from 'novice' to 'expert' and students exhibit an orientation to a deep level of learning. This framework is formulated specifically within this tool as follows:

Structure of scientific knowledge. *Are physics and chemistry weakly connected pieces without much structure and consisting mainly of facts and formulas? Or do they constitute a coherent, conceptual, highly structured, unified whole?*

Nature of knowing and learning. *Does learning science consist mainly of absorbing information? Or, does it rely crucially on constructing one's own understanding by working through the material actively, by relating new material to prior experiences, intuitions, and knowledge, and by reflecting upon and monitoring one's understanding?*

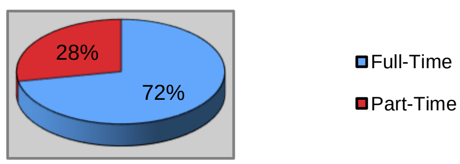
Real-life applicability. *Are scientific knowledge and scientific ways of thinking applicable only in restricted spheres, such as a classroom or laboratory? Or, does science apply more generally to real life?*

Evolving knowledge. *This dimension probes the extent to which students navigate between the twin perils of absolutism (thinking all scientific knowledge is set in stone) and extreme relativism (making no distinctions between evidence-based reasoning and mere opinion).*

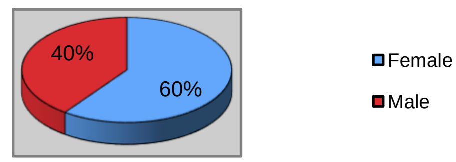
Source of ability to learn. *Is being good at science a matter of fixed natural ability? Or, can most people become better at learning (and doing) science?*

Respondent Demographics

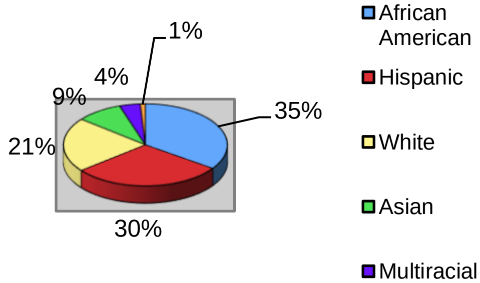
The assessment sample population reflected our general student population at the time and can be seen in the following snapshots:



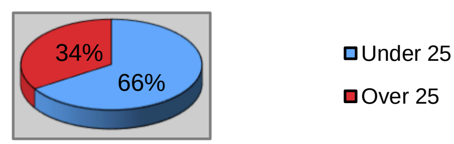
Respondent Registration Status



Respondent Sex



Respondent Race/Ethnicity

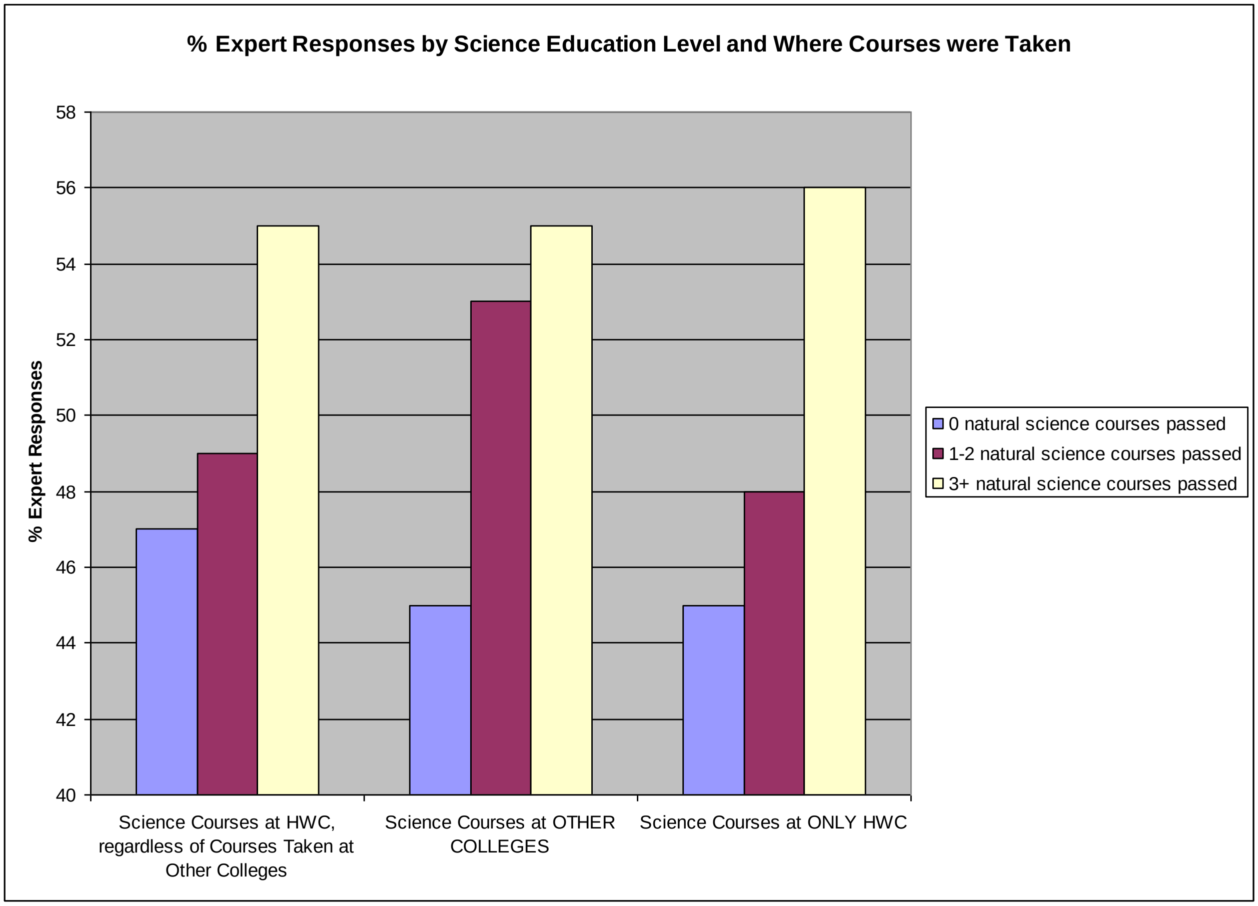


Respondent Age

Key Findings

- 74% of HWC students are comfortable with science *but* only 30% would take a science class if not required to do so.
- Since coming to HWC, 57% of our students *feel confident* about understanding what they read, see and hear.
- Since coming to HWC, 56% of our students agree they are *more likely* to discuss 'life's big questions'.
- Since coming to HWC, 52% of our students are *more likely* to read different types of books.
- 50% of HWC students agreed, to some degree, that the study of science has useful applications to their everyday lives.
- Students consider the work of the instructor paramount in their own efforts to learn science.
- There was a statistically significant difference in 'expert' responses between those students who have taken no natural science courses and those who have taken 3 or more classes. These results are similar among student groups who have taken

natural science courses *only* at HWC and those who have taken natural science courses *only* at other institutions. See graphic:



- ❖ Our natural science courses are as good as other colleges' natural science courses for impacting student learning outcomes and increasing *expert-like* responses in the natural sciences.

What does increasing 'expert-like' mean?

Structure of scientific knowledge – students tend to shift from believing that natural science knowledge consists of memorizing facts, formulas and pieces of information to believing that it is a coherent and structured whole.
Nature of knowing and learning – students' thinking shifts from considering that learning science consists of absorbing information to believing that learning is based on constructing understanding. This understanding is built through learning activities, previous knowledge, intuitions and experiences.
Real-life applicability – students move to believing that scientific knowledge applies to their own lives while at the same time developing or increasing their personal interest about natural science.
Evolving knowledge – as their science experience progresses, students understand that science is an evolving process that is enriched with continued advances in knowledge and learning. Also, they become able to differentiate between opinions and evidence-based interpretation.
Source of ability to learn – the increasing trend in the data shows that our students evolve from the attitude that learning and practicing science is a matter of fixed natural

ability to believing that effective hard work and good study practice strategies are critical factors for success in learning and applying science.

Recommendations and Reflections

The purpose of assessment is to help both students and teachers improve student learning outcomes. Our recommendations, in large part, take the form of more complex questions we need to ask in pursuit of continued commitment to collaborative action for improving student learning at HWC. There are a number of recommendations the Assessment Committee makes using our analysis of the natural science assessment data.

A. As students take more science classes, their understanding becomes more complex, and there is a clear shift from surface definitions of learning to deep definitions of learning.

1. How can faculty support this crucial shift in knowing and learning in all subject areas?
2. How can faculty and administration support more students to make this key shift even if the students take only the minimum natural science courses to successfully graduate?
3. How can faculty improve the ‘applicability’ and relevance of the natural sciences to more of our students?

B. There is clearly a significant shift in expert-like responses when students have successfully completed three science courses or more.

1. Is this effect simply a matter of time, immersion or internalization of the scientific method?
2. Is this effect about more complex expectations, engagement and instructor frames of reference when students pursue science courses beyond the general education requirements?
3. How can instructors move students more rapidly to expert-like understanding of knowledge and learning, even if they only complete one or two natural science courses?
4. Do initial natural science courses contain a lot of ‘content’ that both students and instructors feel necessary to ‘cover’ to be successful?

C. While this assessment and these data were specifically focused on the natural sciences, much applies to student learning in general that could have applicability across a range of disciplines.

1. Can faculty, departments and administration use the shift in student understanding about learning identified in these data (from capability is fixed and innate to capability is directly related to skills practice, real life, and key learning strategies) to improve impact in curricula areas where we already know our students are challenged: English and Math?
2. Do we know what conceptions of learning our entering students have, and how we can exert maximum and speedy influence on this?

D. Considerable professional development resources have been invested in moving faculty from a 'teaching' to a 'learning' orientation. This has certainly been evidenced in policy, documentation and other institutional artifacts.

1. Can the Assessment Committee, CAST, departments and disciplines collaborate more to record practical improvements in student learning, assessment practices and instruction?
2. How can this collaboration happen through simple and targeted implementation?

E. Over time the Assessment Committee has continued to improve its own expertise, through learning in practice. We continue to learn and know that our 'expertise' is always open to change.

1. How can the Assessment Committee speed the timeframe between data gathering and dissemination of findings and recommendations?
2. How can we engage with more faculty, more deeply, to increase the impact of general education assessment findings?
3. Can we design assessments that are 'smarter', requiring less time, and are embedded rather than added on?
4. Can we focus assessments more tightly and capture evidence-based change?

The full '2008 General Education Natural Science Assessment Report' (Fall 2009) can be viewed in full and downloaded from the Assessment Committee Website:
http://sites.google.com/site/hwcassessment/ or
http://faculty.ccc.edu/colleges/hwashington/assessment/

We are very grateful to Liliana Marín, Jaime Millán, Christopher Kabir and Kurt Sheu for all their work on this assessment and report.