Survey Validation

Interviews

39 Students Interviewed on essay survey (“think aloud”): Responses were scored by two reviewers for common answers and misconceptions and used to create survey questions and answer choices.

38 Students Interviewed on MC survey (“think aloud”): Prior to the final survey, questions that received responses (incorrect or correct) with reasoning that did not match the answer choice were revised. This led to 4 dropped questions and 8 with minor and 4 with major revisions. For the questions on the final survey, each question had at least 5 students choose the correct answer for correct reasoning (with the exception of Q3, a particularly difficult question that only received 4 correct responses during interviews). Among distracters receiving more than 15% on the pretest, we collected a average of 5 interview responses (with at least 2) that accurately matched reasoning to the answer choice.

6 Expert Reviews (online survey): Experts answered the survey questions and commented on question accuracy, clarity, and alignment to goal. Of the questions on the final survey, 95% of expert responses were correct. Any questions with issues raised in the comments were either revised (5 Qs) or dropped (6 Qs).

Reliability

Test-Retest (Correlation of percent correct between Spr07 & Fall09):

ALL: r = 0.88

Excluding Q4,14,16 (due to distractor difference): r = 0.92

Commonly available test-interater reliability range between 0.8 and 0.9.

Distracter Distribution: There were no significant differences among the answer choice distributions between Spr10 & F09. (Chi-Square tests; p values range 0.27-0.45; no comparison available for Q4,14,16)

Examples of HACS Utility

EVALUATING INSTRUCTIONAL TECHNIQUES

The HACS has demonstrated how specific homework questions targeting misconceptions can lead to student learning gains on the assessment. E.g., a single homework question appears to increase student learning gain on Q22 (assessing students’ mental models of the overall organization of neuronal connections in the body).

Q2: Gain: PRE Homework Q: 19%, 19%  POST Homework Q: 32%, 29%

For more details see the poster:

Students want homework! Who is it helping, how it helps, and ways to make it work for you.

All Departments: Sarah Wise, Jai Shl, and Françoise Bentley

COMPARING FACTUAL KNOWLEDGE & DEEP UNDERSTANDING

Commonly, students possess factual knowledge about biology without having a deep understanding of the underlying principles or ability to apply those principles. We have embedded several pairs of questions in the HACS that illuminate these issues. Here we present data from one of those pairs:

Smooth Muscle Layering (LG3): In Human Anatomy students learn about the arrangement of smooth muscle layers in the intestine. The reason why multiple layers are needed is that muscle cells can only contract in one direction. Thus if the muscle needs to contract in different directions, multiple layers with different cell orientations are required.

While students are very familiar with the number of muscle layers, they struggle to reason on the process that multiple layers would need and/or how to make the contraction more powerful (bottom).

Q14 L-Gain: 75%

Q14 P=.004; P=0.85

HACS L-Gain w/ D:0.26; D:0.34

Q17 L-Gain: 21%

Q17 P<.000; P=0.28

HACS L-Gain w/ D:0.22; D:0.36

Future Directions & Acknowledgments

• General use in Human Anatomy to examine effectiveness of course changes.

• Sharing results with other faculty. For example, sharing results with the faculty teaching upper level courses: Physiology I/II, Neurophysiology, Biomechanics, etc.

• Use selected questions on senior exit survey.

Thank you to all the students who interwined and/or took the survey in class and to the experts who gave feedback on the HACS.

Thank you to Prevent Education for permission to use figures from Human Anatomy by Manley, Manly, and Wilhen. We received IRB approval for survey administration in class ( exempt status, protocol 0108.9) and student interviews ( expedited status, protocol 0015.08). All work was supported by CU Science Education Initiative in the Department of Integrative Physiology.