

# Supplemental Material

*CBE—Life Sciences Education*

Hsu *et al.*

**Supporting information for Hsu *et al.*, “Investigating the influence of assessment question framing on undergraduate biology student preference and affect”**

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**Supplemental table 1.** Demographic data for the three sections. No students identified as non-binary. Given that students could select more than box for race or ethnicity, the percents sum up to greater than 100%.

Section	Number participating (percent of class)	Gender	Major	Class year	Percent first-generation students	Percent transfer students	Race or ethnicity
1	29 (53.7%)	69.0% female; 31.0% male	44.8% Health Sciences; 17.2% Applied Human Physiology; 17.2% pre-pharmacy; 13.8% Biochemistry; 6.9% Biology	69.0% first years; 13.7% second years; 17.2% third years; 0% fourth years	17.2%	10.7%	51.7% Asian; 51.7% White; 6.9% LatinX; 3.4% Black
2	51 (92.7%)	90.2% female; 9.8% male	38% pre-pharmacy; 30% Health Sciences; 12% Biochemistry; 8% Applied Human Physiology; 6% Chemistry; 2% Biology; 2% Environmental Science and Policy; 2% Math	78.4% first years; 15.7% second years; 3.9% third years; 1.9% fourth years	17.6%	5.8%	56.9% Asian; 29.4% White; 15.7% LatinX; 2.0% Native Hawaiian or Pacific Islander
3	42 (79.3%)	71.4% female; 28.6% male	50.0% Health sciences; 14.3% pre-pharmacy; 16.7% Biochemistry; 11.9% Biology; 7.1% Applied Human Physiology	73.8% first years; 9.5% second years; 11.9% third years; 4.8% fourth years	29.3%	14.3%	47.6% Asian; 45.2% White; 26.2% LatinX

**Supplemental table 2.** Student performance across section and assessments; quiz and exam scores are reported as percents, given that the relative point values differed between these. The mean percent is reported with standard deviation in parentheses.

	<b>Section 1</b>	<b>Section 2</b>	<b>Section 3</b>
<b>Quiz 1</b>	79.7% (15.7%)	80.8% (17.7%)	79.1% (13.8%)
<b>Exam 1</b>	78.2% (19.1%)	81.0% (15.0%)	80.4% (14.5%)
<b>Quiz 2</b>	73.7% (20.1%)	77.4% (17.0%)	75.5% (18.0%)
<b>Exam 2</b>	69.0% (19.1%)	75.7% (18.6%)	73.5% (17.0%)
<b>Quiz 3</b>	70.0% (18.0%)	78.8% (16.0%)	75.4% (16.7%)

**Supplemental table 3.** Means for sense of belonging and identity reflection in beginning of semester baseline survey.

<b>Section number</b>	<b>Sense of belonging</b>	<b>Identity reflection</b>
1	4.03 (0.68)	3.75 (0.64)
2	3.76 (0.81)	3.41 (0.82)
3	3.76 (0.82)	3.45 (0.80)

**Supplemental table 4.** Average scores for stress by section (standard deviation in parentheses).

<b>Section number</b>	<b>Assessment framing variant</b>	<b>Quiz 1</b>	<b>Exam 1</b>	<b>Quiz 2</b>	<b>Exam 2</b>	<b>Quiz 3</b>
1	Authentic	2.41 (0.97)	2.62 (1.21)	2.48 (0.99)	2.20 (0.96)	2.83 (1.06)
2	Self-referential	2.43 (0.91)	2.33 (0.89)	2.60 (1.0)	2.30 (1.04)	2.50 (0.98)
3	Classmate referential	2.57 (0.99)	2.61 (0.95)	2.54 (0.89)	2.52 (0.88)	2.72 (0.90)

**Supplemental table 5.** Average scores for identity by section (standard deviation in parentheses)

<b>Section number</b>	<b>Assessment framing variant</b>	<b>Quiz 1</b>	<b>Exam 1</b>	<b>Quiz 2</b>	<b>Exam 2</b>	<b>Quiz 3</b>
1	Authentic	3.57 (0.84)	3.61 (0.74)	3.49 (0.72)	3.45 (0.66)	3.77 (0.66)
2	Self-referential	3.38 (0.88)	3.57 (0.77)	3.47 (0.80)	3.45 (0.66)	3.54 (0.67)
3	Classmate referential	3.60 (0.81)	3.75 (0.80)	3.48 (0.77)	3.41 (0.85)	3.60 (0.82)

**Supplemental table 6.** Average scores for stress by preferred variant (standard deviation in parentheses).

<b>Assessment framing variant preference</b>	<b>Quiz 1</b>	<b>Exam 1</b>	<b>Quiz 2</b>	<b>Exam 2</b>	<b>Quiz 3</b>
Authentic	2.80 (0.16)	2.75 (0.16)	2.88 (0.19)	2.56 (0.20)	2.80 (0.18)
Self-referential	2.37 (0.09)	2.37 (0.09)	2.48 (0.10)	2.20 (0.09)	2.49 (0.09)
Classmate referential	3.00 (0.24)	2.82 (0.14)	2.90 (0.14)	2.61 (0.20)	2.61 (0.17)

**Supplemental table 7.** Average scores for identity by preferred variant (standard deviation in parentheses)

<b>Assessment framing variant preference</b>	<b>Quiz 1</b>	<b>Exam 1</b>	<b>Quiz 2</b>	<b>Exam 2</b>	<b>Quiz 3</b>
Authentic	3.70 (0.10)	3.64 (0.07)	3.50 (0.07)	3.41 (0.09)	3.66 (0.08)
Self-referential	3.51 (0.06)	3.66 (0.04)	3.55 (0.04)	3.52 (0.04)	3.72 (0.04)
Classmate referential	3.88 (0.16)	3.95 (0.08)	3.74 (0.08)	3.52 (0.10)	3.81 (0.10)

**Supplemental table 8.** Code frequencies for students' reasoning for why they preferred a certain variant, separated by student preferences. Only codes at 5% or more frequency in at least one of the sections are included.

<b><u>Code name</u></b>	<b><u>Percent of responses from students preferring authentic variant</u></b>	<b><u>Percent of responses from students preferring self-referential variant</u></b>	<b><u>Percent of responses from students preferring classmate referential variant</u></b>
Easy to read	30.0%	54.7%	16.7%
Visualization	25.0%	25.0%	25.0%
Less complexity is good	0%	10.0%	26.6%
Fewer words	10.0%	26.6%	8.3%
Identity	0%	12.5%	33.3%
Distraction due to names	0%	12.5%	0%
No preferences or major differences	5.0%	0%	0%
More complexity is good	25.0%	0%	8.3%
Authentic	25.0%	0%	0%
Similarity to past exams	15.0%	1.6%	8.3%
Stereotype threat	5.0%	0%	16.7%

**Supplemental table 9.** Code frequencies for students' reasoning for why they least preferred a certain variant, separated by student preferences. Only codes at 5% or more frequency in at least one of the sections are included.

<b><u>Code name</u></b>	<b><u>Percent of responses from students preferring authentic variant</u></b>	<b><u>Percent of responses from students preferring self-referential variant</u></b>	<b><u>Percent of responses from students preferring classmate referential variant</u></b>
More complexity is bad	47.3%	0%	31.3%
Length	19.1%	0%	50.0%
Less authentic	7.1%	13.3%	28.1%
No preferences or major changes	0%	0%	0%
Distraction due to names	14.3%	0%	12.5%
Intimidation of real study or scientist	19.1%	0%	0%
Less connected (identity)	11.9%	6.7%	3.1%
Hard to visualize	0%	26.7%	6.3%
Similarity to class and past exams	2.4%	6.7%	0%
Stereotype threat	0%	13.3%	0%
Less complexity is bad	0%	6.7%	0%



## ANOVA results

ANOVA comparison	df (between groups, within groups)	F value	Sig
Quiz 1 across the three sections	2, 112	0.12	0.88
Exam 1 across the three sections	2, 112	0.28	0.75
Quiz 2 across the three sections	2, 112	0.36	0.70
Exam 2 across the three sections	2, 112	1.22	0.30
Quiz 3 across the three sections	2, 112	2.54	0.08
Combined assessment scores across the three sections.	2, 112	0.90	0.41
Beginning of semester survey, stress	2, 149	1.39	0.25
Beginning of semester survey, identity	2, 149	2.30	0.11
During semester surveys, stress, quiz 1	2, 259	0.70	0.50
During semester surveys, stress, exam 1	2, 243	2.4	0.09
During semester surveys, stress, quiz 2	2, 215	0.30	0.77
During semester surveys, stress, exam 2	2, 221	2.2	0.12
During semester surveys, stress, quiz 3	2, 201	2.0	0.14
During semester surveys, identity, quiz 1	2, 381	2.9	0.059
During semester surveys, identity, exam 1	2, 732	4.1	0.018
During semester surveys, identity, quiz 2	2, 651	0.05	0.95
During semester surveys, identity, exam 2	2, 669	0.26	0.77
During semester surveys, identity, quiz 3	2, 608	4.5	0.012

### End of semester survey

1. Please read the three versions of the same question above. After reading all three versions, which of these versions would you prefer when taking a quiz/exam?

*[Choices: version A, version B, and version C; students were provided the three examples listed in table 1]*

2. Explain your reasoning for which choice you would most prefer when taking a quiz or exam. Please be as detailed as possible.

3. Which of these versions would you **LEAST** prefer when taking a quiz/exam?

*[Choices: version A, version B, and version C]*

4. Explain your reasoning for which choice you would **LEAST** prefer when taking a quiz or exam. Please be as detailed as possible.