

Supplemental Material
CBE—Life Sciences Education
Upchurch *et al.*

SUPPLEMENTAL MATERIALS

Access to online formative assessments in lower-division undergraduate biology courses:

Investigating barriers to student engagement

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Supplemental table 1: Survey items with number of students who responded that the item is a barrier^a

Category	Item	n students who reported as a barrier	% of sample
Technical resources	I have regular access to an appropriate device, such as a laptop or tablet, to complete the [FA] ^b .	41	3
	I have regular access to the software programs needed to complete the [FA].	50	4
	I have a reliable internet connection where I live that enables me to complete the [FA].	83	7
	I am comfortable using the electronic devices needed to complete the [FA].	53	4
	I find it easy to use the software needed to complete the [FA].	61	5
	I am able to access the internet and complete the [FA] in locations that are convenient to my daily schedule.	60	5
Instructor organization	I can access the instructor or teaching assistants for help with the [FA].	167	13
	My main point of contact, such as the instructor or teaching assistant, is generally responsive to questions about the [FA].	240	19
	I am comfortable contacting the instructor or teaching assistants with questions about the [FA].	207	16
	The due dates and times for the [FA] are clear and easy to find.	77	6
	The directions and expectations from the instructor about the [FA] are clear and the assignment is easy to locate online.	101	8
Social interactions	The instructor provides sufficient guidance in the use of the online delivery system used for the [FA].	161	13
	Other students in the course are a useful resource when I need help on the [FA].	557	44

	I am comfortable reaching out to other students to discuss the [FA].	492	39
	My interactions with students in other parts of the course, such as the lecture or laboratory, make it easier for me to work with them on the [FA].	552	44
	Working with other students on the [FA] has helped me form study groups for exams or other parts of the course	698	55
	I have had support from people outside of the course that enables me to succeed on the [FA].	638	51
	There is sufficient interaction and communication among students with respect to completing the [FA].	606	48
	I have enough time to complete the [FA] while managing my other personal responsibilities, such as job commitments or taking care of others.	162	13
	I have enough time in the week for other activities and responsibilities after completing the [FA].	165	13
Personal engagement	I take responsibility for getting the most out of the [FA].	153	13
	I normally follow through on my plans for completing the [FA].	72	6
	I make it a priority to complete every [FA].	91	7
	I find it easy to get started on the [FA].	233	18
	I avoid multitasking when I am completing the [FA].	367	29
	I can focus on the [FA] even if I receive notifications on my electronic devices.	303	24
Learning environment	I can focus on the [FA] despite the draw of other online activities, such as social media or online games.	255	20
	I put my other electronic devices on silent while I am completing the [FA].	620	49
	I can complete the [FA] in locations convenient to my daily schedule without being interrupted by others.	150	12
	The television and other videos are off when I am completing the [FA].	328	26
Open-ended prompts	You responded that you [Likert response] with the following statement: [Item text]. In 1-2 sentences, please explain why you [Likert response] with the statement.		
	You responded that you [Likert response] with the following statement: [Item text]. Is there something your instructor or institution could do to support you in regard to this statement? Please explain in 1-2 sentences		

^aAn item was considered a barrier if students selected “strongly disagree,” “disagree,” “somewhat disagree,” or “neither agree nor disagree” for the item.

^bThe portion of each question in brackets was replaced with the name of the activity used in a given course in order to use labels that would be familiar to students (e.g., “homework quiz”).

Supplemental table 2: Final survey participant demographic information by institution type

	2-year		4-year	
	<i>n</i> ^a	% of institution's sample	<i>n</i> ^a	% of institution's sample
Gender ^b				
Female	196	76	710	71
Male	53	20	277	28
Self-describe	<4	<1.6	<4	<0.4
Race/ethnicity				
Non-URM	191	74	852	85
URM ^c	48	19	119	12
Self-describe	6	2	5	0.5
Class rank				
First-year	76	29	481	48
Sophomore	78	30	236	24
Junior	39	15	172	17
Senior	12	4.6	89	9
Postbaccalaureate	27	10	7	0.7
Graduate student	7	2.7	<4	<0.4
Other	8	3.1	10	1
First-generation status				
Not first-generation	86	33	638	64
First-generation	163	63	342	34
Language spoken at home				
English	193	75	911	91
Other	60	23	83	8.3
Career plan				
Life sciences	226	87	764	76
Other	69	27	183	18

^aNumbers do not add to full sample size because some students left the given item blank. Exact counts $0 < n < 4$ not specified for privacy reasons.

^bThose who self-described their gender all identified as non-binary.

^cUnderrepresented racial/ethnic groups included participants who self-identified as African American/ Black, Hispanic/Latinx, Native American/Alaska Native, or Native Hawaiian/Pacific Islander.

Supplemental table 3: Open-ended prompt 1 codebook

You responded that you [Likert response] with the following statement: [Item text]. In 1-2 sentences, please explain why you [Likert response] with the statement.			
Code	Description	Examples	
		Item	Student quote
Intended interpretation	<ul style="list-style-type: none"> • Student response indicates a reasonable interpretation of the survey item. • It is clear that the student understands what the item is asking. • There is an apparent connection between the item and response. 	<p>I have regular access to an appropriate device, such as a laptop or tablet, to complete the FA.</p> <p>I can focus on the FA even if I receive notifications on my electronic devices.</p>	<p>“I have a personal laptop and have access to the school's computers if needed.”</p> <p>“I sometimes get distracted with my phone while I work on these assignments”</p>
Ambiguous response	<ul style="list-style-type: none"> • Student response seems somewhat related to the item. • There is a connection between the item and student response, but the exact connection is unclear. 	<p>The instructor provides sufficient guidance in the use of the online delivery system used for the FA.</p> <p>I normally follow through on my plans for completing the FA.</p>	<p>“[Instructor] was the best science professor I've ever had.”</p> <p>“I need a good grade.”</p>
Unintended interpretation	<ul style="list-style-type: none"> • Student response has evidence of a misinterpretation of the survey item. • The student has attempted to address the item, but their response indicated that they read the question in a different way than intended. 	<p>The due dates and times for the FA are clear and easy to find.</p> <p>The directions and expectations from the instructor about the FA are clear and the assignment is easy to locate online.</p>	<p>“I though the topics of [FA] would match up with the weeks topics but it didn't always”</p> <p>“My instructor records her zoom sessions. In her zoom sessions, not only does she briefly go over the lecture slides, but she also answers [FA] questions.”</p>
Off-topic response	<ul style="list-style-type: none"> • Student response is entirely off-topic and not at all relevant to the item (e.g., “I had a sandwich for lunch”). • Student clearly does not attempt to understand and answer question. 	<p>I can access the instructor or teaching assistants for help with the FA.</p>	<p>“Why did we have a short time for quizzes”</p>
No response provided	<ul style="list-style-type: none"> • Student responds with “N/A” • Response is left blank 		

Supplemental table 4: Open-ended prompt 2 codebook

“You responded that you [Likert response] with the following statement: [Item text]. Is there something your instructor or institution could do to support you in regard to this statement? Please explain in 1-2 sentences.”			
Code	Description	Examples	
		Item	Student quote
Something to improve/change	<ul style="list-style-type: none"> Student response identifies something that could be changed or improved upon 	There is sufficient interaction and communication among students with respect to completing the [FA].	“I think it would be helpful for the instructor to encourage collaboration on these assignments is her goal is for us to work together on them.”
Something that should continue	<ul style="list-style-type: none"> Student response identifies something already occurring that should continue 	I have regular access to the software programs needed to complete the [FA].	“Continue providing assistance to both instructors and students with software/learning programs to allow for cohesive transition to in person learning whilst still incorporating online resources.”
No specific suggestions/nothing can be done	<ul style="list-style-type: none"> Student response contains no specific suggestions Student responds that nothing can be done to help them 	The instructor provides sufficient guidance in the use of the online delivery system used for the [FA].	“There is nothing different that my instructor needs to do.”
Unrelated/random response	<ul style="list-style-type: none"> Student response is entirely off-topic and not at all relevant to the item (e.g., “I had a sandwich for lunch”). 	My main point of contact, such as the instructor or teaching assistant, is generally responsive to questions about the [FA].	“Thank you for this semester”
Left blank or answered “N/A”	<ul style="list-style-type: none"> Student responds with “N/A” Response is left blank 		

Supplemental table 5: Mixed-effects model to investigate differences in barrier category mean scores. $R^2 = 0.48$.

Fixed effect tests				
	<i>df</i>	F ratio	<i>p</i>	
Barrier category	4, 4940	656.22	<0.0001	
REML variance component estimates				
Random effect	Var ratio	Var component	SE	Wald p-value
Instructor	0.034	0.032	0.016	0.051
Student[Instructor]	0.257	0.241	0.018	<0.0001
Residual		0.938	0.019	
Total		1.211	0.028	

Supplemental table 6: Mixed-effects models^a to determine relationships between demographics and barrier scores, separated by institution type. Predictors were included in separate models for each barrier category. Significant relationships (p<0.05) are in bold.

Independent variables	Dependent variables									
	2-year					4-year				
	Technical resources	Instructor organization	Social interactions	Personal engagement	Learning environment	Technical resources	Instructor organization	Social interactions	Personal engagement	Learning environment
Demographics^b	Estimate±SE ^c									
Gender (Reference: Female)										
Male	-0.08±0.16	0.04±0.12	0.02±0.24	-0.13±0.18	-0.30±0.19	-0.12±0.06	-0.01±0.06	0.01±0.11	-0.11±0.07	0.10±0.08
Self-describe ^d						-0.43±0.87	-1.04±0.75	-0.29±1.44	-1.21±0.90	-1.62±1.12
Race/ethnicity (Reference: Non-URM)										
URM ^e	-0.04±0.17	0.22±0.13	-0.14±0.25	0.10±0.18	0.48±0.20	0.04±0.09	0.14±0.08	-0.28±0.15	0.20±0.10	0.12±0.12
Self-describe	-0.17±0.49	-0.30±0.36	0.05±0.70	-0.46±0.52	0.36±0.57	0.19±0.39	0.11±0.33	0.18±0.64	0.65±0.40	0.51±0.50
Class rank (Reference: First-year)										
Sophomore	0.27±0.36	0.10±0.26	0.69±0.52	0.27±0.39	0.67±0.42	-0.48±0.28	-0.02±0.24	0.97±0.46	0.08±0.29	-0.16±0.36
Junior	0.10±0.36	-0.10±0.26	0.42±0.52	0.08±0.38	0.07±0.42	-0.34±0.28	-0.04±0.24	0.65±0.46	0.05±0.29	-0.20±0.36
Senior	0.18±0.38	0.22±0.27	0.86±0.54	0.22±0.40	0.47±0.44	-0.41±0.28	0.06±0.24	0.74±0.47	-0.07±0.29	-0.12±0.37

Postbaccalaur eate	-0.21±0.44	-0.01±0.32	0.27±0.63	-0.50±0.47	-0.40±0.51	-0.34±0.29	-0.09±0.25	0.59±0.49	0.02±0.31	-0.12±0.38
Graduate student	0.25±0.38	0.13±0.28	-0.03±0.55	0.17±0.41	0.72±0.44	-0.12±0.45	0.02±0.39	0.25±0.74	-0.23±0.46	0.18±0.57
Other	0.56±0.52	-0.23±0.38	-0.01±0.75	0.76±0.55	0.25±0.60	-0.87±0.91	0.38±0.78	-0.94±1.50	-0.04±0.94	-0.75±1.17
First-generation status (Reference: Non first-generation)										
First- generation	0.02±0.15	-0.09±0.11	0.05±0.22	-0.08±0.16	0.06±0.17	-0.06±0.06	0.03±0.05	0.02±0.10	-0.18±0.06	0.08±0.08
Language (Reference: English)										
Non-English	-0.72±0.17	-0.25±0.12	0.40±0.24	-0.40±0.18	-0.06±0.19	-0.34±0.11	-0.29±0.10	0.07±0.19	-0.25±0.12	-0.16±0.14
Career (Reference: Life sciences)										
Non-Life sciences	-0.12±0.15	-0.11±0.12	-0.05±0.23	-0.10±0.16	0.20±0.18	-0.10±0.07	0.00±0.06	0.01±0.11	-0.14±0.07	-0.11±0.09

^aBarrier category score ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type. Instructor=random effect

^bReference categories were selected based on the group with the most students.

^cEstimates indicate the effect based on being a member of the focal group in comparison to the reference group.

^dThose who self-described their gender all identified as non-binary; there were not enough individuals in this group at the 2-year institution for statistical analysis

^eUnderrepresented racial/ethnic groups included participants who self-identified as African American/ Black, Hispanic/Latinx, Native American/Alaska Native, or Native Hawaiian/Pacific Islander.

Supplemental table 7: Mixed-effects model investigating the relationship between demographics and course performance, accounting for instructor. Significant relationships ($p < 0.05$) are in bold.

Independent variables	Estimates of fixed effects			
	Estimate \pm SE	<i>df</i>	<i>t</i>	<i>p</i> -value
Demographics				
Gender (Reference: Female)				
Male	-0.608 \pm 0.681	975.846	-0.893	0.372
Self-describe	9.305 \pm 9.228	972.176	1.008	0.314
Race/ethnicity (Reference: Non-URM)				
URM	-2.373\pm0.912	976.721	-2.601	0.009
Self-describe	-3.981 \pm 3.306	976.707	-1.204	0.229
Class rank (Reference: First-year)				
Sophomore	-3.292 \pm 2.387	975.310	-1.379	0.168
Junior	-2.758 \pm 2.400	974.456	-1.149	0.251
Senior	-2.374 \pm 2.449	975.842	-0.969	0.333
Postbaccalaureate	-2.016 \pm 2.571	976.352	-0.784	0.433
Graduate student	2.335 \pm 2.890	976.238	0.808	0.419
Other	1.084 \pm 4.467	977.291	0.243	0.808
First-generation status (Reference: non first-generation)				
First-generation	-3.666 \pm 0.651	978.753	0.746	0.456
Language (Reference: English)				
Non-English	0.763\pm1.023	979.387	-6.309	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.539\pm0.719	979.387	-6.309	0.000
Institution type (Reference: 4-year)				
2-year	-4.384 \pm 2.614	9.921	-1.677	0.125

Course performance \sim gender + race/ethnicity + class rank + first-generation status + language + career + institution type. Instructor=random effect

*Supplemental table 8: Mixed-effects model investigating the relationship between **technical resources** and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.*

Independent variables	Estimates of fixed effects			
	Estimate±SE	df	t	p-value
Demographics				
Gender (Reference: Female)				
Male	-0.523±0.677	974.694	-0.772	0.440
Self-describe	9.801±9.170	971.130	1.069	0.285
Race/ethnicity (Reference: Non-URM)				
URM	-2.361±0.907	975.614	-2.604	0.009
Self-describe	-3.996±3.285	975.601	-1.216	0.224
Class rank (Reference: First-year)				
Sophomore	-3.145±2.372	974.167	-1.326	0.185
Junior	-2.653±2.385	973.351	-1.113	0.266
Senior	-2.114±2.434	974.751	-0.868	0.385
Postbaccalaureate	-1.689±2.556	975.254	-0.661	0.509
Graduate student	2.268±2.872	975.130	0.790	0.430
Other	0.831±4.440	976.150	0.187	0.852
First-generation status (Reference: non first-generation)				
First-generation	-3.683±0.646	977.228	1.275	0.203
Language (Reference: English)				
Non-English	1.310±1.028	978.568	-6.174	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.419±0.716	978.568	-6.174	0.000
Institution type (Reference: 4-year)				
2-year	-4.254±2.638	9.880	-1.612	0.138
Barrier category				
Technical resources	1.312±0.358	972.310	3.662	0.000

Course performance ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type + technical resources. Instructor=random effect

Supplemental table 9: Mixed-effects model investigating the relationship between **instructor organization** and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.

Independent variables	Estimates of fixed effects			
	Estimate±SE	df	t	p-value
Demographics				
Gender (Reference: Female)				
Male	-0.597±0.680	974.870	-0.879	0.380
Self-describe	10.253±9.218	971.206	1.112	0.266
Race/ethnicity (Reference: Non-URM)				
URM	-2.444±0.911	975.700	-2.683	0.007
Self-describe	-3.884±3.299	975.714	-1.177	0.239
Class rank (Reference: First-year)				
Sophomore	-3.367±2.382	974.440	-1.413	0.158
Junior	-2.755±2.395	973.492	-1.150	0.250
Senior	-2.477±2.444	974.904	-1.013	0.311
Postbaccalaureate	-1.966±2.565	975.406	-0.766	0.444
Graduate student	2.212±2.885	975.168	0.767	0.443
Other	1.162±4.458	976.345	0.261	0.794
First-generation status (Reference: non first-generation)				
First-generation	-3.706±0.649	977.721	0.953	0.341
Language (Reference: English)				
Non-English	0.977±1.025	978.333	-6.329	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.543±0.718	978.333	-6.329	0.000
Institution type (Reference: 4-year)				
2-year	-4.733±2.601	10.008	-1.819	0.099
Barrier category				
Instructor organization	0.937±0.411	977.973	2.282	0.023

Course performance ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type + instructor organization. Instructor=random effect

*Supplemental table 10: Mixed-effects model investigating the relationship between **social interactions** and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.*

Independent variables	Estimates of fixed effects			
	Estimate±SE	df	t	p-value
Demographics				
Gender (Reference: Female)				
Male	-0.572±0.681	975.026	-0.839	0.402
Self-describe	9.249±9.222	971.130	1.003	0.316
Race/ethnicity (Reference: Non-URM)				
URM	-2.472±0.914	975.923	-2.703	0.007
Self-describe	-3.988±3.304	975.557	-1.207	0.228
Class rank (Reference: First-year)				
Sophomore	-3.024±2.393	974.112	-1.264	0.207
Junior	-2.600±2.401	973.374	-1.083	0.279
Senior	-2.172±2.451	974.790	-0.886	0.376
Postbaccalaureate	-1.880±2.571	975.164	-0.731	0.465
Graduate student	2.339±2.888	975.077	0.810	0.418
Other	0.968±4.465	976.122	0.217	0.828
First-generation status (Reference: non first-generation)				
First-generation	-3.645±0.650	977.670	0.787	0.432
Language (Reference: English)				
Non-English	0.805±1.023	978.582	-6.336	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.557±0.719	978.582	-6.336	0.000
Institution type (Reference: 4-year)				
2-year	-4.373±2.674	9.870	-1.635	0.133
Barrier category				
Social interactions	-0.295±0.212	978.565	-1.393	0.164

Course performance ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type + social interactions. Instructor=random effect

*Supplemental table 11: Mixed-effects model investigating the relationship between **personal engagement** and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.*

Independent variables	Estimates of fixed effects			
	Estimate±SE	df	t	p-value
Demographics				
Gender (Reference: Female)				
Male	-0.415±0.668	974.443	-0.621	0.534
Self-describe	11.649±9.044	971.074	1.288	0.198
Race/ethnicity (Reference: Non-URM)				
URM	-2.716±0.895	975.494	-3.034	0.002
Self-describe	-4.434±3.238	975.431	-1.369	0.171
Class rank (Reference: First-year)				
Sophomore	-3.455±2.338	974.062	-1.478	0.140
Junior	-2.690±2.351	973.243	-1.144	0.253
Senior	-2.184±2.398	974.590	-0.911	0.363
Postbaccalaureate	-1.703±2.518	975.080	-0.676	0.499
Graduate student	2.247±2.831	974.953	0.794	0.428
Other	0.081±4.378	975.944	0.018	0.985
First-generation status (Reference: non first-generation)				
First-generation	-3.385±0.639	977.318	1.237	0.216
Language (Reference: English)				
Non-English	1.243±1.005	978.780	-6.110	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.312±0.706	978.780	-6.110	0.000
Institution type (Reference: 4-year)				
2-year	-4.649±2.675	9.866	-1.738	0.113
Barrier category				
Personal engagement	2.039±0.314	976.617	6.490	0.000

Course performance ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type + personal engagement. Instructor=random effect

Supplemental table 12: Mixed-effects model investigating the relationship between **learning environment** and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.

Independent variables	Estimates of fixed effects			
	Estimate±SE	df	t	p-value
Demographics				
Gender (Reference: Female)				
Male	-0.626±0.681	974.923	-0.918	0.359
Self-describe	9.797±9.236	971.156	1.061	0.289
Race/ethnicity (Reference: Non-URM)				
URM	-2.442±0.914	975.704	-2.672	0.008
Self-describe	-4.115±3.307	975.768	-1.244	0.214
Class rank (Reference: First-year)				
Sophomore	-3.359±2.387	974.335	-1.407	0.160
Junior	-2.777±2.400	973.462	-1.157	0.248
Senior	-2.415±2.449	974.830	-0.986	0.324
Postbaccalaureate	-1.987±2.570	975.394	-0.773	0.440
Graduate student	2.212±2.892	975.182	0.765	0.445
Other	1.135±4.467	976.297	0.254	0.800
First-generation status (Reference: non first-generation)				
First-generation	-3.695±0.651	977.756	0.776	0.438
Language (Reference: English)				
Non-English	0.794±1.023	978.393	-6.289	0.000
Career (Reference: Life sciences)				
Non-Life sciences	-4.524±0.719	978.393	-6.289	0.000
Institution type (Reference: 4-year)				
2-year	-4.483±2.611	9.940	-1.717	0.117
Barrier category				
Learning environment	0.315±0.266	973.959	1.183	0.237

Course performance ~ gender + race/ethnicity + class rank + first-generation status + language + career + institution type + learning environment. Instructor=random effect

Supplemental table 13: Mixed-effects model investigating the relationship between number of categories reported with sufficient access and course performance, accounting for demographics and instructor. Significant relationships ($p < 0.05$) are in bold.

Independent variables	Estimates of fixed effects
	Estimate \pm SE
Gender (Reference: Female)	
Male	-0.618 \pm 0.681
Self-describe	9.886 \pm 9.251
Race/ethnicity (Reference: Non-URM)	
URM	-2.406\pm0.913
Self-describe	-4.100 \pm 3.309
Class rank (Reference: First-year)	
Sophomore	-3.383 \pm 2.390
Junior	-2.799 \pm 2.401
Senior	-2.439 \pm 2.450
Postbaccalaureate	-2.042 \pm 2.571
Graduate student	2.273 \pm 2.891
Other	1.181 \pm 4.469
First-generation status (Reference: non-first-generation)	
First-generation	-3.682\pm0.651
Language (Reference: English)	
Non-English	0.816 \pm 1.025
Career (Reference: Life sciences)	
Non-Life sciences	-4.512\pm0.720
Institution type (Reference: 4-year)	
2-year	-4.407 \pm 2.589
Number of categories reported with sufficient access	0.327 \pm 0.354

Course performance \sim gender + race/ethnicity + class rank + first-generation status + language + career + institution type + number of categories reported with sufficient access.

Instructor=random effect

Supplemental table 14: Prompt 2 responses by institution type

Type of suggestion	Institution type	
	2-year (% , N ^a =259)	4-year (% , N=1003)
Scheduling logistics	4.6	5.6
FA format	3.9	4.4
Consistent communication with students	4.6	3.1
Devices, internet, or other technical resources	3.1	2.7
Course delivery	2.3	5.1
Requirements/instructions	1.5	2.7
FA content	0.0	2.0
Way to contact/meet other students	1.5	1.8
Friendliness/approachability	1.2	1.5
Provide guidance/study tips	2.3	0.8
Create study groups	0.4	2.2
Peer interaction/group activities	1.9	2.4
Feedback	0.4	1.1
FA alignment with lecture	0.4	1.0
Grading criteria	1.9	1.0
Flexibility/understanding	1.2	0.5
Materials	0.8	0.6
Instruction content	0.8	0.9
Study environment	0.8	0.5
Encourage collaboration	0.8	0.9
Office hours	0.4	0.6
Instructor knowledge	0.4	0.1
Course pace	0.4	0.3
Support for underrepresented students	0.0	0.1

^aN=Number of student responses

Supplemental table 15: Prompt 2 responses by instructor (%)

Type of suggestion	Instructor ^a										
	1 (156)	2 (242)	3 (179)	4 (43)	5 (119)	6 (25)	7 (85)	8 (49)	9 (13)	10 (18)	11 (307)
Scheduling logistics	3.8	5.8	6.1	0.0	4.2	4.0	2.4	6.1	15.4	11.1	6.5
FA format	4.5	4.1	4.5	0.0	1.7	4.0	5.9	4.1	0.0	0.0	5.5
Consistent communication with students	3.2	2.1	1.7	4.7	4.2	4.0	4.9	2.0	0.0	5.6	4.2
Devices, internet, or other technical resources	1.3	3.7	4.5	4.7	2.5	0.0	2.4	2.0	15.4	0.0	1.6
Course delivery	7.1	5.0	2.8	2.3	6.7	4.0	1.2	6.1	0.0	0.0	4.9
Requirements/instructions	1.9	1.7	5.0	0.0	4.2	4.0	2.4	6.1	15.4	11.1	6.5
FA content	0.0	1.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	4.2
Way to contact/meet other students	1.3	2.9	2.2	4.7	2.5	0.0	1.2	0.0	0.0	0.0	1.0
Friendliness/approachability	1.9	1.2	1.1	2.3	3.4	0.0	1.2	0.0	0.0	0.0	1.0
Provide general guidance/study tips	0.0	0.8	0.6	0.0	0.8	0.0	3.5	2.0	0.0	0.0	1.3
Create study groups	4.5	1.7	5.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.7
Peer interaction/group activities	2.6	2.9	2.8	0.0	2.5	4.0	1.2	4.1	0.0	0.0	1.6
Feedback	0.0	1.2	1.1	0.0	3.4	0.0	1.2	0.0	0.0	0.0	1
FA alignment with lecture	1.9	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Grading criteria	0.0	0.8	0.6	2.3	0.0	4.0	0.0	4.1	7.7	0.0	2.3
Flexibility/understanding	1.3	0.4	0.6	2.3	0.0	4.0	0.0	0.0	0.0	5.6	0.3
Materials	0.6	1.2	0.6	0.0	0.0	0.0	0.0	2.0	0.0	5.6	1.3
Instruction content	0.0	0.8	0.0	0.0	2.5	0.0	1.2	0.0	0.0	5.6	1.3
Study environment	1.9	0.0	0.6	0.0	0.0	0.0	1.2	0.0	7.7	0.0	0.3
Encourage collaboration	0.6	0.4	0.6	0.0	0.8	4.0	0.0	2.0	0.0	0.0	1.6
Office hours	0.0	0.0	0.6	2.3	0.8	0.0	0.0	0.0	0.0	5.6	4.2
Instructor knowledge	0.0	0.4	0.0	0.0	0.0	0.0	0.0	2	0.0	0.0	0.0
Course pace	0.0	0.4	0.0	0.0	0.8	0.0	1.2	0.0	0.0	0.0	0.3
Support for underrepresented students	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^aNumber of student responses for each instructor given in parentheses.