

Supplemental Material

CBE—Life Sciences Education

Ovid *et al.*

SUPPLEMENTAL TABLES

Table S1 The percentage of students across self-identified ethnicity ($n = 89$ students total). The number of students is given in parentheses.

Self-Identified Ethnicity	Percent Students (%) (n)
Latino/a	34.8% (31)
Asian	19.1% (17)
White	18% (16)
Filipino/a	7.9% (7)
Decline to state	5.6% (5)
African American/Black	3.4% (3)
Filipino/a, White	2.2% (2)
Latino/a, White	2.2% (2)
Middle Eastern	2.2% (2)
Afghan	1.1% (1)
Filipino/a, Asian	1.1% (1)
Mixed	1.1% (1)
White, Asian	1.1% (1)

Table S2. Examples of student rationales from the choice activity for Positively-phrased Instructor Talk quotes from the stimulus set, perceived as promoting the most positive learning environment (in alignment with researchers) or the most negative learning environment (in misalignment with researchers, based on the evaluation activity).

Instructor Talk Quote	Example Student Rationales
Positively-phrased Instructor Talk Perceived as Promoting the Most <u>Positive</u> Learning Environment	
+BISR1	<p>“I know that there were some folks who, when they looked at their score on Thursday, were shocked and not very happily surprised. And if that's the case for you, I told people earlier today as well, you know, you're not alone. So, don't feel like you're the only one who maybe didn't do as well as you had hoped.”</p> <p><i>I think it's important to encourage people to keep on trying and not get discouraged by one exam.</i></p> <p><i>[It] lets students know they're not alone and more than a few people did just as bad as you. Shouldn't be too hard on yourself.</i></p>
+BISR2	<p>“All right, I shared data from our class about how you guys kind of didn't do so well on the assessment last week. But, it's okay, you know. We can always improve.”</p> <p><i>Instructor acknowledges that people didn't do well on an assignment but encourages and reminds them that there is always room for improvement. Gives the students motivation to grow and improve.</i></p> <p><i>Affirming to students that there is always room for improvement really helps with the pressure of thinking you have to do well all the time.</i></p>
+ECC1	<p>“All right, so the volume is dying down, which leads me to suggest that we're about to start talking about what happened over the weekend rather than the assignment. So, let's see what we came up with. So, what I'm going to do is I'm going to pick on people.”</p> <p><i>Learning and understanding from the teacher is good but asking questions sometimes seems intimidating. By being able to talk to your group mates or neighbors for understanding it can better the learning. Also, if you both don't understand asking a teacher seems less threatening with 2+ people.</i></p> <p><i>This may be scary, but it'll force the students to think about the question and be ready for the professor to call on them.</i></p>
+ECC2	<p>“But, the most important people in the room are not necessarily us, your instructors. They're actually the people sitting right next to you. In this course, one of the most important things you can do is talk to the people who are next to you, figure out what's in your head and how to fix it if it's not quite right.”</p> <p><i>I really resonated to this quote because it talks about student-student interactions and reestablishing the idea indirectly that we are all intelligent and collectively can gain knowledge and learn things from one another that we might not have known before. "Figure out how to fix it. It's not quite right" was something I liked because it provides an "okay" for error. In science we all make mistakes and it's okay! We learn from them and then improve.</i></p> <p><i>As we move on in our careers or even further schooling, the power of networking and collaborating is very important. It is what will help us as students and individuals progress toward our own goals.</i></p>

+EPC1

“I’m going to try to make this class as relevant as possible for people who are interested in going into medicine, into dentistry, into nursing.”

This example shows a person who is willing to listen to the class and change the material so that it is relevant for the class they're teaching. It shows that they care about making real-life connections with the topic.

It shows that the instructor isn't only going to be reading word for word off slides or assigning chapters in age old textbooks-they'll be teaching modern, relevant information that the students will be able to use.

+EPC2

“So, someone asked, why do we have to do all those writing assignments? And, you know, that's really because to learn something, you have to do it. You know, if you're learning to play the guitar, you have to play the guitar, not just listen to experienced people playing it, right? If you're learning to become biologists or geneticists, you have to just do it. And writing is one very good way of doing it. Speaking is another way of doing it. And so, you'll be talking a lot and you'll be writing a lot in class.”

It shows the instructor really cares about the learning of the students and is giving them multiple methods the be able to apply the concepts, such as writing and speaking.

First, it gives a very realistic outlook on how a students should learn biology. You have to actually do science in order to understand how it works. If my teacher told me this, I'd be more motivated to learn and be more hands-on.

+SPE1

“I went to a PhD program at Stanford briefly for a bit, and worked at some developmental biology labs. But then I decided to leave and go for a master's and teach instead because teaching is what I really like to do more than anything else. So, my background is not as a medical doctor, but as a researcher.”

...the professor is being vulnerable. Vulnerability creates comfort and among one another and establishes a community where you feel you can share anything. This specific person admittedly said that he/she left Stanford (a very looked upon school) to pursue another passion. I felt that "Wow you can always change your mind and your path and that's completely okay."

Professors that express their background could motivate students to pursue different options besides being in the medical field.

+SPE2

“I actually got a bachelor's degree in environmental biology ages ago in the Cal State system. So, I am a product of the Cal State system, just like you are.”

Letting students know you got a degree from the same family of colleges let them know success is possible and job opportunity is possible.

Some people feel like instructors are highly educated and come from prestigious schools. When students hear that the instructor went to the school they are teaching at it makes some students feel better about their college choice.

+US1

“There's still some time until the presentations, but don't of course, wait too long because the longer you wait without rehearsal and practice - the more distant the concepts are going to be. Science is a bit of language that needs to be practiced.”

This would promote a positive learning environment for me because it shows that my professor not only cares about the content of my presentation, but also the delivery of it which would be extremely beneficial in the future. In addition, when a professor reminds me of an assignment it lets me know that I should probably start it soon and the earlier I finish the better I do the more I'll enjoy a class.

The instructor discourages procrastination while also advising better practices in biology.

+US2

“I think the labs are really, really cool, so I'm excited about them. And I'm excited for you guys to get to go through them.”

I think that if the instructor is excited then it makes me more interested and curious to see why. That also means they don't hate teaching.

The instructor seems to be interested and excited which could make the course fun and students might actually take away a lot from the course.

Positively-phrased Instructor Talk Perceived as Promoting the Most Negative Learning Environment (>25% Misalignment in Evaluation Activity)

+ECC1

"All right, so the volume is dying down, which leads me to suggest that we're about to start talking about what happened over the weekend rather than the assignment. So, let's see what we came up with. So, what I'm going to do is I'm going to pick on people."

Picking on people is not a good way of learning. Sometimes that makes students insecure and not even show up to class.

At the end of this quote when they say, "I'm going to pick on people," it gives me anxiety. I've always hated being called or to answer a question in class. It makes me less inclined to want to participate [it] makes me hate discussions. Sometimes I'll participate on my own, but when a professor says they'll pick people it makes me want to run away.

Table S3. Examples of student rationales from the choice activity for Negatively-phrased Instructor Talk quotes from the stimulus set, perceived as promoting the most negative learning environment (in alignment with researchers) or the most positive learning environment (in misalignment with researchers, based on the evaluation activity).

Instructor Talk Quote	Example Student Rationales
Negatively-phrased Instructor Talk Perceived as Promoting the Most <u>Negative</u> Learning Environment	
-DISR1	<p>“Some people find that if you haven't had a basic biology class before coming in here, it's a little harder. You've got to learn some of those basic concepts a little faster than other folks.”</p>
	<p><i>Everyone is different and everyone learns differently from each other. No instructor should tell a student that they need to learn concepts a little faster.</i></p> <p><i>This makes the student feel as if they are behind in the class, already setting an expectation of not succeeding.</i></p>
-DISR2	<p>“You don't need to sneak in. You're right on time today for a change.”</p>
	<p><i>Talk about fostering an unsafe environment for the students! How incredibly rude to pick on a student who walked in late. The professor has no idea what the student might be going through. They could be grieving, lost their car, live extremely far away. To call out a student like that in the middle of a classroom is unacceptable.</i></p> <p><i>If a professor said this to me especially if I was right on time I would probably cry. It's one thing to mention if I'm 10 minutes late, but to call me out in front of everyone if I'm on time is another time. As a result, if I am late in the future, I wouldn't even go to class for fear I'd be called out. I'd skip class.</i></p>
-DCC1	<p>“Don't think I'll just be showering and you'll be standing there below the shower and having a good drenching of information. No. You have to do your job as students, okay? So, that's very critical.”</p>
	<p><i>Because it's a strange analogy; doesn't seem like the teacher cares or want to find a solution more than he wants to patronize his students. Maybe it's his/her fault? Maybe they should teach them different learning strategies if they're not learning.</i></p> <p><i>I don't find that a job is something, an instructor should call a class, because it seems intimidating. This instructor doesn't seem approachable and needs everyone to be independent.</i></p>
-DCC2	<p>“So, I stood here on Wednesday and told you point blank there would be no questions about plants on your lab quiz. Were there any questions about plants on your lab quiz? There were seven questions about plants on your lab quiz. Not one person complained, okay? So, that makes you all very sweet, but seriously, you should have complained.”</p>
	<p><i>The professor misinformed the students of what would be on the test. Preventing the students from preparing effectively for the test.</i></p> <p><i>It's not a student's job to keep the instructor honest. Furthermore, will a complaint save a grade? It would be very frustrating to me if that happened, and it'd be hard for me to respect the professor.</i></p>

-CPC1	<p>“So, don't be giving me these random scales on your graphs that look funky. Among other things, my poor little brain is really tired and I can't make sense of it, okay? Or, no, I could make sense of it, but I don't want to. Okay?”</p>	<p><i>Saying I could make sense of I but I don't want it to a student is very discouraging and has effects on the students learning.</i></p> <p><i>This quote already gives me a vibe that the professor isn't even willing to accept mistakes and will look down on you for doing so. As a student, we're all here with one sole purpose, which is to learn. A big part of learning is making mistakes and then understanding them enough to not make them in the future.</i></p>
-CPC2	<p>“I take credit for only five percent of your grade or less than that. Your grade, whether it's an A, B, C - whatever it is - 95% of it is yours - your contribution.”</p>	<p><i>Professors should take more responsibility than this. It seems like someone who says this could just to less-than-stellar job and if students are responding poorly they could just shrug it off. A professor should try to adapt to what may work best for their students.</i></p> <p><i>While it's true that students are doing the work for the grade, the instructor's teaching plays a big role in the student's understanding.</i></p>
-SPJ1	<p>“And so, because we're doing things a little bit strangely in lecture, I wanted to make sure I was here for that. But, at 2:00 I hope to be having my head on a pillow, catching up on some sleep. My flight was cancelled coming home. I was online for three and a half hours till 2:30 in the morning Sunday trying to get a flight here so that I didn't arrive sometime on Wednesday. So, I managed to do that, but I'm a little tired. So, if I say something that sounds really strange and that doesn't make any sense, be even more diligent than usual about raising your hand, because maybe it didn't make any sense, okay?”</p>	<p><i>This person seemed to be all over the place. It sounded like they just needed to take a person day to recover, which isn't a bad thing. It's better than trying to teach while making no sense. Sometimes, people just need to know when to rest.</i></p> <p><i>I totally understand that professors have a life outside of the classroom, but this quote presents someone who is excessive [in] talking about their life problems and basically saying that the students might get wrong information and if they do, it's on them. I don't think this would be appreciated when students are looking up to them for the right answers.</i></p>
-SPJ2	<p>“I can't stand listening to myself talk because - oh, God. Do I sound like that? I sound like a moron or something. I don't know.”</p>	<p><i>If they can't stand hearing themselves speak they shouldn't teach. The way they sounds shouldn't matter. Students learning is what matters.</i></p> <p><i>The instructor seems unsure of themselves which is weird because a teacher shouldn't be criticizing themselves like that in front of a class.</i></p>
-MS1	<p>“So, we'll see if this is our new class size, if I've managed to scare people away, or if this is just people being tardy.”</p>	<p><i>Makes it seem like they want to scare people away and don't care for them.</i></p> <p><i>Insinuates they expect people to drop/that the class will be one people will want to drop.</i></p>
-MS2	<p>“Are you all excited to be here? You're thinking about it. Some of you are like I've heard scary things about this class.”</p>	<p><i>This sets forth the tone that the class will be difficult for students to thrive and do well. It will provide them with a negative experience.</i></p> <p><i>If an instructor said this to me I would feel like they are just trying to make themselves feel better because they know that something's wrong with the class.</i></p>

Negatively-phrased Instructor Talk Perceived as Promoting the Most Positive Learning Environment (>25% Misalignment in Evaluation Activity)

-CPC2

“I take credit for only five percent of your grade or less than that. Your grade, whether it's an A, B, C - whatever it is - 95% of it is yours - your contribution.”

Makes people take ownership of their work and how much effort they put in.

I think this would promote the most positive learning environment because it really gives students the credit that they're doing the work, resulting in their grade whether good or bad.

-SPJI

“And so, because we're doing things a little bit strangely in lecture, I wanted to make sure I was here for that. But, at 2:00 I hope to be having my head on a pillow, catching up on some sleep. My flight was cancelled coming home. I was online for three and a half hours till 2:30 in the morning Sunday trying to get a flight here so that I didn't arrive sometime on Wednesday. So, I managed to do that, but I'm a little tired. So, if I say something that sounds really strange and that doesn't make any sense, be even more diligent than usual about raising your hand, because maybe it didn't make any sense, okay?”

I believe we forget that our professors are also human beings that have lives outside of the classroom.

I like how the professor talked about his life so students would understand what he/she was going through at the moment. It's important to make students feel comfortable enough to raise their hands and ask questions.

-MS2

“Are you all excited to be here? You're thinking about it. Some of you are like I've heard scary things about this class.”

A teacher breaking the ice and trying to calm the class down would make the class flow a lot better and make it not as stressful.

They're being truthful and they acknowledge how scary it can be taking a STEM course. Honesty and some wit is good.

Table S4. Demographic comparisons for the proportion of students that remembered non-content instructor language they perceived as promoting a positive or a negative learning environment evaluated with Pearson chi-square tests with Bonferroni corrections for multiple comparisons.

Demographic Comparison		χ^2	<i>P</i>
Positive Learning Environment			
Women	Men	0.00	1.00
First-generation	Continuing-generation	0.00	1.00
PEER	Non-PEER	1.27	0.260
POC	Non-POC	0.00	0.984
Negative Learning Environment			
Women	Men	0.945	0.331
First-generation	Continuing-generation	1.79	0.181
PEER	Non-PEER	1.01	0.315
POC	Non-POC	2.96	0.085

Table S5. The percentage of Instructor Talk remembered by undergraduate biology students as promoting a positive learning environment and categorized by researchers to the subcategory level using the Instructor Talk frameworks ($n = 166$ student memories). The number of student memories for each subcategory is in parentheses.

Category	Subcategory	Percent of Student Memories of Instructor Talk Promoting a Positive Learning Environment
Building the Instructor/Student Relationship	Demonstrating Respect for Students	34% (57)
	Revealing Secrets to Success	5% (9)
	Boosting Self-Efficacy	13% (21)
Establishing Classroom Culture	Pre-framing Classroom Activities	5% (8)
	Practicing Scientific Habits of Mind	1% (1)
	Building a Biology Community among Students	6% (10)
	Giving Credit to Colleagues	-none-
	Indicating That it is Okay to be Wrong or Disagree	2% (4)
Explaining Pedagogical Choices	Supporting Learning through Teaching Choices	3% (5)
	Using Student Work to Drive Teaching Choices	1% (2)
	Connecting Biology to the Real World and Career	1% (2)
	Discussing How People Learn	1% (1)
	Fostering Learning for the Long Term	5% (9)
Sharing Personal Experiences	Recounting Personal Information / Anecdotes	2% (4)
	Relating to Student Experiences	3% (6)
Unmasking Science	Being Explicit about the Nature of Science	1% (2)
	Promoting Diversity in Science	6% (10)
	Fostering Wonder	2% (3)
Categorized within Negatively-phrased Instructor Talk framework		7% (12)

Table S6. The percentage of instructor language remembered by undergraduate biology students as creating a negative learning environment and categorized by researchers to the subcategory level using the Instructor Talk frameworks ($n = 141$ student memories). The number of student memories for each category is in parentheses.

Category	Subcategory	Percentage of Student Memories of Instructor Talk Promoting a Negative Learning Environment
Dismantling the Instructor/Student Relationship	Ignoring Student Challenges	18% (25)
	Assuming Poor Behaviors from Students	9% (13)
	Making Public Judgments about Students	14% (19)
Disestablishing Classroom Culture	Expecting Students to Know What to Do	16% (22)
	Parallel to “Practicing Scientific Habits of Mind”	-none-
	Discouraging Community Among Students	1% (1)
	Criticizing Colleagues	1% (1)
	Encouraging Only the Right Answer	-none-
Compromising Pedagogical Choices	Expressing Doubt in Pedagogical Choice	4% (6)
	Using Convenience to Drive Teaching Choices	5% (7)
	Parallel to “Connecting Biology to the Real World and Career”	-none-
	Teaching to a Subset of Students	1% (1)
	Focusing on the Grade / Short Term	4% (5)
Sharing Personal Judgment	Sharing Self-Judgment / Self-Pity	-
	Distancing from Student Experiences	2% (2)
Masking Science	Being Implicit about the Nature of Science	3% (4)
	Intimidating Students from Science	16% (23)
	Parallel to “Fostering Wonder in Science”	1% (1)
Categorized within Positively-phrased Instructor Talk framework		8% (11)

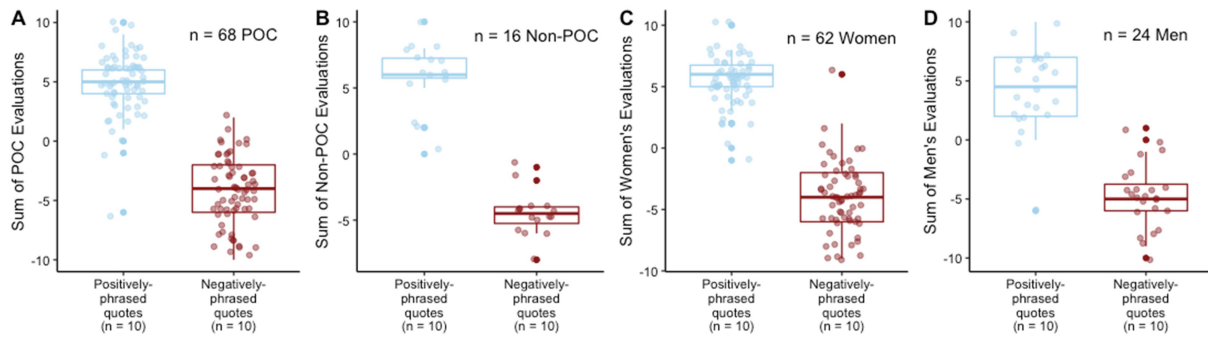


Figure S1. Disaggregated by Gender and Race, Student Evaluation Activity for all 20 Instructor Talk quotes from the stimulus set perceived as promoting a positive or negative learning environment. Across demographics, students' overall evaluations of 20 Instructor Talk quotes were in alignment with researchers for Positively-phrased (blue) and Negatively-phrased (red) Instructor Talk based on Researcher Categorizations (Harrison et al., 2019). Each point indicates the summed, total value for each student, by self-reported demographic, including A) n = 68 People of Color (POC), B) n = 16 Non-POC, C) n = 62 Women, and D) n = 24 Men. Students with sums of +10 and -10 were in complete alignment with researchers for Positively-phrased and Negatively-phrased Instructor Talk, respectively. If students were unsure or chose randomly then the sum value would be close to 0. The boxplots show the median and the first and third quartiles of the data. The lower and upper whiskers extend 1.5 times the interquartile range from the first and third quartiles, respectively. Points for individual student scores are dispersed horizontally for clarity.