Supplemental Material

CBE—Life Sciences Education

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Supplemental Materials for

Making a first impression: Exploring what undergraduate instructors do and say on the first day of introductory STEM courses

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Supplemental Methods

Supplemental Methods 1: Modifications to the Instructor Talk framework

Here, we provide examples of two additional types of changes made to the original Instructor Talk framework (Harrison et al., 2019; Seidel et al., 2015): reorganizing categories/codes and adding additional codes. A full description of the final codebook and changes can be found in Supplemental Table 2.

1. In the original framework the *unmasking science* category consisted of three codes: *being explicit about the Nature of Science*, *promoting diversity in science*, and *fostering wonder*. We chose to make these codes into separate categories because they have different purposes and *being explicit about the Nature of Science* was more common than the other two codes in our data.

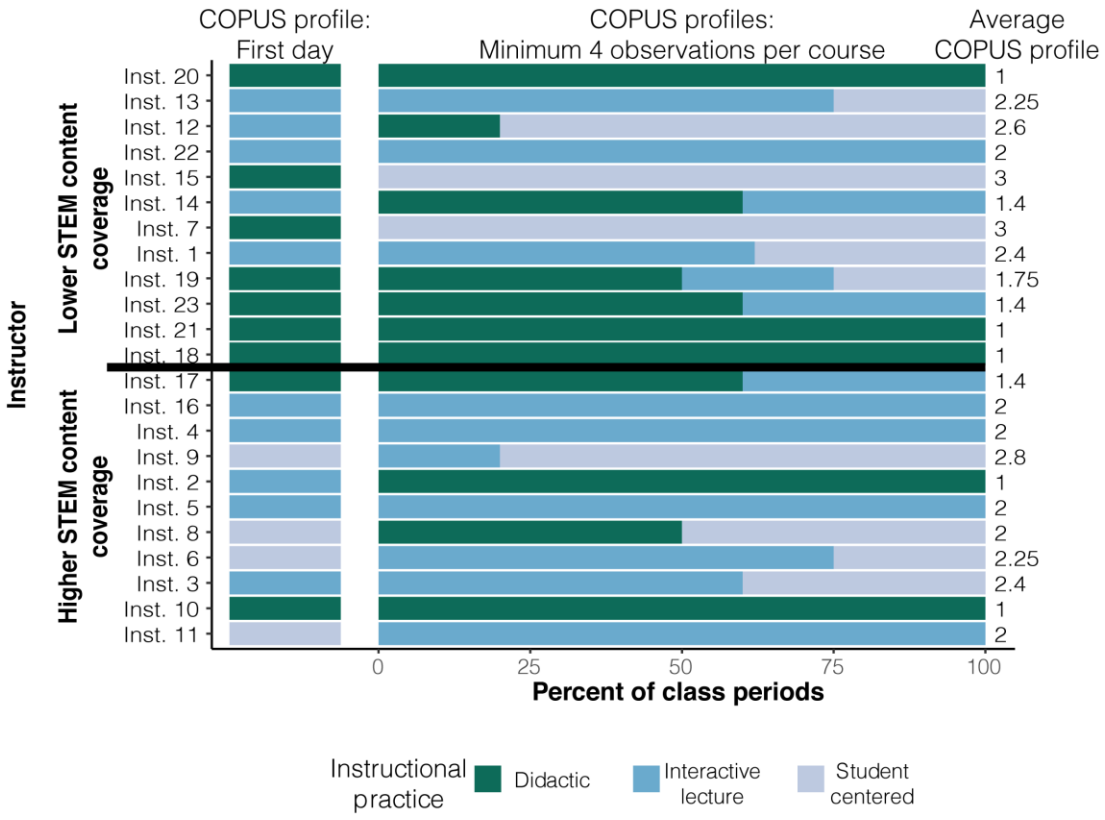
2. We added two negatively phrased codes *criticizing the system* and *discouraging students from asking questions* because codes did not exist to capture when instructors described challenges placed on them by the department, university, or wider academic system, such as having large class sizes or when instructors told students what questions they should not ask.

Supplemental Methods 2: Classroom observations

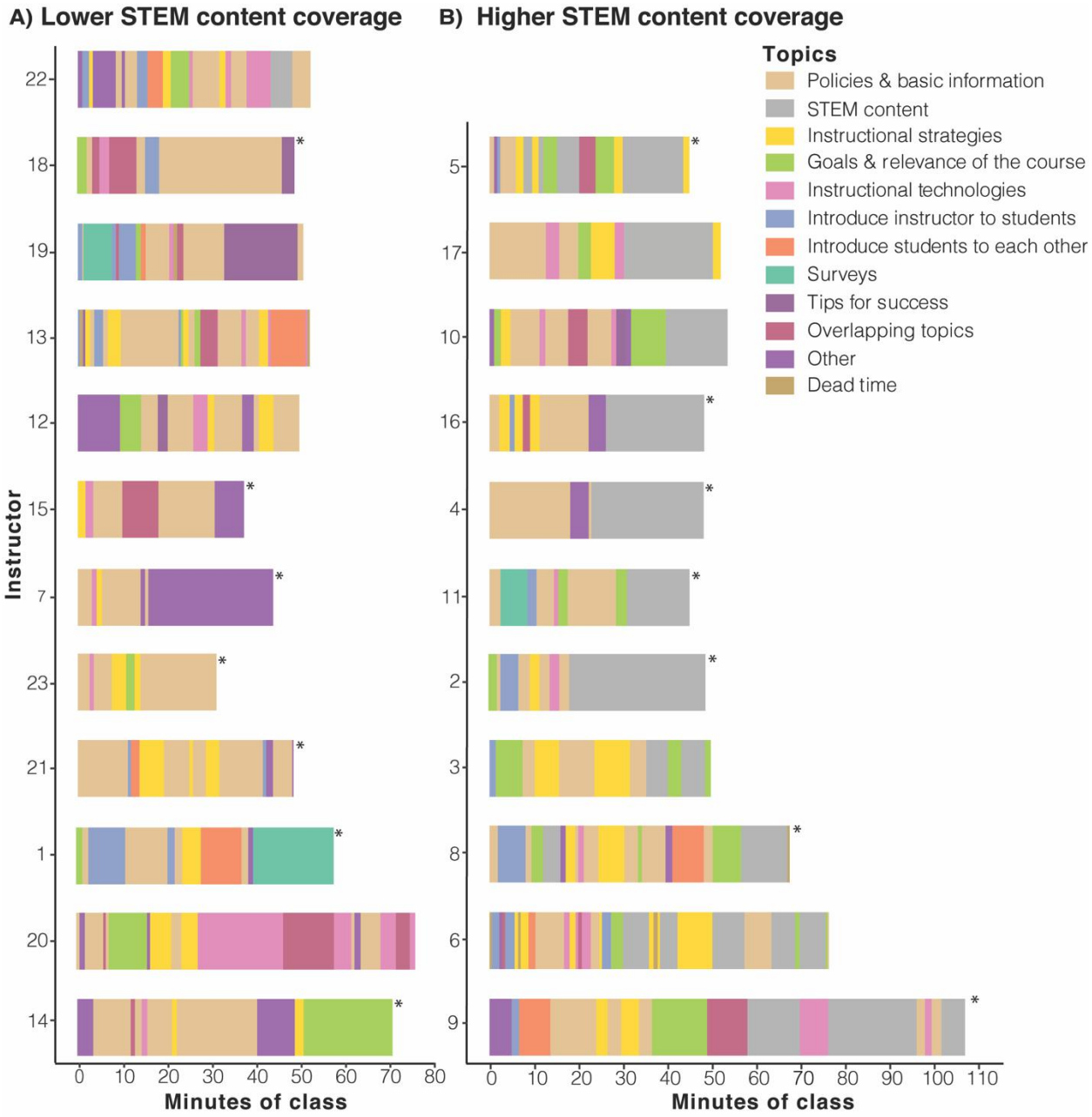
To characterize the instructional practices used by instructors on the first day of class, we used the Classroom Observation Protocol for Undergraduate STEM (COPUS; Smith et al., 2013). This protocol allowed us to capture a range of student and instructor behaviors and added an additional dimension beyond topics and Instructor Talk. Additionally, we observed the four or five subsequent class periods from each course. Five courses were co-taught by instructional teams. For two of these courses, we conducted a total of 10 and 13 observations, respectively, because multiple instructors were involved in the professional development program. We used the COPUS analyzer tool at COPUSprofiles.org (Stains et al., 2018) to categorize the classroom observations into an aggregated cluster between 1 and 7.

These clusters span didactic, interactive, or student-centered teaching practices. In our dataset, the class periods of 11 instructors fell under only one cluster, but the remaining instructors had class periods that spanned multiple clusters (Supplemental Figure 1). We assigned class periods classified as *didactic* a value of 1, *interactive lecture* a value of 2, and *student centered* a value of 3. We then calculated the average instructional practices from each instructor. The average instructional practice was binned between 1-1.49, 1.5-1.99, 2.0-2.49, and 2.5-3.0 in order to convert the continuous average into four categories. These categories were used for the Kruskal-Wallis tests in Supplemental Table 3.

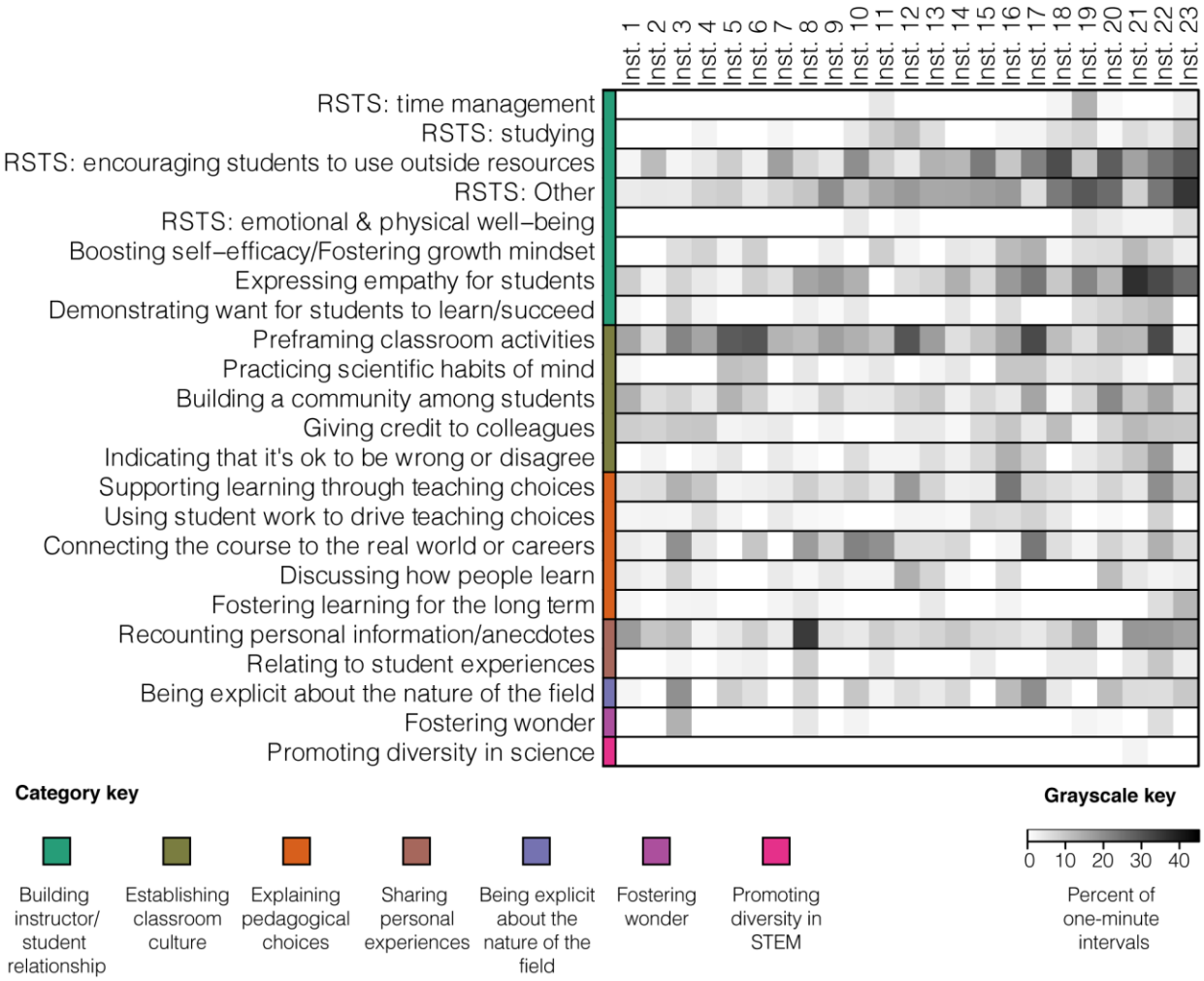
Supplemental Figures



Supplemental Figure 1. Types of instructional practices observed. Individual class periods were analyzed using COPUS (Smith et al., 2013) and categorized according to their COPUS profile (Stains et al., 2018). The left bars represent the profile observed on the first day of class, and the right bars represent the percent of 4-5 subsequent class periods (not including the first day) with each profile. However, there are two courses for which there were additional observations (see Supplemental Methods 2). Instructors are ordered according to the clusters depicted in Figure 1B, with a black line differentiating the two groups. Values to the right of the stacked bar chart represent the average COPUS profile for each instructor on a scale from 1 (didactic) to 3 (student centered) for subsequent class periods.



Supplemental Figure 2. Timeline of topics for each class. Classes are from the cluster with (A) lower or (B) higher STEM content coverage. Colors indicate the topic being discussed. Classes that ended early are denoted with an asterisk.



Supplemental Figure 3. Variation of positively phrased code use across instructors. Heatmap showing the percent of one-minute intervals each instructor spent on Instructor Talk codes. Each column represents one instructor. Code colors in the leftmost column represent the positively phrased talk categories from Figure 3A. RSTS = Revealing secrets to success.

Supplemental Tables

Supplemental Table 1. Codebook for topics.

Non-content topics	Definition
Instructional strategies	Time spent covering what will occur during a typical class period or week. This topic includes time spent in lab or recitation/breakout sessions. It also includes introducing activities or talking points that will be covered later on the first day.
Policies & basic information	Time spent covering grading policies, classroom policies, technology policies (e.g., cell phone use), expectations about work related to class (e.g., explaining expected attendance at talks/seminars), safety/emergency policies and procedures, and other similar policies.
Instructional technologies	Time spent ensuring students know how to use classroom technologies (e.g., clickers or course management system).
Goals & relevance of the course	Time spent explaining why students should care about or choose to take the class and the goals of the class. The instructor may discuss the class in relation to careers, life-long learning, daily life, university requirements, or current events.
Surveys	Time spent on explaining surveys or having students take surveys. This topic is not time spent on pre-quizzes but rather surveys about students' backgrounds, interests, etc.
Introduce instructor to the students	Time spent on students learning about the instructors or instructors learning about students (e.g., students raising hands to indicate their majors or instructors sharing anecdotes). Teaching/learning assistants were considered instructors for the purpose of this code.
Introduce students to each other	Time spent giving students opportunities to talk to their peers about things that are not course content. Can also include time the instructor spends reporting to students about the demographics of those taking the course.
STEM content	Time spent on course content including students taking content-focused pre-tests.
Tips for success	Time spent covering tips and tricks that may help students do well in college overall. This topic is

	not spent on class-specific policies but strategies that could apply to any class (e.g., get enough sleep, don't put off homework until the last minute, etc.).
Dead time	Greater than 30 seconds occurred where time was not spent on anything in particular (e.g., instructor changing PowerPoints or doing something with technology).
Other	Any time spent on the course that did not fit into one of the previous categories.

Supplemental Table 2. Codebook and modifications from the original Instructor Talk framework.

Positively phrased non-content Instructor Talk categories				
Final category	**Final code**	**Final definition**	**Original framework category**	**Original framework code**
Building the instructor/student relationship	Revealing secrets to success: time management	Information about actions or resources that could help students manage their time.	Building the instructor/student relationship	Revealing secrets to success
	Revealing secrets to success: studying	Information about actions or resources that could help students study more or more effectively. Specifically focuses on test/exam preparation.	Building the instructor/student relationship	Revealing secrets to success
	Revealing secrets to success: encouraging students to use optional resources	Information about actions or resources students can use to seek help including office hours. These are resources related to learning, not student well-being.	Building the instructor/student relationship	Revealing secrets to success
	Revealing secrets to success: emotional and physical well-being	Information about actions or resources related to student well-being. These resources are not about learning but rather about well-being.	Building the instructor/student relationship	Revealing secrets to success
	Revealing secrets to success: other	Information about actions or resources that seem helpful, but do not fall into one of the other categories.	Building the Instructor/Student Relationship	Revealing secrets to success
	Boosting self-efficacy/fostering growth mindset	Compliments or positive feedback on student work or effort. Statements indicating that all students can succeed given the right effort or tools.	Building the instructor/student relationship	Boosting self-efficacy
	Expressing empathy for students	Considerations of students' responsibilities and needs both within and outside of class. Descriptions of how the instructor adapts based on students' needs. Acknowledging challenges that students might face.	Building the instructor/student relationship	Demonstrating respect for students
	Stating want for students to learn/succeed	Statements about wanting all students to learn and succeed in this course or college in general.		Not in the original framework
Sharing personal experiences	Recounting personal information/ anecdotes	Information about the instructor's personal life or their likes and dislikes. This code could include expressing excitement related to having taught this particular class before.	Sharing personal experiences	Recounting personal information/ anecdotes

	Relating to student experiences	Personal information specifically about the instructor's college experience and their approach to college and how that echoes students' experiences.	Sharing personal experiences	Relating to student experiences
Establishing classroom culture	Pre-framing classroom activities	Information on what activities or instructional practices will occur within the classroom throughout the semester. May include how an activity will be done, but not including exam procedures.	Establishing classroom culture	Pre-framing classroom activities
	Practicing scientific habits of mind	Directions to "think like a scientist/engineer/mathematician," such as critical thinking, using data, or being skeptical. Does not need to describe these specifically as STEM skills.	Establishing classroom culture	Practicing scientific habits of mind
	Building a community among students	Suggestions that students help each other during in-class activities and for studying outside of class. Also includes breaking down barriers between students by sharing information about themselves with other students.	Establishing classroom culture	Building a biology community among students
	Giving credit to colleagues	Positive comments about colleagues' teaching such as advice, ideas, resources, hard work, caring about students, being good instructors, etc. Also includes giving credit to a group such as a department for good teaching.	Establishing classroom culture	Giving credit to colleagues
	Indicating that it is okay to be wrong or disagree	States that being wrong, providing a wrong answer, or disagreeing with someone is okay or is part of the learning process. Also, may state that instructors can make mistakes. Suggests that the instructor is not interested in hearing the correct answer but instead curious about the students' thought processes.	Establishing classroom culture	Indicating that it is okay to be wrong or disagree
Explaining pedagogical choices	Supporting learning through teaching choices	Explains why the instructor chose to structure the course or activities in a way that will help students learn. Includes statements about things required to be done outside of class that will improve activities inside of class.	Explaining pedagogical choices	Supporting learning through teaching choices

	Using student work to drive teaching choices	Indicates that the instructor uses information from students, either in the form of direct feedback, formative assessments, or pre-tests to make pedagogical decisions.	Explaining pedagogical choices	Using student work to drive teaching choices
	Connecting the course to the real world and career	Relates course to the real world or a student's career. Expressions that the class can help prepare students for life beyond college.	Explaining pedagogical choices	Connecting biology to the real world and career
	Discussing how people learn	Explains how learning works from a biological, sociological, or psychological perspective. May include references to research on learning.	Explaining pedagogical choices	Discussing how people learn
	Fostering learning for the long term	States that the goal is for students to retain knowledge long-term and not just for the test. Explains how pedagogy helps accomplish this.	Explaining pedagogical choices	Fostering learning for the long term
Being explicit about the nature of the field	Being explicit about the nature of the field	Explains how STEM is done such as making predictions or that it is iterative, hard, or maybe frustrating. Includes talking about the Nature of Science.	Unmasking science	Being explicit about the nature of the field
Promoting diversity in STEM	Promoting diversity in STEM	Explains why it is important for diverse people to engage in STEM, acknowledges the lack of diversity in STEM, or highlights diverse STEM practitioners.	Unmasking science	Promoting diversity in STEM
Fostering wonder	Fostering wonder	Encouraging student excitement and curiosity about STEM including general statements about the wonders of science. Does not need to relate to careers or applications of STEM.	Unmasking science	Fostering wonder
Negatively phrased Instructor Talk categories				
Final category	**Final subcategory**	**Final definition**	**Original framework category**	**Original framework subcategory**
Dismantling the instructor/student relationship	Ignoring student challenges	Not empathizing with student experiences. Statement ignores challenges for students in class or students' needs/responsibilities outside of class.	Dismantling the instructor/student relationship	Ignoring student challenges
	Assuming poor behaviors from students	Stating that the instructor expects students to try and game the system (i.e., lie, cheat, use unapproved resources, or not use approved resources) or that students' don't care about their own learning.	Dismantling the instructor/student relationship	Assuming poor behaviors for students

	Making public judgments about students	Provides examples of students who have not succeeded or who have been embarrassed. Provides negative feedback or statements about students based on their characteristics or single actions.	Dismantling the instructor/student relationship	Making public judgments about students
	Discouraging students from asking questions	Statements suggesting or requesting that students do not ask the instructor or other instructors questions about a topic, at a particular time, or in a particular way.		Not in the original framework
Disestablishing classroom culture	Expecting students to know what to do	Statements requiring students to know hidden behaviors or knowledge about college or know how to "think like a scientist/engineer/mathematician". This can include expecting students to defend themselves/stick up for themselves to people in positions of authority or know about resources, study behaviors, or policies.	Disestablishing classroom culture	Expecting students to know what to do
	Discouraging community among students	Telling students not to work together or that other students may not have accurate information.	Disestablishing classroom culture	Discouraging community among students
	Criticizing colleagues/resources	Criticizing resources that instructors do not control/did not create such as learning centers, tutors, teaching/learning assistants, textbooks, and online source materials.	Disestablishing classroom culture	Criticizing colleagues
	Encouraging only the right answer	Broadly suggests that the right answers are the only goal and ignores the benefits/learning opportunities provided by wrong answers. If the faculty member shuts down a student who shares a wrong answer, that is coded as Making Public Judgments rather than here.	Disestablishing classroom culture	Encouraging only the right answer
	Criticizing the system	Criticizes how the university, department, or unit arranges classes or sets course requirements such as enrollment size or classroom space.		Not in the original framework
Compromising pedagogical choices	Expressing doubt in pedagogical choice	Indicates that the instructions provided or classroom activities the instructor is asking students to engage in are potentially not useful, will not work, or will not	Compromising pedagogical choices	Expressing doubt in pedagogical choice

		be fun for students.		
	Using convenience to drive teaching choices	Indicates that the instructor makes teaching choices based on ease for themselves or not based on information from students. Indicates that they do not try to connect the course to student interests or career paths.	Compromising pedagogical choices	Using convenience to drive teaching choices
	Teaching to a subset of students	Indicates that as long as some students are understanding the material, the instructor will continue with content.	Compromising pedagogical choices	Teaching to a subset of students
	Focusing on the grade/short-term	Expresses that the goal is for the students to get certain grades and retain information for tests.	Compromising pedagogical choices	Focusing on the grade/short-term
Sharing personal judgment	Sharing self-judgment/self-pity	Recounts anecdotes that put the instructor in a negative light or are self-deprecating.	Sharing personal judgment	Sharing self-judgment/self-pity
	Distancing from student experiences	Information specifically about the instructor's college experiences that emphasizes how different their experiences were from all or a subset of students' students' experiences.	Sharing personal judgment	Distancing from student experiences
Masking STEM	Being implicit about the nature of science	Describes STEM or a related fact as a mystery that the instructor cannot understand/or is uninterested in understanding. Indicates that students shouldn't worry about understanding the details of some content/topic.	Masking science	Being implicit about the nature of science
	Intimidating students from science	Indicates that the course is meant to remove unsuccessful students from the major or career path.	Masking science	Intimidating students from science

Supplemental Table 3. Kruskal-Wallis rank sum tests. Tests are between the dependent variable consisting of two clusters (higher STEM content and lower STEM content) identified in Figure 1B and the independent variables university, course, and instructional practice that could contribute to differences in clustering.

	Kruskal-Wallis chi-squared	**df**	***p* value**
University	0.1	2	0.95
Course size	0.53	2	0.77
Class period length	0.15	1	0.9
Average COPUS profiles from at least 4-5 class periods after the first day	2.94	3	0.4

Supplemental Table 4. Number of non-content topics covered and switches between topics.

Instructor	# of non-content topics	# of switches
1	6	11
2	6	10
3	5	11
4	2	4
5	5	15
6	7	30
7	3	9
8	7	20
9	7	17
10	6	13
11	6	9
12	5	12
13	6	23
14	4	10
15	3	5
16	4	8
17	5	8
18	5	6
19	7	15
20	6	15
21	4	13
22	7	20
23	4	7

Supplemental Table 5. Pearson correlation tests. Tests for correlation between each of the Instructor Talk categories and average COPUS profiles (Supplemental Methods 2). Negative *r* values indicate a negative correlation, positive *r* values indicate a positive correlation. Statistical significance is indicated by * $p < 0.05$.

Category	***r***	***p* value**	**Df**
Building instructor/ student relationship	-0.44	0.036*	21
Establishing classroom culture	-0.082	0.711	21
Explaining pedagogical choices	-0.096	0.66	21
Sharing personal experiences	-0.054	0.8	21
Being explicit about the nature of the field	-0.3	0.17	21
Fostering wonder	0.1	0.63	21
Promoting diversity in STEM	-0.3	0.16	21
Other	0.001	1	21
Negative	-0.45	0.03	21

Supplemental Table 6. Themes within Instructor Talk instances coded as *other*. The general themes outlined here captured 137 out of 213 intervals (64%) that had been coded as *other*.

General theme	Specific ideas
Academic integrity	(1) sharing reasons why students might cheat and how to avoid those reasons (2) explaining the difference between helping others and cheating, defining cheating to help students understand, or explaining copyright laws (3) emphasizing the importance of academic integrity using examples of previous students who have faced consequences (4) emphasizing the consequences of academic integrity issues taking up instructor time
Advice from prior students	Specific: (1) written testimonials from students about cheating, written messages from students giving general advice (2) advice from undergraduate learning/teaching assistants General: statements such as "students who did X say Y," statements are actionable by students
Curriculum details	sharing details about the history of the curriculum being used
Distractions	(1) general information about how electronics can be distracting (2) indicating that coming to class late is disruptive to fellow students
Enjoy teaching	instructor says they enjoy teaching the course
Other: building instructor/student relationship	(1) instructor mentions wanting to learn students' names or learn about them (2) prefacing going over academic integrity by emphasizing that the instructor trusts students but have to cover the policies (3) instructor gives examples of conversation topics that students can come talk to them about during office hours (e.g., skills building, personal interests, scientific interests)
Philosophy	(1) philosophy about setting up classroom environments to encourage collaboration instead of competition (2) philosophy of the role of instructors (3) philosophy about what college is like
Student evaluations/feedback	(1) quotations from student evaluations that are not course-based (e.g., about the instructor) (2) statements such as "students seem to like X," differs from advice from students

	in that these statements are more focused on feedback about students' preferences
Surveys for this project	(1) the purpose of surveys (e.g., to learn about students, to improve the course, for students to preview content, to do research)

Supplemental References

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