Supplemental Material

CBE—Life Sciences Education

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APPENDIX A

Interview protocol for screening interviews

I will start by telling you a little bit about our study. Although active learning can lead to greater student learning than lecture alone, these strategies are not always effective. We want to dig a little bit more into this, so we are talking to instructors that use active learning to see how long they have been using these strategies, what these strategies look like in their classroom, and how they know when these strategies are working. We believe there is a difference in the knowledge used to implement active learning that results in the different outcomes. We hope to elicit this difference using a video-survey and apply our findings to designing professional development that is aimed at providing instructors with the knowledge and skills they need to become even more effective.

We are using these phone conversations to screen possible participants before referring them to the video survey. However, we have found that there is rich data given related to the screening process and would like your permission to record and use the responses for qualitative analysis. We hope to add another dimension to the knowledge instructors use by looking at the way they describe their own classrooms and instructional decision-making. We will only use information gathered during this phone call should you be deemed eligible and willing to participate in the video-survey. If you are deemed ineligible or choose not to participate in the video-survey, your records will be permanently deleted.

1. Do you teach any large enrollment biology courses?
2. How long have you been using active learning in those courses?
3. What types of active learning do you use, what does AL look like in your classroom?
4. How do you decide what to use?
5. How do you know when something is or isn't working?
6. Are there other ways you use feedback from students to inform your teaching?

APPENDIX B

Developing and Refining Lesson-Analysis Survey

The lesson-analysis survey created for this study included three videos of real active-learning lessons in a college biology course. Each video was accompanied by writing prompts to elicit teacher noticing. Prior lesson-analysis instruments guided our instrument development. We revised and refined the videos and writing prompts using both pilot data and expert feedback. We describe this process in detail below.

Video production

Videos for this instrument needed to be short to minimize participant burden, but also needed to show a section of a lesson that could stand alone. We also required high-quality audio and video and footage of both the instructor and students. We filmed numerous classrooms to collect sufficient and appropriate footage for our research goals. We used two or three cameras each time we filmed, allowing us to simultaneously capture what the instructor and students were doing. We also recorded audio in the classrooms using two to four microphones, including a lapel microphone to clearly capture the voice of the instructor, two shotgun boom microphones pointed at the students to capture student voices, and the microphone on one or more cameras to capture the collective sound of the classroom. We told students in the filmed courses that the videos would primarily be viewed by college instructors, and that designated parts of the room would not be filmed if they did not wish to appear in video. We produced over eight hours of classroom footage from which we created short (i.e., 3-5 minute) clips for the the survey.

We selected and edited video and audio footage to create clips that showed a variety of teaching decisions and practices. We began this process by identifying sections of footage that would be meaningful on their own and that included multiple practices, such as lecturing, small-group discussion, and whole-class discussion. We then spliced instructor footage with footage of students so that viewers had the opportunity to notice both. We added subtitles as necessary so the viewer always had access to what the instructor and featured students were saying. We also began each video with information about the class to provide context for viewers, including the institution type, course title, class size, and current topic. We used Adobe Premier Pro CC v9.2 for all video and audio editing.

Testing and refining lesson-analysis survey

We paired video clips of active-learning classrooms with prompts to elicit teacher knowledge. Prompts asked respondents to critically analyze what was happening in the shown lessons and were modeled after prior investigations (e.g., Sherin and van Es 2009, Santagata and Angelici 2010, Kaiser et al. 2015). Pilot versions of our lesson-analysis survey tested both general prompts such as, "What three things stood out to you in this lesson?" and prompts that were specific to a scene in a video, such as, "The instructor asks students to come down to the front of the room and project their work to the whole class. Why do you think she uses this strategy?"

We tested Pilot Version 1 of the lesson-analysis survey by collecting responses from instructors with varying levels of teaching experience and training. Our pilot testing revealed that the more specific prompts elicited shorter answers that revealed less about the knowledge of the respondent. We also saw redundant answers in response to three more general prompts. Lastly, we noticed that not all instructors provided reasoning for their thinking. Therefore, we decided to use two general prompts, and to add explicit instructions to each question to encourage respondents to state their reasoning. Pilot Version 2 of the lesson-analysis survey used different prompts for each video. Though the prompts varied by video, they shared similarities. Prompts included: "Explain what strategies you saw this instructor use that you would keep. Explain the reasons behind your choices."; "What missed opportunities, if any, did you see in this lesson? Explain your reasoning."; and "What did the instructor do that was particularly effective? Explain your reasoning." We further emphasized our requests for reasoning using underlined and italicized text.

Next we used expert feedback to refine the videos and prompts. This approach is commonly used to improve the content validity of the inferences that can be drawn from an assessment. Content validity establishes that the questions appropriately represent the intended knowledge domain (Campbell and Nehm 2013). We sought feedback from researchers who had previously developed and used video-based surveys to assess teacher noticing among K-12 instructors. We asked these experts to draw on their research expertise to provide feedback. We also sought feedback from individuals who work directly with college instructors to provide teaching professional development. We asked these experts to draw on their extensive experience working with faculty to think about how they expected faculty to respond to the

videos and prompts. We gathered feedback from six experts across these two domains using the same questions. We asked them to complete the survey as a respondent would so that they could comment on the whole experience. They also answered four questions for each video: (1) Do you expect this video and prompts to elicit instructor thinking, especially interpretations and evaluations they would make if they were the instructor of the lesson? Why or why not?; (2) Are there prompts, or type of prompts, you would recommend in light of our goal of differentiating experienced from new instructors?; (3) Are there changes to the video that you would suggest?; (4) Do you have any other feedback? We provided experts with incentive for participation and followed-up by email as necessary to fully understand their feedback.

We refined the video-based questions based on this expert feedback to create Pilot Version 3 of the lesson-analysis survey. Expert feedback was overwhelming confirmatory, stating that they expected the videos and writing prompts to elicit teacher knowledge. We made a few changes based on what we learned, including replacing one video. One expert suggested we might elicit more diverse knowledge if some of the videos showed active-learning instruction with more room for improvement, so we added a clip of a more inexperienced instructor. We also eliminated one prompt ("Imagine this instructor has asked you to observe her class and provide feedback. Describe the following and explain your reasoning.") based on expert feedback that placing respondents in the role of providing evaluative feedback might cause them to be more careful in what they write and therefore omit important thoughts. Based on a suggestion from two people, we added a question that asked respondents to synthesize across all three videos. Finally, we recognized that the order of videos and prompts could affect the answers we elicited. For example, a respondent may notice something they would not otherwise notice in Video 3 because they noticed it in Video 1. The most appropriate way to handle this limitation for our study was to keep the order of videos the same for each respondent to avoid introducing variation in answers that results from the order of items.

We collected data from a sample of respondents using Pilot Version 3. The prompts were similar across videos. For the first two videos, the prompts asked respondents to identify what was effective and what could be improved and why, but were stated in different ways. We used only a prompt about effectiveness for the third video because pilot work and expert feedback demonstrated that people--even experts--struggled to identify room for improvement in this video, rendering the question useless in discriminating among instructors with different levels of

expertise. The sixth prompt asked for synthesis across videos: "Consider the three examples of teaching that you have just seen. What teaching strategies used by one or more of these instructors do you consider most important for student learning in large college biology courses?"

The data collected allowed us to refine the prompts a final time and conduct preliminary data analysis. Respondents included nine experts and seven novices. Initial qualitative analysis revealed that the question that asked for synthesis across videos elicited vague responses compared to other questions, so we cut this question. We also noticed that answers written in complete sentences were easier to analyze because we had to make fewer inferences about what the respondents meant. Therefore, we added explicit instructions to use complete sentences to each prompt. We also simplified the instruction provided prior to the videos. The final change we made to prompts was to use the exact same language in prompts across all three videos. In the final version of the lesson-analysis survey, instructors responded to two written prompts after the first two videos: (1) What was effective and why did you think it was effective?, (2) What needs to be improved and why? How would you make it different? After the third video, we asked instructors to respond to question (1). Both questions ended with this sentence: Please use complete sentences.

Appendix B References

Campbell CE, Nehm RH (2013) A critical analysis of assessment quality in genomics and bioinformatics education research. CBE-Life Sciences Education 12, 530-541.

Kaiser G, Busse A, Hoth J, König J, Blömeke S (2015) About the complexities of video-based assessments: Theoretical and methodological approaches to overcoming shortcomings of research on teachers' competence. International Journal of Science and Math Education 13: 369-387.

Santagata R, Angelici G (2010). Studying the impact of the lesson analysis framework on preservice teachers' abilities to reflect on videos of classroom teaching. Journal of Teacher Education 61, 339-349.

Sherin MG, van Es EA (2008) Effects of Video Club participation on teachers' professional vision. Journal of Teacher Education 60(1), 20-37.

APPENDIX C

Full Online Survey

Key:

Instructions provided within the survey appear in this font.

Questions that participants were asked to answer appear in this font.

You will be shown three short videos of college classrooms. We are interested in your observations of teaching and learning in these classrooms. For each video, we will ask you to answer one or both of the following:

1. What was effective and why do you think it was effective?

2. What needs to be improved and why? How would you do it differently?

[Participants watch video 1]
Consider the teaching and learning in this classroom.

What was effective and *why* do you think it was effective? Please use complete sentences.

What needs to be improved and *why*? How would you do it differently? Please use complete sentences.

[Participants watch video 2]
Consider the teaching and learning in this classroom.

What was effective and *why* do you think it was effective? Please use complete sentences

What needs to be improved and *why*? How would you do it differently? Please use complete sentences.

[Participants watch video 3]
Consider the teaching and learning in this classroom.

What was effective and *why* do you think it was effective? Please use complete sentences.

This section asks you about your own classroom teaching.

Consider the biology topics addressed in each video. Please indicate how often you have taught each topic in a college course.

Topic	I have never taught this topic	I have taught this topic but not in the past three years.	I have taught this topic at least once in the past year.
Human ancestry and phylogeny			
Genetic drift			
Golgi structure and function			

How do you know when learning is occurring in your classroom?

How do you maximize student learning in your classroom?

This section asks questions about your own teaching practices. It should take less than 5 minutes to complete. The next page is the last page of questions.

NOTE TO READERS: This section is from the Teaching Practices Inventory (Wieman and Gilbert 2014)

Please consider the largest undergraduate biology course you have taught and answer the following questions with that class in mind.

Class Features and Activities

What course information is provided to students via hard copy or course webpage? Please select ALL that apply.

- ❑ List of topics to be covered
- ❑ List of topic-specific competencies (skills, expertise) students should be able to achieve (what students should be able to do)

- ❏ List of competencies that are not topic related (e.g., critical thinking, problem solving, etc.)
- ❏ Course goal(s) that concern changing students' attitudes and beliefs (e.g., their interest, motivation, perception of relevance, beliefs about their competencies, beliefs about learning)
- ❏ None of the above

To the best of your estimation, please provide the following information about your course. (Please input a numerical character)

- ❏ Number of students enrolled in a single section of this course
- ❏ Number of times per week class meets
- ❏ Average number of times per class that you pause to ask questions
- ❏ Average number of times per class that students work in small groups to answer a question or solve a problem
- ❏ Average number of times per class that you present students with a scenario, demonstration, or simulation
- ❏ Average number of times per class that you ask students to make a prediction about what will occur in a scenario/demonstration/simulation, then show the result and compare students' predictions to the observed result
- ❏ Average number of times per term (i.e., semester or quarter) that you talk to the class about why material is useful and/or interesting to students' lives and careers

Comments on any of the above.

Please select ALL that occur in this course:

- ❏ Students asked to read/view material on upcoming class session
- ❏ Students read/view material on upcoming class session AND complete assignments or quizzes on it shortly before class or at the beginning of class
- ❏ Reflective activity at end of class periods, e.g. "one minute paper" or similar (students briefly answering questions, reflecting on lecture and/or their learning, etc.)
- ❏ Formal student presentations (oral or poster)
- ❏ None of the above

What fraction of a typical class period do you spend lecturing (e.g., presenting content, deriving mathematical results, presenting a problem solution)?

- ❏ 0-20%
- ❏ 21-40%
- ❏ 41-60%
- ❏ 61-80%

- ❑ 81-100%

Considering the time spent on major topics, approximately what fraction was spent on the process by which the theory/model/concept was developed?

- ❑ 0-10%
- ❑ 11-25%
- ❑ More than 25%

Which methods do you use during class to collect responses in REAL TIME from all students? (Check all that occur in your course):

- ❑ electronic ("clickers") with student identifier
- ❑ electronic anonymous
- ❑ colored cards
- ❑ raising hands
- ❑ written student responses that are collected and reviewed in real time
- ❑ None of the above

How many questions per class are followed by student-student discussion?

How many times per class is a student response system used as a quiz device? (counts for points and no student discussion)

NOTE TO READERS: End of Teaching Practices Inventory Questions

For how long have you used the teaching strategies you reported on this page?
_____ Number of terms (i.e., semesters or quarters)

You did it, this is the last page!

Have you engaged in any of the following professional activities? Please select ALL that apply.

- ❑ Participated in 40+ hours of teaching professional development, such as teaching workshops/seminars, graduate-level courses in teaching and learning, etc.
- ❑ Led teaching professional development, such as teaching workshops/seminars, graduate-level courses in teaching and learning, etc.
- ❑ Published peer-reviewed education research
- ❑ Presented education research at a professional conference

- ❏ Had formal training in education research (not teaching) as a graduate student, postdoc, or faculty member
- ❏ Conducted or been trained to conduct classroom observations using a published protocol, such as RTOP, COPUS, EQUIP, or PORTAAL
- ❏ None of the above

To the best of your knowledge, how many semesters have you taught college courses (excluding any semesters you taught as a graduate student)?
_____ Number of terms (i.e., semesters or quarters)

Please upload your CV here. This is one way we can document the scientific approach you have taken to your teaching.

What is your gender?

- ❏ Female
- ❏ Male
- ❏ Other _____
- ❏ No Response

With which race/race(s) do you most closely identify with? Please select ALL that apply.

- ❏ African American/Black
- ❏ American Indian or Alaskan Native
- ❏ Asian
- ❏ Latino
- ❏ Native Hawaiian or other native Pacific Islander
- ❏ White
- ❏ Other _____
- ❏ No Response

With which ethnicity do you most closely identify with?

- ❏ Hispanic
- ❏ Non-Hispanic
- ❏ No Response