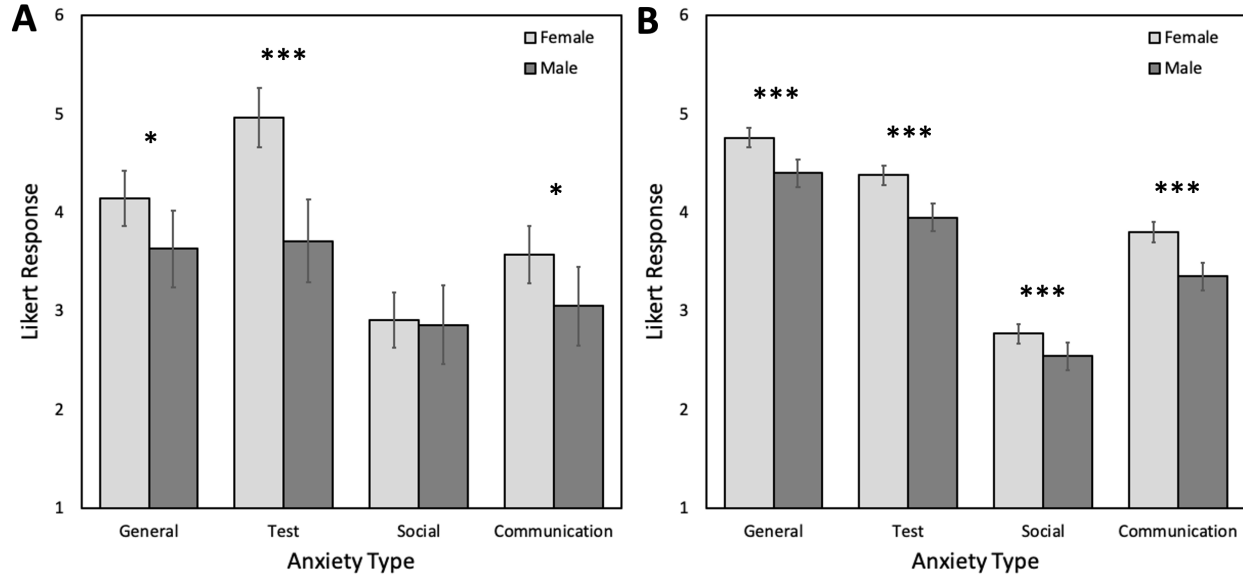# Supplemental Material

CBE—Life Sciences Education

Adkins-Jablonsky *et al*.

Does Kahoot! cause anxiety? Exploring effects of an ungraded gamified student response system in two different introductory biology classes
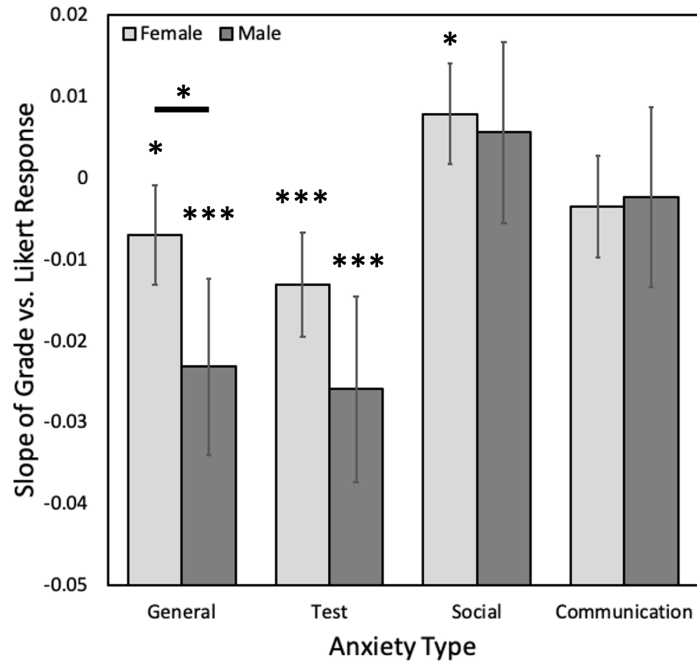
Sarah J. Adkins-Jablonsky, Justin F. Shaffer, J. Jeffrey Morris, Ben England, Samiksha Raut
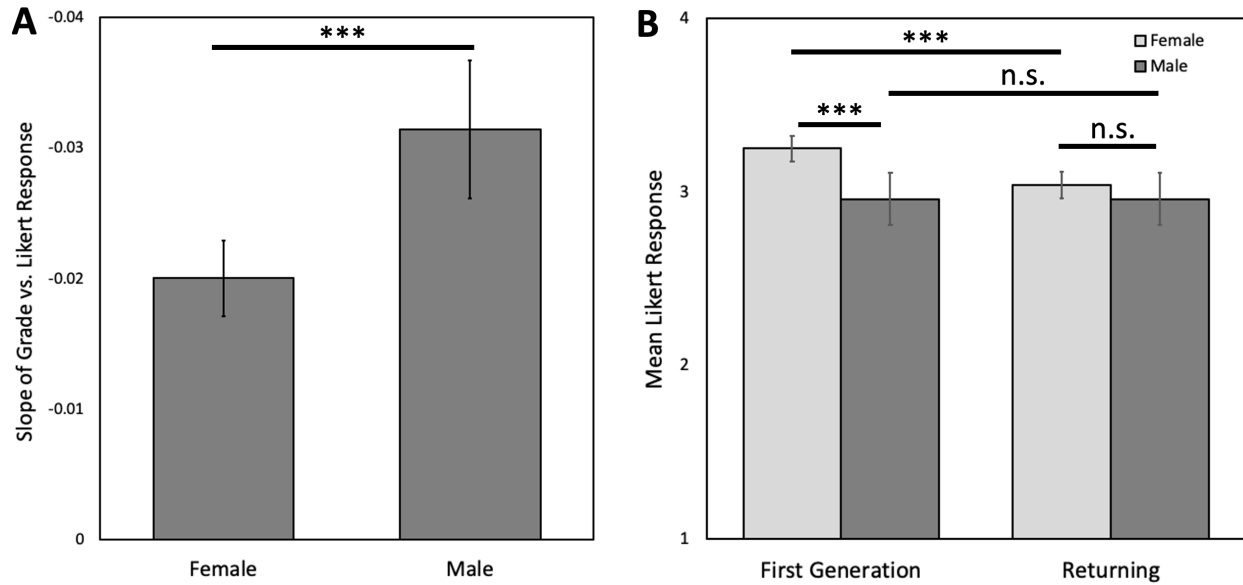
Supplemental Materials

Supplemental Figure 1. Baseline anxiety levels for students at U1 (Panel A) and U2 (Panel B). Values are the estimated mean Likert responses for female (light gray bars) and male (dark gray bars) students from pre-semester surveys inquiring about levels of four types of anxiety. Estimates were obtained as extended marginal means from linear mixed-effects models. At U2, the significant effect of a student's final grade for the course was incorporated by calculating the means based on the mean score for the class (72.5%). General and Test anxiety instruments were on a 7-point Likert scale, with a value of 4 indicating neutrality; Social and Communication anxiety instruments used a 5-point scale with 3 indicating neutrality. Error bars represent the 95% confidence interval of the estimate, and asterisks indicate significant differences between male and female responses (*, $p < 0.05$; ***, $p < 0.001$).

Supplemental Figure 2. Differences in baseline anxiety based on student academic performance. Baseline anxiety responses from pre-semester surveys at U2 were significantly related to the score a student would ultimately earn in the course. Asterisks above individual bars indicate a significantly non-zero slope of the regression of final grade on Likert response; asterisks above a line connecting two bars indicate a significant difference between the slopes for male and female students. *, $p < 0.05$; ***, $p < 0.001$. Error bars indicate the 95% confidence interval of the slope estimate.

Supplemental Figure 3. Effects of demographics on U2 student anxiety responses to pedagogical techniques. A) Both male and female U2 students who ultimately earned lower scores in the course were more likely to report higher anxiety levels related to all pedagogical techniques surveyed (e.g. Fig. 1), but the slope for male students was significantly more negative than for female students. B) First-generation female students reported significantly higher anxiety levels related to pedagogical techniques than returning female students as well as all male students. There was no impact of first-generation status on reported male anxiety levels. Error bars represent the 95% confidence interval of the LME estimate. ***, $p < 0.001$; n.s., not significant.

Supplemental Table 1. Demographic information. n, number of students included in final analysis; CI, 95% confidence interval of the mean; URM, under-represented minority.

University/ Section	n	College Year (mean +/- CI)	College Year (median)	Grade (mean +/- CI)	Grade (median)	% Female	% URM	% First Generation
U1	60	2.6 +/- 0.3	2	83.2% +/- 2.9	82.3%	67%	47%	32%
U2 Sec 1	338	1.1 +/- 0.1	1	69.2% +/- 1.2	68.6%	80%	55%	69%
U2 Sec 2	356	1.3 +/- 0.1	1	75.7% +/- 1.2	77.4%	68%	26%	47%

University 1 Interval surveys (1, 2, and 3)

Alias: _____

The scale for the following items is as follows:
1 = Strongly disagree
2 = Disagree
3 = Neither agree or disagree
4 = Agree
5 = Strongly agree

Circle the number which best describes your level agreement to the following statements:

1. I feel motivated to study for BY124.	1	2	3	4	5
2. If we did not play Kahoot!, I would feel more stressed on the exam.	1	2	3	4	5
3. I feel anxiety when I play Kahoot!	1	2	3	4	5
4. Anxiety I feel when I play Kahoot is overwhelming.	1	2	3	4	5
5. I feel more motivated to study for BY124 after playing Kahoot!	1	2	3	4	5
6. I prefer Kahoot! to other student response systems (i.e. Clickers).	1	2	3	4	5
7. Kahoot! helps me engage with the lecture material.	1	2	3	4	5

Please provide any comments you have about Kahoot! (positive, neutral, or negative) in the space below:

University 1 Pre and Post Survey

Alias: _____

The scale for the following items is as follows:
1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Neither agree or disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

Circle the number which best describes your level agreement to the following statements:

1. Biology lecture makes me nervous	1	2	3	4	5	6	7
2. Biology lecture is stressful	1	2	3	4	5	6	7
3. Biology lecture makes me anxious	1	2	3	4	5	6	7
4. Biology lecture scares me	1	2	3	4	5	6	7
5. Biology lecture is a complex subject	1	2	3	4	5	6	7
6. Biology lecture is complicated	1	2	3	4	5	6	7
7. Biology lecture is difficult	1	2	3	4	5	6	7

8. When I take a test I think about how poorly I am doing compared with other students.

1	2	3	4	5	6	7

9. When I take a test I think about items on other parts of the test I can't answer.

1	2	3	4	5	6	7

10. When I take tests I think of the consequences of failing.

1	2	3	4	5	6	7

11. I have an uneasy, upset feeling when I take an exam.

1	2	3	4	5	6	7

12. I feel my heart beating fast when I take an exam

1	2	3	4	5	6	7

The scale for the following items is as follows:
1 = Strongly disagree
2 = Disagree
3 = Neither agree or disagree
4 = Agree
5 = Strongly agree

13. I dislike participating in group discussions.	1	2	3	4	5
14. Generally, I am comfortable while participating in group discussions.	1	2	3	4	5
15. I am tense and nervous while participating in group discussions.	1	2	3	4	5
16. I like to get involved in group discussions.	1	2	3	4	5

17. Engaging in a group discussion with new people makes me tense and nervous.

1	2	3	4	5

18. I am calm and relaxed while participating in group discussions.	1	2	3	4	5
19. I have no fear of giving a speech.	1	2	3	4	5

20. Certain parts of my body feel very tense and rigid while giving a speech.

1	2	3	4	5

22. I feel relaxed while giving a speech.	1	2	3	4	5

22. My thoughts become confused and jumbled when I am giving a speech.

1	2	3	4	5

23. I face the prospect of giving a speech with confidence.	1	2	3	4	5
24. While giving a speech, I get so nervous I forget facts I really know.	1	2	3	4	5

The scale for the following items is as follows:

1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Neither agree or disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

How anxious did each of the following course components make you?
In lecture…

1. Listening to the Professors questions	1	2	3	4	5	6	7
2. Answering the concept questions in class	1	2	3	4	5	6	7
3. Answering open-ended questions in class	1	2	3	4	5	6	7
4. Playing Kahoot!	1	2	3	4	5	6	7
5. Working in small groups	1	2	3	4	5	6	7
6. Asking a question in front of the class	1	2	3	4	5	6	7
7. Professor asking you a question in class	1	2	3	4	5	6	7
8. Answering a question in front of the class	1	2	3	4	5	6	7
9. Taking exams	1	2	3	4	5	6	7

In SI session…

1. listening to your SI lecture	1	2	3	4	5	6	7
2. Answering open-ended questions	1	2	3	4	5	6	7
3. Working in small groups	1	2	3	4	5	6	7
4. Completing the worksheets	1	2	3	4	5	6	7

Outside of class…

1. Reading the textbook	1	2	3	4	5	6	7
2. Completing the reading guides	1	2	3	4	5	6	7
3. Completing weekly review quizzes on canvas	1	2	3	4	5	6	7
4. Studying for exams	1	2	3	4	5	6	7
5. Talking to the professor	1	2	3	4	5	6	7
6. Attending the office hours by the professor	1	2	3	4	5	6	7

8. What career are you thinking about pursuing? (write-in response): _____

9. How much time did you spend last week playing video and/or computer games?
      a. ____Hours (write in response)
      b. No time

10. Do you like to play video and/or computer games?
      a. Never played/Not at all (skip question 11) 0
      b. Very Much (3)
      c. Somewhat (2)
      d. Not Really (1)

11. Why do you play the games you checked above? (Choose at most 3)
      a. I like the graphics/realism
      b. Relaxation/recreation/escapism
      c. It improves my hand-eye coordination
      d. It challenges my mind
      e. It's such a great feeling to master or nish a game
      f. I'll play anything when I'm bored
      g. Other (write-in response): _____

University 2 Pre and Post Surveys

(Printer Friendly) Preview Survey

This is a preview of your survey as your participants will see it.

Next: Verify >>	or Cancel

1. Enter Responses > 2. Verify & Submit > 3. Submission Successful

Bio 93 Pre-Course Survey Fall 2017 A

Help Contact Info
Displays survey help/contact information provided at publish

Instructions

This survey is part of a research study investigating student anxiety* in Biology classes. The questions will be asking about Bio Sci 93 this quarter, specifically the levels of anxiety you may feel during class lecture. *Anxiety and stress are different, but if you are feeling stress, you are probably also feeling anxiety.

This project will collect responses at the beginning and end of the quarter. We are asking for your names on the survey so we can link your responses to both surveys and then your final course grade. The researchers will also be retaining your responses with your name so that if you respond to this same survey in a future biology class, your responses can be matched. Your name would never be reported along with your responses in any published results.

The survey is voluntary and asks you to answer a variety of questions. It may take 5-10 minutes to complete. You will receive one participation point for completing this survey.

Please go to the following link to read more about this study.

https://eee.uci.edu/17f/05200/researchstudy

1. Please respond to the following items about what you think the lecture portion of Bio Sci 93 will be like this quarter. Please respond using a scale of strongly disagree to strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Biology lecture makes me nervous	○	○	○	○	○	○	○
Biology lecture is stressful	○	○	○	○	○	○	○
Biology lecture makes me anxious	○	○	○	○	○	○	○
Biology lecture scares me	○	○	○	○	○	○	○
Biology lecture is a complex subject	○	○	○	○	○	○	○
Biology lecture is complicated	○	○	○	○	○	○	○
Biology lecture is difficult	○	○	○	○	○	○	○

ⓘ Learn more about the transition to EEE+ Canvas ›

2. Rate each of the following active learning practices based on how much ANXIETY you think they will cause you to feel during class this quarter. Use the following scale:
   1 - no anxiety
   4 - moderate anxiety
   7 - high anxiety

	1 - no anxiety	2	3	4 - moderate anxiety	5	6	7 - high anxiety
You are asked to respond to a clicker question (a question that you answer with your iClicker device).	○	○	○	○	○	○	○
You are asked to volunteer to answer a question the instructor has posed.	○	○	○	○	○	○	○
You are called on by name to answer a question the instructor has posed.	○	○	○	○	○	○	○
You are asked to play a game that gives you points for answering questions correctly and as fast as possible.	○	○	○	○	○	○	○
You are asked to work with others in class to answer questions or complete an in-class activity.	○	○	○	○	○	○	○
You are asked to come to the front of the class to draw on the board.	○	○	○	○	○	○	○
You are asked to come to the front of the class to participate in a demonstration.	○	○	○	○	○	○	○

3. Please respond to the following items. Use the following scale: 1 = not at all true of me to 7 = very true of me

	1 - not at all true of me	2	3	4	5	6	7 - very true of me
When I take a test I think about how poorly I am doing compared with other students.	○	○	○	○	○	○	○
When I take a test I think about items on other parts of the test I can't answer.	○	○	○	○	○	○	○
When I take tests I think of the consequences of failing.	○	○	○	○	○	○	○
I have an uneasy, upset feeling when I take an exam.	○	○	○	○	○	○	○
I feel my heart beating fast when I take an exam.	○	○	○	○	○	○	○

4. Please respond to the following items. Use the following scale: 1 = strongly disagree to 5 = strongly agree.

	1 - strongly disagree	2	3	4	5 - strongly agree
I dislike participating in group discussions.	○	○	○	○	○
Generally, I am comfortable while participating in group discussions.	○	○	○	○	○
I am tense and nervous while participating in group discussions.	○	○	○	○	○

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	1 - strongly disagree	2	3	4	5 - strongly agree
Engaging in a group discussion with new people makes me tense and nervous.	○	○	○	○	○
I am calm and relaxed while participating in group discussions.	○	○	○	○	○

5. Please respond to the following items. Use the following scale: 1 = strongly disagree to 5 = strongly agree

	1 - strongly disagree	2	3	4	5 - strongly agree
I have no fear of answering a question in front of the class.	○	○	○	○	○
Certain parts of my body feel very tense and rigid while answering a question in front of the class.	○	○	○	○	○
I feel relaxed while answering a question in front of the class.	○	○	○	○	○
My thoughts become confused and jumbled when I am answering a question in front of the class.	○	○	○	○	○
I face the prospect of answering a question in front of the class with confidence.	○	○	○	○	○
While answering a question in front of the class, I get so nervous I forget facts I really know.	○	○	○	○	○

6. Please respond to the following items. Use the following scale 1 = not at all true of me to 7 = very true of me

	1 - not at all true of me	2	3	4	5	6	7 - very true of me
I believe I will receive an excellent grade in this class.	○	○	○	○	○	○	○
I'm certain I can understand the most difficult material presented in the readings for this course.	○	○	○	○	○	○	○
I'm confident I can learn the basic concepts taught in this course.	○	○	○	○	○	○	○
I'm confident I can understand the most complex material presented by the instructor in this course.	○	○	○	○	○	○	○
I'm confident I can do an excellent job on the assignments and tests in this course.	○	○	○	○	○	○	○
I expect to do well in this class.	○	○	○	○	○	○	○
I'm certain I can master the skills being taught in this class.	○	○	○	○	○	○	○
Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	○	○	○	○	○	○	○

1. Enter Responses > 2. Verify & Submit > 3. Submission Successful

Next: Verify >>	or Cancel

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University 1 Post Demographic Survey

What is your gender?
      a. Male
      b. Female
      c. Other (option to write-in response): _____
      d. Prefer not to respond

With which race(s)/ethnicity do you most closely identify? Please choose all that apply.
      a. American Indian or Alaska Native
      b. Asian
      c. Black or African American
      d. Native Hawaiian or other Pacific Islander
      e. White
      f. Hispanic or Latinx
      g. Other (option to write-in response): _____
      h. Prefer not to respond

What is the maximum level of education completed by either of your parents/legal guardians?
      a. 4-year/Bachelor's college degree or higher
      b. 2-year/Associate's degree or some college
      c. None of the above
      d. Prefer not to respond

What year are you in college?
      a. First year
      b. Second year
      c. Third year
      d. Fourth year
      e. Fifth year
      f. Other (option to write-in response): _____
      g. Prefer not to respond

What is your major? (write-in response): _____

Of the following, which is the highest biology course that you took in high school?
      a. I did not take biology in high school
      b. Biology
      c. Honors Biology
      d. AP Biology
      e. Other (option to write-in response): _____
      f. Prefer not to respond

By the end of the semester, how many biology courses will you have taken during your college career?
      a. 0
      b. 1
      c. 2
      d. 3
      e. 4 or more
      f. Prefer not to respond

What is your current college GPA? If you have not completed your first semester of college, please put "NA". (write-in response):
_____

Which of the following standardized tests did you take?
   a. SAT
   b. ACT
   c. Neither of the above
   d. Prefer not to respond
If SAT: What was your SAT Math score? (write-in response): _____
If ACT: What was your ACT Math score? (write-in response): _____

Are you in an Honors program at your institution?
   a. Yes
   b. No
   c. Prefer not to respond
If Yes: Which Honors program are you in? (write in response): _____

What is your major? (write-in response): _____

Which of the following describes you with relation to pre-professional programs?
   a. I am pre-medicine
   b. I am pre-dental
   c. I am pre-pharmacy
   d. I am pre-veterinary medicine
   e. I am in a pre-professional science program not listed here (option to write-in response): _____
   f. I am not in a pre-professional science program
   g. Prefer not to respond

What career are you thinking about pursuing? (write-in response): _____

How much time did you spend last week playing video and/or computer games?
   a._____Hours (write in response)
   b. No time

Do you like to play video and/or computer games?
   a. Never played/Not at all (skip questions 16 and 17)
   b. Very Much
   c. Somewhat
   d. Not Really

What types of games do you play? (Circle all that apply)
   a. Action (Call of Duty)
   b. Adventure (Mario, Skyrim)
   c. Simulation (Grand Theft Auto)
   d. Sports (Wii sports)
   e. Strategy/Puzzle (Minecraft, Tetris)
   f. Educational (BrainQuest, Luminosity)

Why do you play the games you checked above? (Choose at most 3)
   a. I like the graphics/realism
   b. Relaxation/recreation/escapism
   c. It improves my hand-eye coordination
   d. It challenges my mind
   e. It's such a great feeling to master or nish a game
   f. I'll play anything when I'm bored
   g. Other (write-in response): _____