The Use of Stuffed Microbes in an Undergraduate Microbiology Course Increases Engagement and Student Learning

Ginny Webb
Division of Natural Sciences and Engineering, University of South Carolina Upstate, Spartanburg, SC 29303

INTRODUCTION

Attendance, attention, and engagement are vital components for student learning and are crucial for student success in an introductory microbiology course (1–4). Finding methods to increase engagement in a lecture with approximately 85 to 95 students can be challenging.

In my Introductory Microbiology course, infectious diseases are covered in the last quarter of the class, which spans the last three weeks of the semester. Approximately 60 infectious diseases are covered during this short amount of time and it is challenging for students to retain all of the information provided. This final section of the course is still always the students’ favorite part of the course.

In an effort to increase student engagement, I began to incorporate stuffed, plush microbes in an activity I termed “Catch the Bug.” The “Catch the Bug” activity had several goals: 1) Increase student engagement and interaction, 2) Increase attendance, and 3) Begin incorporating these infection-causing microbes earlier in the semester.

PROCEDURE

Stuffed, plush microbes

Large stuffed microbes representing various pathogenic microbes were purchased from GIANTmicrobes. These stuffed microbes are true to shape and display various features that provided students a visual interpretation of cell structures. For example, the Escherichia coli stuffed microbe displays peritrichous flagella and the Giardia lamblia stuffed microbe has two “eyes” symbolizing its two nuclei. The stuffed, plush microbes used were: Clostridium botulinum, Escherichia coli, the Ebola virus, the measles virus, Giardia lamblia, Staphylococcus aureus, Vibrio cholerae, Mycobacterium tuberculosis, the Rabies virus, Neisseria meningitidis, and Streptococcus pyogenes.

“Catch the Bug” during weekly lecture

My microbiology lecture is a 75-minute class that meets twice a week. During the first five minutes of lecture, one day a week, a new stuffed microbe was presented to the class. Two to five PowerPoint slides were provided to discuss the microbe and the resulting infection (Appendix 1 and 2). These notes were not provided on the class website, so students had to be present in class to receive the material. During each “Catch the Bug” presentation, I showed the class the stuffed microbe and discussed its shape and structure. Students then passed the stuffed microbe around so they could take a closer look.

To keep students engaged, I randomly threw the microbes out during class. The student who caught the microbe would be asked a question about it (Appendix 3). Any microbe that had been covered during a weekly “Catch the Bug” discussion could be thrown out. Therefore, as the semester proceeded, the number of microbes that students could be asked about increased. The goal of this was two-fold: 1) Keep students engaged by providing interesting but educational breaks during a lengthy lecture, and 2) Motivate students to study the microbes so they would be prepared for questions they may be asked. The questions were meant to be low-pressure and students often helped one another with the answers. In addition to in-class questions, five questions about the “Catch the Bug” microbes were included on each test.

An anonymous survey was given to students at the end of the semester to gain their feedback about the “Catch the Bug” activity.

The effect of stuffed microbes on retention

I conducted an experiment to determine whether the use of stuffed, plush microbes aids in retention of information about the microbes. Student volunteers were divided into two classes of 25 students each. These groups then attended a separate mini-lecture session. At the beginning of the session, a pretest was administered asking questions about the four microbes that would be covered during the session. Following the pretest, both groups received a lecture providing information about the four microbes.
PowerPoint slides used were the same for the two groups. In one group, the stuffed, plush microbes were used as visuals and were passed around the class. Following the lecture, students were allowed to study their notes for five minutes, and then a posttest was administered. An anonymous survey was given to both groups after the sessions.

Safety

There were no safety issues related to this activity. The Institutional Review Board reviewed this project and determined it to be exempt.

CONCLUSION

“Catch the Bug” survey

Student opinions about the semester-long “Catch the Bug” activity were overwhelmingly positive, with approximately 93% of the class stating they enjoyed the activity (59 students were surveyed). The results of the survey, shown in Figure 1, demonstrate that the “Catch the Bug” activity accomplished each of its goals. The first goal was to increase student engagement, and the majority of students agreed that the activity helped them stay alert and pay attention in lecture. I also found this activity increased student interest in the topic. The second goal was to increase attendance, and students agreed that having the “Catch the Bug” session during class motivated them to come to class and to be on time. The third goal was to begin covering these microbes earlier in the semester to help prepare students for the full infectious disease portion of the class. In all, 98% of students felt the “Catch the Bug” activity helped prepare them for the infectious disease portion of the class. Students also believed that visualizing and holding the microbes helped them better retain the information.

Use of stuffed microbes during lecture

Figure 2 compares the overall results of the pre- and posttest scores of the two groups following the mini-lecture session. Recall that stuffed microbes were used during the lecture for one group but not for the other group. The overall scores between the two groups were

1) I enjoyed the “Catch the Bug” activity this semester.
2) Having the stuffed microbe to see and hold helped me to stay alert and pay attention during lecture.
3) Having the stuffed microbe presentation motivated me to attend class.
4) Having the stuffed microbe presentation motivated me to be on time to class.
5) Visualizing and holding the microbes helped me remember their shapes.
6) Visualizing and holding the microbes helped me remember facts about them.
7) Knowing questions would be asked randomly in class motivated me to study the information about the microbes.
8) Knowing questions would be asked randomly in class helped me stay alert and pay attention during class.
9) Studying a microbe each week during the semester helped prepare me for the infection unit at the end of the semester.
10) Having the stuffed microbes in class increased my interest in the topic.

FIGURE 1. Results of a student survey on the “Catch the Bug” activity (n=59).
not significantly different. I next wanted to determine whether having the stuffed microbes to visualize and hold would allow students to better remember their shapes and structures. Figure 3 shows the pre- and posttest results of only the questions that were about shape or structure. When comparing these scores, the group presented with stuffed microbes had a higher posttest score on shape- and structure-related questions ($p < 0.05$). The results of a survey given to students in the stuffed microbe group are shown in Figure 4. As shown in the figure, $96\%$ of students in the stuffed microbe group felt that having the stuffed microbes during lecture helped them stay engaged. A total of $88\%$ of the group felt that having the stuffed microbes helped them stay alert, and $100\%$ of students felt that having the stuffed microbes assisted with their retention of material. In particular, $92\%$ of students strongly agreed that visualizing the microbe helped them to remember the microbes’ shape.

![Figure 2](image1.png)

**FIGURE 2.** Comparisons of pre- and posttest scores and overall improvement during microbiology lecture sessions with and without the use of stuffed microbes ($n=25$). Error bars represent standard deviation.

![Figure 3](image2.png)

**FIGURE 3.** Comparisons of pre- and posttest scores and improvement on shape- or structure-related questions during microbiology lecture sessions with and without the use of stuffed microbes (* denotes $p<0.05$ using student t-test; $n=25$). Error bars represent standard deviation.

![Figure 4](image3.png)

**FIGURE 4.** Results of a student survey following a microbiology lecture session. Students were presented with stuffed microbes during the lecture and a survey was administered at the end of the lecture ($n=25$).
In summary, student surveys suggest that using stuffed, plush microbes in an undergraduate introductory microbiology course increased students’ interest, engagement, and retention of material.

SUPPLEMENTAL MATERIALS

Appendix 1: Sample Ebola PowerPoint
Appendix 2: Sample whooping cough PowerPoint
Appendix 3: Follow-up questions

ACKNOWLEDGMENTS

The author declares that there are no conflicts of interests.

REFERENCES