

# Preparing Student Study Guides through Peer Collaboration in the Technological Era

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## Abstract

Incorporating active learning exercises into large lecture courses is particularly challenging, especially when it comes to examination preparation materials. Traditionally, study guides are used as a tool to guide student learning and review pertinent information. However, instructor produced review guides limit active participation of students in the study process, and the independent reading and review of study materials has previously been shown to fall short of being inclusive for students. Here I describe a tool used in a large introductory biology lecture for the implementation of peer produced study guides. The activity includes in-person peer discussion followed by online peer collaboration to design a study guide of potential exam materials, incorporating the advantages of both active learning and the use of study guides. This format provides a platform for students of diverse learning backgrounds to actively participate in the development and refinement of study materials. I conclude by discussing the assessment, secondary advantages, and adaptability of this tool and teaching strategy.

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## BACKGROUND

Study guides are often used as learning directors in undergraduate courses, and are known to assist in learning, increase student involvement, provide students with an understanding of expectations, and improve material comprehension and metacognition (1). Study guides are supportive of active learning goals, as they encourage effective study skills and independent learning (2). However, both the method of production and the method of review can highly alter the effectiveness of such materials.

In large classes, such as introductory lecture courses, it can be tempting to provide students with an instructor written study guide used exclusively for independent review. This approach pairs well with student reported preferences of note review, mnemonic formation, and the reproduction of notes for study (3). However, this inherently limits the active learning components of exam preparation (4,5). Studies show that responding to questions on a study guide, such as fill in the blank questions, multiple choice questionnaires, or summarizing lecture material has beneficial effects on student exam performance (4,5). However, while students report that they prefer answering pre-existing questions on a study guide, they perform at even higher levels when they are required to develop the questions (6).

Limitations such as class size and time investment can make implementing active learning exercises daunting due to a lack of adequate assistance (7). Collaborative learning addresses some of these issues by decreasing workload for instructors and increasing the responsibility of students to construct knowledge (7). Peer collaborative learning, a form of active learning, has been shown

to enhance thinking, attitude, comprehension, and social skills in the classroom (8) by providing students with the opportunity to actively participate in discussion of course material, which is a necessity for learning (9).

As study guides are shown to increase student performance, and are often requested by students, I support their use in my classes. However, I aim to incorporate active learning with an emphasis on peer collaboration into my assignments. While this can be particularly difficult in large classes, I find that the creation of a peer produced study guide is one way to effectively do so.

## PEER PRODUCED STUDY GUIDES

### *Peer Produced Exam Preparation Materials*

Rather than preparing a study guide for students to review, which limit the scope of student studying and active learning, I prepared an opportunity for my students to produce examination preparation materials as an interactive task. This approach is easily adaptable to both in-person and online formats. By engaging in this task, students were able to prepare study materials in collaboration with their classmates, have long-term access to a constantly evolving study aid, and access many different explanations of concepts through their peers' perspectives.

### *Course Details*

While I have used this method as a Teaching Assistant in other courses, this specific exercise was completed in two separate sections of an introductory biology course, Organismal Biology. Organismal biology is part of a series of introductory coursework for Biology majors in preparation for upper-level coursework. In the Spring of 2019, I co-instructed this course. In the class, we

covered topics such as the taxonomic classification, structure, biology, and diversity of all living organisms. The two sections contained 234 and 202 registered students. In each section, students were assigned to groups of four to six group members. While teaching, I used a combination of lecture and active learning activities (i.e., iClicker questions, group exams, group activities). The course met in a lecture auditorium twice weekly for 75-minutes.

### Activity Description

In class, I asked students to anonymously write down (1) one question about the class material that they found unclear, and (2) to define one important term. I explained that it could be any question, ranging from a definition to how concepts relate to one another. I told them to fold their piece of paper in half, and pass their paper to someone in their vicinity without viewing the question they had received. I then asked them to pass the sheet of paper two additional times. Once the students had exchanged questions enough to remain anonymous, I asked them to look at the question. I then gave them approximately fifteen minutes at the end of class to discuss the question with their peers. Following class, their homework assignment was to access a discussion board I had opened on Canvas and post the question and term definition they had received (Figure 1, Supporting File S1. Peer Produced Study Guides – Sample Discussion Posts and Replies). I then had them answer their assigned question. Finally, I instructed students to add a minimum of two *meaningful* responses to other students' posts to get full credit. I explicitly explained to students that only posts that expanded content knowledge would receive full credit. Because the class material is cumulative over the semester, I left the discussion thread open for continued contribution through questions, responses, and review for the remainder of the semester. It acted as a live document for exam preparation. Example discussion posts highlighting the type of questions and answers that were provided by students are included (Supporting File S1. Peer Produced Study Guides – Sample Discussion Posts and Replies). Additional examples spotlight uses of the guide by students that were not predicted by instructors, but were likely beneficial for student preparation.

One important note is to make it clear to students that there will be repeat questions posted to the board, and that is okay. One of the benefits of this design is that students can be exposed to the same information explained by different people in alternative ways.

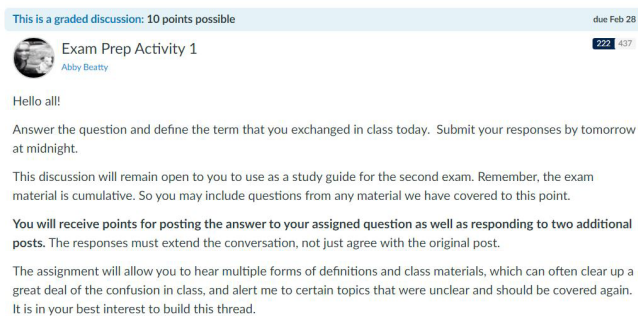


Figure 1. Image of Discussion Board prompt provided to students displaying the number of student contributions (N = 437). A grading rubric and more detailed prompt are also available as supplemental information (Supporting File S2. Peer Produced Study Guides – Student Assignment Prompt and Rubric).

### How to Use the Guide

I found many benefits of this peer produced study guide. First was the apparent use to the students as review material for the exam. Second, I found that students had varying ways of explaining the material to one another, and student comments indicated that these new explanations made the information 'click' when it had not previously. Third, I found that the interaction of students in class and online led to a deeper understanding of how class materials related to one another, which goes beyond the memorization of facts that can result from reviewing pre-made study guides.

The final use of the guide was specific to me as the instructor. Typically, I rely on "reading the room" to get a sense of confusion from the students. However, in a room with a capacity for almost 280 students, this can be difficult. Often, misconceptions of class materials are only clear following examinations. As students build new knowledge off of their pre-existing knowledge base (10,11), it is important to address any misconceptions as early as possible. When I read through the responses to the discussion post, I was able to identify clear patterns of misunderstanding, and address them prior to examination.

### Student Utilization

While participating in the exercise is a learning experience in itself, continued learning is completely reliant on students' drive to use the material after completing the assignment. To further build my confidence in the assignments use, I downloaded the Canvas access statistics for the subset of students (N=396) who completed the assignment. On average, each student accessed the guide 13.63 times over a period of seven weeks, indicating continued use of the study guide following the required portion of the class assignment.

### Heightened Importance

The proportion of courses offered in an online format has increased over time. We continue to search for ways to maintain active learning teaching models in an electronic format. Integrating active learning through web-based instruction can be particularly difficult. Like many other instructors in the Spring of 2020, my co-instructor and I were forced to seamlessly transition to online instruction due to the outbreak of COVID-19. While many other active learning and peer collaborative learning activities would have been difficult to maintain, the canvas-based peer produced study guide provided a platform for continued student interaction. This type of method is perfect for distance learning, whether by design or implementation in times of emergency.

## SCIENTIFIC TEACHING THEMES

### Active Learning

As outlined in the activity's description, students had the opportunity for peer collaborative learning both in the classroom and on the discussion forum while completing this assignment. Additionally, the students are actively engaged in the preparation, refinement, and implementation of the guide rather than passively participating in the review process.

### Assessment

Students received credit for contributing an original post to the discussion thread as well as their responses to other students' posts. The course design included 200 participation points that

made up 20% of their grades. However, students were offered the opportunity for ~300 points over the course of the semester, and to get full credit students needed to accumulate 200 of the available points. Participation was low stake for their course grades even though it was required. The assignment was worth a total of 10 points. Students earned 5 points for submitting and answering their assigned question, 2.5 points for including their important term, and 2.5 points for contributing to two additional posts. Full credit was given for thorough responses that extended the conversation. Assessment was completed one week after being assigned, but the discussion board remained open for student review for the remainder of the semester. The grading rubric used for assessment is also provided as a supplemental file (Supporting File S2. Peer Produced Study Guides – Student Assignment Prompt and Rubric).

Because all exams in the course were cumulative, and the information students contributed to the study guide was relevant to multiple exams, it is not possible to correlate participation in the study guide to exam grades. However, Canvas access statistics did show that students access the study guide continuously, indicating sustained use of the resource over the course of the semester.

### *Inclusive Teaching*

In my model, the study guide was used as a supplemental resource to textbooks and lecture. Textbooks are the most commonly used resources for learning in classrooms but are often divisive for students who are not strong readers (1). The same can be said for review guides that are produced by instructors to be read and reviewed by students independently. Previous studies have shown that supplementation of text with study guides provides benefits both for students with learning disabilities and reading and language deficits, equalizing student achievement in the classroom (12). Additionally, I have anecdotally found that while minoritized students, introverted students, and students with accommodations are less likely to speak up in class, those groups participated well in the discussion-based study guide. This type of assignment gives the opportunities to ask anonymous questions without the influences of social stigmas or fear of public speaking, and allows students to perform at their own pace. This may create the opportunity for equal participation from all students in a low-pressure environment.

### **SUPPORTING MATERIALS**

- S1. Peer Produced Study Guides – Sample Discussion Posts and Replies
- S2. Peer Produced Study Guides – Student Assignment Prompt and Rubric

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