

Active Learning in the Undergraduate Classroom: A Journal-Club Experience Designed to Accentuate Course Content

• KELSI L. ANDERSON

ABSTRACT

Students in the natural sciences should be prepared as undergraduates to read and apply concepts from the scientific literature. I describe a strategy that enforced the necessity to deliver high volumes of content while incorporating an active-learning technique. Students were assigned to read and discuss articles from the scientific literature that complemented content being delivered via traditional lecture. Students were encouraged to participate by coming to class prepared with written questions, and discussion was directed by instructor-prepared prompts. Students were assessed via low-stakes assignments based primarily on participation. This teaching method has proved effective, as verbally reported by past students who are currently enrolled in graduate programs. These students report feeling more prepared than their peers to discuss and learn from the scientific literature.

Key Words: Active learning; journal club; discussion-based teaching.

○ Introduction

Undergraduate education is moving away from the “sage on the stage”

experience to classrooms engaged in active learning. The high volume of content that must be covered in the natural sciences, however, often presents a roadblock for instructors who want to implement active-learning strategies but feel that these techniques distract from content delivery. Here, I describe an active-learning technique that maintains a focus on content. In my undergraduate biology classes, I incorporated a journal club that included a discussion of scientific, peer-reviewed studies that reinforced and applied the content delivered via traditional lectures. Journal clubs are discussion forums that allow students to practice their ability to effectively read, retain, and apply information from the peer-reviewed scientific literature. This is

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an expertise that will help students understand the way in which science is communicated while developing their critical-thinking and analytical skills (Kozeracki et al., 2006). The idea of an undergraduate journal club is not new, but incorporating it into a lecture-based classroom may be (or this technique may simply be unreported in the literature); previously published studies primarily describe journal clubs that exist as stand-alone classes (Roberts, 2009; Senkevitch et al., 2011; Clark et al., 2014; Goldina & Weeks, 2014).

I attempted various strategies over the past several semesters in an effort to develop an effective journal-club experience. One example of a past attempt had individual students or pairs prepare a formal presentation on an article of their choosing that supported the course content. Although the presenters were well prepared and had a critical understanding of the article, this method failed to generate critical thinking and discussion by their peers (see below). The current model was developed in a sophomore-level microbiology course, and is the method that has been the most successful and engaging. This method included engagement of all members of the class via low-stakes assignments designed to generate critical thinking and evaluation of the article through individual assignments, small-group discussion, and whole-class discussion.

○ Procedure

The class in which this study took place was a sophomore-level microbiology course at Concordia University consisting of 24 students meeting three times a week at 8:30 to 9:20 a.m. (50 minutes) for the lecture and two times a week at 11:05 a.m. to 12:55 p.m. for the laboratory (110 minutes). Seven lecture periods during the 15-week undergraduate semester were dedicated to the journal club (Table 1).

All seven lecture periods were conducted on the third day of a 3-day sequence of content delivery; the first 2 days were taught via

Table 1. Journal-club content.

Content Area	Article	Exit Ticket Prompts
Microbial Growth	Chen, C.Y. & Chung, Y.C. (2012). Antibacterial effect of water-soluble chitosan on representative dental pathogens <i>Streptococcus mutans</i> and <i>Lactobacilli brevis</i> . <i>Journal of Applied Oral Science</i> , 20, 620–627.	What experiments should the authors perform next to expand their data?
Bacterial Genetics	Huddleston, J.R. (2014). Horizontal gene transfer in the human gastrointestinal tract: potential spread of antibiotic resistance genes. <i>Infection and Drug Resistance</i> , 7, 167–176.	How does this article demonstrate what we discussed in lecture for the last 2 days?
Immune Response	Taylor, K. et al. (2014). Toll mediated infection response is altered by gravity and spaceflight in <i>Drosophila</i> . <i>PLoS ONE</i> , 9, e86485.	Is this study relevant to the human immune system?
Host–Microbe Interaction	Hampton, T.H. et al. (2014). The microbiome in pediatric cystic fibrosis patients: the role of shared environment suggests a window of intervention. <i>Microbiome</i> , 2, 14	Should cystic fibrosis patients be prescribed routine treatments to diversify their microbiome?
Epidemiology	Luth, W. et al. (2013). When pictures waste a thousand words: analysis of the 2009 H1N1 pandemic on television news. <i>PLoS ONE</i> , 8, e64070.	What responsibility do scientists have in helping others to understand the difference between truth and exaggeration in media coverage?
Vaccines & Antibiotics	Chang, S. et al. (2003). Infection with vancomycin-resistant <i>Staphylococcus aureus</i> containing the <i>vanA</i> resistance gene. <i>New England Journal of Medicine</i> , 348, 1342–1347.	Is the occurrence of <i>vanA</i> gene a product of horizontal gene transfer or naturally occurring? How do you know?
Viruses	Hütter, G. et al. (2009). Long-term control of HIV by CCR5 Delta32/Delta32 stem-cell transplantation. <i>New England Journal of Medicine</i> , 360, 692–698.	Does the article suggest a cure for HIV? Why or why not?

traditional lecture with material presented from the course textbook. Prior to the first journal club, students were given instruction on the most effective means by which to approach the scientific literature. Many students become overwhelmed and frustrated with the technical details of an article; I encouraged them to focus on the main points and significance of the study by first reading the abstract, then the introduction and results, without reading the Methods section at all. For each journal club, students were assigned to come to class prepared by having read the selected article and written three discussion questions. At the beginning of each journal-club class period, I gave a brief introduction to the paper, specifically focusing on the results, to ensure that all students had a working knowledge of the main points of the article (10 minutes). Students then broke into small groups (no more than four students per group) for discussion (25 minutes). To help facilitate their discussion, students were given a simple worksheet that asked them to identify the hypothesis, rationale, data, conclusions, and significance of the study (Table 2).

To facilitate discussion-based critical thinking, students were told to also answer their three previously prepared questions and choose one question that they wanted to examine further; this question was written on the white board to be discussed as a whole class (10 minutes). Following previous attempts to generate whole-class discussions, I found that prompting the students to write their questions on the white board led to more fruitful participation than simply giving students an open-ended opportunity to ask questions. Following the large-group discussion, students turned in

Table 2. Journal-club discussion worksheet.

Questions	Answers
Why was this study done?	
What were the preliminary data?	
What was the hypothesis?	
How was the study done?	
What were the results?	
What was the significance of the results?	

their discussion worksheet, three questions with answers, and an exit ticket (5 minutes). Exit-ticket questions were designed to assess higher-order thinking by challenging the students to apply the content from the scientific article to the concepts they had learned from the textbook (see Table 1). Quantitatively, the journal club was worth 10% of the overall class grade and was assessed via participation rather than by correct answers. Participation was assessed on a partial-credit basis. Students received full credit by meeting four elements: attendance, turning in the three required discussion questions, answering the exit-ticket question, and turning in the group-discussion worksheet. Partial credit was awarded if any of the previously stated elements were omitted.

○ Conclusion

The teaching technique described here aimed to incorporate active learning into the undergraduate biology classroom by emphasizing the importance of discussion-based learning and understanding of the scientific literature. While journal clubs typically exist outside of the traditional classroom, the experience described here incorporated a journal club into the classroom by selecting articles that reinforced the delivery of the required content and allowed students to engage in experiential learning by reading and discussing how the concepts they learned in the lecture were applied in the scientific literature. The challenges with this study were twofold. The first challenge was the ability to facilitate student-engaged discussion. Teaching students how to write discussion-generating questions, choosing a paper that students could connect with, and choosing a paper that was not overly technical all aided in overcoming this challenge. The second challenge was in developing a quantitative method of assessment. In attempts to evaluate the journal-club experience, I found that lowering the stakes of the assignment led to more thoughtful participation by the students (currently worth 10% of the overall class grade and based on participation, as described above). In past semesters, when stakes were higher (25–30% of overall class grade), students were more hesitant to admit a lack of understanding because they assumed that this would reflect poorly on their grade. With a high-stakes assignment, students often aimed to impress rather than to learn. On the other hand, when less emphasis was placed on the grade, students were more likely to genuinely engage in discussion and admit to their confusion or discontent with aspects of the paper. Despite these challenges, simple exposure

to the journal-club experience has proved effective for the students. Previous students who participated in the journal club and are currently enrolled in graduate programs have verbally reported feeling more advanced than their classmates, in terms of familiarity with the scientific literature and their ability to critically evaluate it and in being more at ease when presented with literature-based assignments.

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