



Facilitating Engaging Journal Clubs in Online Upper-Level Undergraduate Courses[†]

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STEM curricula often prepare students with fundamental knowledge, allowing students to have strong backgrounds in technical concepts. However, upper-level students may lack the ability to critically analyze primary research articles, which is important for understanding the current state of the field. Journal clubs can be used within the classroom to facilitate discussion of recent work and teach students to critically analyze research and data. Traditional journal clubs (JCs) are conducted in face-to-face classrooms and consist of presentations and discussions. It is possible to adapt these techniques to form virtual Journal Clubs (vJCs) when courses are taught fully online; however, student engagement is often lacking and can lead to less knowledge gained in vJCs. In this article, we summarize several key teaching tips and best practices which we used to increase student engagement in vJCs. We found that vJCs, compared to JCs, equally increased student perceptions of their skills in reading, analyzing, and critiquing scientific literature and decreased their perceived levels of stress and frustration.

INTRODUCTION

STEM curricula often focus on strengthening the understanding of field-specific fundamental knowledge, allowing students to have a strong background in technical concepts. However, upper-level students may lack the ability to critically analyze primary research articles important for understanding the current state of the field. Students are often intimidated and confused by the complexity of the writing and figures that form the basis of these articles (1). Journal clubs (JCs) have been shown to be effective in a variety of learning outcomes including improving knowledge and critical appraisal skills (2–4), perceived reading habits (5, 6), and reading behavior (7), and they have also proven useful in undergraduate education (8, 9). While there is no JC standard (2), different strategies for implementing JCs have been reported (10, 11). JCs for undergraduate students are typically conducted in face-to-face classrooms. However, it can be challenging to facilitate a remote, virtual Journal Club (vJC) that engages students to lead robust and stimulating discussions and increases their self-perception of paper reading skills.

At UMass Lowell, JCs are typically included in two

upper-level Biomedical Engineering (BME) courses and are conducted face-to-face within the classroom. The courses were switched to a virtual model and vJC was adopted, presenting several challenges. Undergraduates lack confidence when reading articles and need support from instructors and peers who can guide them through the process (12). However, within a remote environment, students may feel isolated, adding more stress to an already frustrating experience. Student engagement may suffer as students are shy or unsure of how to participate in discussion. Students also must learn how to use new technologies along with preparing their discussion points. Here we summarize key strategies to help increase student engagement in vJCs.

PROCEDURE

Two upper-level BME courses at UMass Lowell conducted vJCs (Course 1: 7 to 10 students; Course 2: two sections of 15 to 21 students). vJC included a presentation (Course 1: individual; Course 2: teams of 3 or 4) and discussion of the article.

vJC preparation

Before vJC started, paper and team selection were facilitated on an editable Google sheet which listed all vJC dates where students provided a link to their selected article (5 to 12 articles per semester). Students selected papers of interest (specific topics may be provided.) Instructors checked these articles to ensure that they (i) had data to

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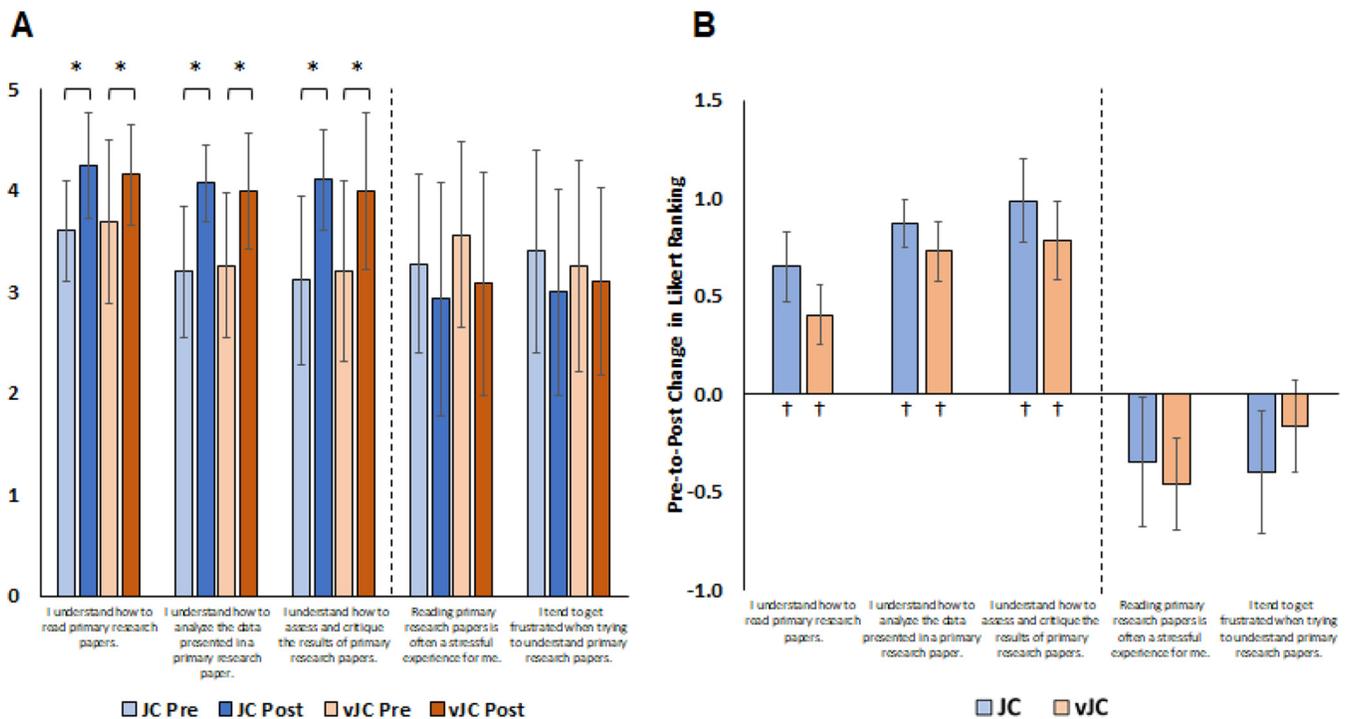


FIG 1. Students reported an increase in literature reading skills after participating in journal clubs. (A) Student responses to pre- and post-journal club in a traditional face-to-face environment (blue, $N = 25$ pre, 28 post) and in a virtual remote learning environment (orange, $N = 39$ pre, 38 post). Questions were on a Likert scale from 1 = Strongly Disagree to 5 = Strongly Agree. (B) Changes in student ratings after participating in journal club. All skill-based questions show an increase, while stress-related questions show a decrease. The dashed line separates questions related to skill and students' stress. Error bars indicate standard deviations. For comparison of pre/post surveys, * indicates a statistically significant difference ($P < 0.05$ with Bonferroni correction). For change in Likert ranking analysis, † indicates a statistically significant difference from zero ($P < 0.05$ with Bonferroni correction).

analyze (i.e., not a review paper), (ii) were on appropriate topics, (iii) had at least three to four figures, and (iv) were from a credible source. The vJC started with a discussion of how to create a professional, safe environment for debate, and leading a paper discussion was modeled by the instructor. For subsequent vJCs, students' pre-work assignment (small course) was to read the article and fill out a Figure Facts template (11) or read the article (large course).

vJC facilitation

vJCs were conducted synchronously on Zoom and consisted of students presenting for 15 min and leading 30 to 45 min of discussion. The presentation and discussion may occur simultaneously depending on presenter style and level of student engagement. Those presenting were made co-hosts and shared screens with slides containing paper materials (e.g., figures, background, methods) and prepared discussion questions. In the small class discussion, students could freely unmute themselves. In larger classes, students pressed the "raise hand" icon, unmuting themselves when called on by the presenter. In both cases, students could also discuss in the chat. The presenters read these aloud before responding to help those without good access to the chat or watching post-class videos. The discussion was designed to engage students through peer facilitation;

instructors refrained from speaking as much as possible, only prompting when there was a lull in the conversation. Discussion focused on credibility of data presented, future directions, and figure design. The presenters and their classmates turned on their videos to support each other. The chat feature was extremely popular, allowing shy students to participate. Presentations were recorded and made available.

vJC evaluation and assessment

Assessment of vJC included grades for both presentation and discussion. Grading was done using a holistic rubric (13) (Appendix 2). Students completed a reflection assignment at the end of vJC to help them create transferable links between knowledge and practice (Appendix 3). The final exam also included an exercise where students read and critically analyzed a new paper (Appendix 4).

CONCLUSION

Instructors found high student engagement in vJC in both the small and the large course. Each discussion was meaningful and had strong participation with all students participating. Several factors seemed to contribute to this

Student Remarks

"I think the journal club presentations were good online because it made discussion a little bit easier. We could all type in the chat versus having to wait and ask our questions at the end of the presentation (what would happen in person) or try and compete for talking time with other classmates."

"The emphasis of participation in journal club was the most effective part of the online learning for me. I feel like if you incorporated 'journal club'-like activities in other online lectures it would be more effective."

"Yes, I think learning the material translated well to online. The only difficulties were ensuring I did not get distracted during lectures. Having journal club online I think was just as effective as it would've been in person."

"I think that this experience was really great. Even translating to online learning the format for journal club worked so well. It probably helped that we had such a small class size, so everyone got a chance to speak and it might not work well in larger classes. To make it adjustable there would have to be break out groups and then maybe one final discussion at the end with everyone but this would be more time consuming and I think the amount of time dedicated to journal club vs. lecture content was perfect."

FIG 2. Student reflections on the virtual journal club experience. Student quotes were taken from the end-of-semester reflection assignment and course evaluation. The students volunteered these comments about the virtual/online methodology without prompting.

high level of engagement. First, having the instructor model a presentation set the tone for the class and gave students an exemplar of expectations. Second, allowing students access to articles at least 2 weeks in advance and including participation grades gave adequate time and incentive for students to prepare. Third, the chat feature was extremely beneficial, though it can lead to simultaneous conversations. Lastly, the instructors created a safe environment for students to voice opinions freely. When adapting this technique for other courses, modifications such as using breakout rooms in larger classes or instructor-directed topic selection may be needed.

Students in both courses filled out pre- and post-surveys to assess students' experience during the course, approved as exempt by the UMass Lowell Institutional Review Board (20-050-LI-EXM). Surveys contained 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) questions (Appendix 1). Two-tailed Student's *t* tests with Bonferroni correction were used and significance was

determined ($P < 0.05$.) Our results indicate that the move to a remotely facilitated vJC was positively rated by students. Survey results indicate that student perceptions of their skills in reading, analyzing, and critiquing scientific literature significantly increased by between 0.41 and 0.78 Likert points (Fig. 1). The data also suggest that perceived levels of stress and frustration while reading scientific literature were lessened through this experience by 0.16 to 0.46 Likert point, though this finding was not statistically significant. Importantly, these results show similar, non-significant changes to students' rankings after participating in a traditional JC in a prior semester (Fig. 1) (Appendix 1), suggesting that vJCs may be similarly effective as JCs. Qualitatively, students and instructors both found vJC effective. Student comments were generally positive and suggest effectiveness (Fig. 2).

In summary, we have found that remote incorporation of primary literature in upper-level courses is viable through the design of engaging vJCs. These discussions

can significantly impact students' self-reported ability to understand and critique novel concepts within the field. Furthermore, vJCs seem promising as an alternative option that can increase participation of shy students and benefit those who are absent. However, direct measurements of skill development and student participation are still needed. Inclusion of virtual journal clubs into the traditional classroom may also be a promising pedagogical option.

SUPPLEMENTAL MATERIALS

- Appendix 1: Survey questions and data table
- Appendix 2: Grading rubric for journal club
- Appendix 3: Journal article reflection assignment
- Appendix 4: Journal article analysis, final exam question

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