

## **2006-2663: JOURNAL CLUB: A FORUM TO ENCOURAGE GRADUATE AND UNDERGRADUATE RESEARCH STUDENTS TO CRITICALLY REVIEW THE LITERATURE**

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# **Journal Club: A Forum to Encourage Graduate and Undergraduate Research Students to Critically Review the Literature**

## **Abstract**

This contribution outlines a strategy that the author has used to counteract literature lethargy and train beginning researchers how to efficiently learn from and critique articles. Journal Club is a weekly meeting with all members of the research group where a research article related to each student's project is discussed by the entire research group. Due to multiple projects in the lab, each researcher contributes to discussions of articles tangentially related to their own research; this is a long-term benefit because it increases the breadth of each individual's knowledge. The discussion questions strive to increase the depth of knowledge in each topic. Lastly, the student involvement in discussions teaches critical thinking and aids in developing foresight to more effectively plan experiments. Outcomes of the Journal Club activity have been increased student knowledge of the literature, decreased apprehension in younger students toward understanding technical publications, and a slight increase in productivity towards publication goals within the group. Including this weekly meeting as an independent study course for credit also encourages all students to read the articles prior to the meeting and enhances participation in group discussions.

## **Introduction**

New faculty encounter many challenges as they strive to set up their research lab and get a research group started. Keeping abreast of the literature sometimes falls by the wayside in-between preparing for classes, ordering equipment, teaching laboratory procedures to students, grading, scholarly writing, writing proposals, etc. As many of us know, familiarity with current literature is crucial to conducting sound research. While the new faculty member may have periodic cramming sessions with the literature prior to submitting a proposal or other scholarly writing, their researchers in the lab can overlook this important component of conducting sound research.

Regular, organized meetings focused only on reading and discussing articles in the literature can help overcome this literature lethargy, strengthen the education of students, and bolster the quality of research conducted in the lab group. Involving undergraduate students in literature critiques is not a new concept and has been found to be beneficial [1]. The involvement of undergraduates in a literature review seminar has the added benefit of encouraging these students to pursue graduate studies in engineering [2]. Advice on conducting graduate seminars is available in "The New Professor's Handbook" where the authors assert that, "a seminar program can go a long way in helping graduate students acquire the knowledge and skills to become independent researchers" [3]. More specifically, research skills that can be obtained via a seminar program include:

- "identify important research questions and specific hypotheses to be tested."
- "identify the experimental and theoretical research methods used to test the hypotheses."
- "apply the methods and interpret the results."
- "communicate the results orally and in writing" [3]

Journal Club utilized a discussion format, which is particularly beneficial for young researchers because it also demonstrates and promotes practice of logic skills, critical thinking, and verbalization of ideas. Wilbert McKeachie lists a number of attributes of discussions in his book, "Teaching Tips: A Guidebook for the Beginning College Teacher" including that discussions [4]:

- "Help students become aware of and formulate problems using information gained from readings or lectures."
- "Help students learn to think in terms of the subject matter by giving them practice in thinking."
- "Help students learn to evaluate the logic of, and evidence for" a research technique, results, and conclusions.
- "Give students opportunities to formulate applications of principles."
- "Develop motivation for further learning."
- "Use the resources of members of the group." [4]

This last point is also extremely beneficial to the progression of research within the group. Very frequently, when a student encounters a tough problem, the group can brainstorm ideas to solve the problem or provide a new perspective to the challenge.

In this article, the author builds from existing knowledge and offers practical advice on implementing this technique in a new faculty member's research group comprised of young graduate students and undergraduate students. This literature seminar provides a forum within which to mentor students and discuss attributes of academia related to scholarly writing and publications. Journal Club also provides a construct within which students can learn to read, discuss, and understand papers in their research field. This structured approach decreases student's apprehensions and intimidation of technical literature and improves their ability to write technical papers for publication. This paper concludes with a brief discussion of the technical merits of developing a literature review forum.

### **Starting up the Weekly Literature Review Meetings**

The author has had two years of experience as a faculty member and during that time has started three graduate students and five undergraduate students within her research group. The suggestions included herein are a culmination of strategies that have been most successful in mentoring neophyte researchers to obtain a satisfactory familiarity with the literature and in maintaining knowledge of more senior group members on the current literature.

When starting a formalized literature review session, the author has found that it is important to clearly convey the purpose and importance of the activity. The following is an excerpt from a document the author provides her students on their first day, "The purpose of Journal Club is to encourage everyone in the group to remain abreast of the literature. The discussion of articles tangentially related to your research will benefit you by increasing the breadth of your knowledge. Your depth of understanding and retention of articles in your own research area will increase as you practice and prepare for leading discussions within the forum. The discussion questions will increase the depth of your knowledge in electrokinetics. In addition, your involvement in discussions will teach you to think critically and will aid in developing your own experiments and skills."

Secondly, it is important to remain organized and to communicate well in advance the student's assigned article and presentation date. The author develops a syllabus for each semester outlining objectives of the Journal Club, the schedule, and expected performance. The schedule is published on the lab's website and updated to reflect any changes made throughout the semester [5]. More recently, this has been organized into a 1-credit hour directed individual study course with a full 5 point (A through F) grading scale. The students write a short 3-page report on their research, including a literature review as a final project in the course. An excerpt from the syllabus on course objectives and grading is included below.

“Objectives:

After completion of the course, you will be able to:

- Critically read current literature in electrokinetics and microdevices.
- Lead a discussion on a research article.
- Demonstrate the ability to adapt techniques from articles into your own lab work.
- Critique techniques and conclusions asserted in the literature.
- Independently conduct a literature search and obtain articles via on-campus and off-campus resources.
- Analyze data to determine trends.
- Begin practicing writing a research article using your own research project and data.

Daily Grades

- The main activity in this course is the critical reading of assigned articles and integral involvement in discussions of them.
- This requires reading the article in advance of the meeting, prompt attendance at all meetings, and active participation in discussions.
- You will be receive a daily grade at each meeting that will be computed as follows:
  - o (30%) Prompt attendance
  - o (30%) Demonstrate prior knowledge of article (having read it prior to the meeting)
  - o (40%) Discussion of topics including asking questions, assessment of content, interpretations, etc.

Presenter's Grade

- On the days you lead discussions, you will need to prepare an article summary (2 to 3 paragraphs) and an outline of discussion items.
- You will be graded on the following rubric:
  - o (30%) Preparation and demonstration of familiarity with the article
  - o (30%) Article summary
  - o (40%) Outline and discussion of topics including answering and asking questions, assessment of content, interpretations, etc.”

The first semester the author conducted Journal Club, she handed out a stack of articles, assigned a literature search, and allowed the students to choose their own articles to present. A number of problems arose with this approach. The foremost was that students who were preparing last minute did not share their chosen article with the other participants in a timely fashion. The other members of the discussion group were relegated to the role of observers and the quality of discussions lacked as a result. This reduced the educational merit of the activity for everyone involved including the presenter. The following semester, the author required that the article be approved two weeks in advance with photocopies of the article distributed to other participants one week in advance. For unknown reasons, the students were not reliable about having their

article approved two weeks in advance and the advisor expended a great deal of effort “nagging” the students to get this information in. In subsequent semesters, the advisor has chosen articles for the students and communicated that they are free to choose another article that they feel is more beneficial to their research project provided it is approved two weeks in advance with copies of the newest article being distributed to all participants at the prior meeting. This has worked well. However, one pervasive problem has been that participation and preparation dwindles as the semester progressed. Interestingly, students experience the same time crunch that faculty members do and the important activity of reading literature falls by the wayside.

It is hoped that the structure and construct of the 1-credit hour directed individual study course would help keep literature reviews as an important component of student’s activities. One advantage of including Journal Club as a directed individual study course is that students can enroll in the class semester after semester and earn credit each semester. While institutional rules relating to use of directed individual study credit vary, the author has found that graduate students are able to use up to 6 hours towards their required coursework, while undergraduate students may utilize up to 3 hours towards their technical elective requirements in the curriculum. Therefore, it is expected that the students will take the 1 credit hour directed individual study course every semester that they are actively involved in research.

### **Guiding the Quality of Presentations and Discussions**

Students do not possess an innate ability to glean information from dense technical articles. It is necessary to demonstrate and teach how to read an article and lead a discussion on the topic. The entire course is a learning experience for the students. However, they need a solid foundation from which to build. The first meeting involves a discussion of logistics (discussed below) and the presentation and discussion of an example article by the author and advisor of the research group.

The author advises her students to begin by reading the abstract, introduction and conclusions on the first read through. Next, it can be beneficial to read the figure captions, study the figures and any tables. The students are then advised to start back at the beginning and read through the article, taking notes or underlining as is comfortable. Reread paragraphs or sections as necessary, then leave the article overnight and read it again the following day to prepare discussion notes for Journal Club. The students are advised to proof read their notes and to practice their summary and discussion questions. After the meeting, the article summary and discussion notes are posted on the research group’s website and in the group’s EndNote and Dossier databases for easy reference at a later date [5,6].

Journal Club starts out with the student providing a brief overview and discussion of the introduction / purpose of the article and its applicability to his / her research project. Discussions cover five main areas including novel or adaptable research methods, fundamental equations and assumptions in any theory sections, trends and comparisons between experimental / theoretical results, and a critique of conclusions based on the data. These are further enumerated below:

1. The research methods
  - a. What was novel about the techniques?
  - b. Was there anything that could have been done better?
  - c. Were all variables properly controlled for?

- d. Can we adapt anything in our own lab?
2. Theory (if included in the article)
  - a. What fundamental equations did the authors start with?
  - b. Did the assumptions they made make physical sense within their system?
  - c. What are the limitations of the final equations?
3. Experimental / theoretical results provided in the paper
  - a. What trends are shown by the figures?
  - b. What questions are left unanswered?
  - c. Were the author's conclusions consistent with the data?
4. Conclusions
  - a. What is the next logical step for this research to take?
  - b. How would you go about conducting research to answer any unanswered questions?
  - c. How will it benefit the research conducted in our lab?
5. Overall
  - a. What was well written, well explained, well communicated in the paper?
  - b. What was poorly written / explained / etc in the paper?

Developing the technical vocabulary and confidence to discuss dense technical articles is a skill that develops with practice. Leading a discussion is a skill that is developed via practice and perceptive efforts, but doesn't necessarily develop on its own. Due to the nature of Journal Club, students actively participating will simultaneously be developing their technical vocabulary and their confidence. However, the art of leading a discussion sometimes requires direct attention. As a supplement, students are provided with two websites, "Tips for Leading Discussions" and "Giving Presentations and Leading Discussions" [7,8] followed by Chapter 3: Conducting Discussions from The New Professor's Handbook [3] or Chapter 4: Organizing Effective Discussions [4].

These sources all agree, the foremost goal is to establish a non-threatening climate that is inviting to open discussion. Very frequently, the students are concerned that they will appear "dumb" and so they rush through their prepared notes so quickly that other students do not have the time to comprehend the information and are relegated to observers of a monologue. As a secondary facilitator, it is necessary for the advisor / instructor to slow or stop the presenter and ask questions for understanding. The discussion resources suggest that a facilitator can de-emphasize their role in the discussion by asking open-ended questions [7]. This invites involvement by the group and enriches the depth of discussion of the article.

Journal Club usually ends with a discussion on how to apply the findings or directions for future research. It is beneficial to conduct Journal Clubs in a room with a round table for discussions and a whiteboard where brainstorming can be graphically demonstrated. The author has found that discussions sometimes migrate to topics that more trained individuals take for granted, such as order of authorship, or that the research appears perfectly planned out in a preplanned linear fashion. When writing an article, the author's have the advantage of hindsight; they were able to describe what worked and progress logically from start to finish. As students are challenged with writing their own first drafts of articles, they find that chronology is not always a logical progression of the research story. These discussions add another dimension of unplanned mentoring that occurs within a successful research group.

## **The Merits of this Strategy**

As a portion of the course grade, students are asked to write a three-page final report on their research for the semester. The report is to include a motivation, background and literature review, premise of the research project, experimental description, results including plots of data, and interpretations / conclusions. Non-research students in the course are asked to conduct a literature search and write a three-page review article. For both of these cases, documentation of the articles discussed in Journal Club is important. As the new student's research project progresses, they can develop their final report into formal papers for submission to journals. The fruition of these efforts is currently in progress in the author's lab.

In addition to the merits of an organized and sustained discussion of current literature, a Journal Club activity can also add dimension to any new faculty member's growing credentials. The author advises developing this activity into a course not only because it will help sustain motivation on the part of all participants, but it can also be included as a new course developed. This activity is particularly important when putting together your tenure and promotion packet. A Journal Club course can also be included in your student contact hours calculation on annual review forms. Additionally, if the class is opened to all interested undergraduate and graduate students, it can lead to increased enthusiasm for your research area within the student population and possibly encourage an undergraduate student to pursue an advanced degree in your area.

When considering adopting a new activity, new faculty should critically assess whether the activity supports their efforts for tenure and if it adds to their existing workload. While it is difficult to quantify time spent mentoring graduate students to read the literature via traditional mentoring techniques, the author has felt that Journal Club streamlined these efforts considerably. The formal, structured forum allowed the author to efficiently disseminate strategies to read and critique the literature to multiple students at one time while simultaneously following up on their progress. The administrative details relating to grading added a small amount of time, but this was offset by improved attitudes and efficiency of gleaning important information from the articles. In addition, the structured forum promoted documenting the important concepts (via Dossier and EndNote) and stimulated creative ideas.

## **Conclusions**

Within this contribution to the New Engineering Educators Division of ASEE, the author outlines a strategy to keep all members of a research group abreast of the technical literature in their field. The goal of such a Journal Club is to counteract literature lethargy and to train beginning researchers how to effectively learn from and critique articles. A number of additional benefits arise from this activity and are discussed. Quantitative student feedback on their learning experience will be sought for the Spring 2006 semester and will be included in the conference presentation.

The purpose and importance of the literature reviews were described; the author suggested that this be clearly communicated to all participants. Portions of an example syllabus for a literature review class were provided and resources on leading discussions were given. Learning objectives were enumerated and included such skills as learning to critically review the literature and to write a preliminary technical report. Rubrics were described that could be used for

grading purposes or as guidelines from which to provide feedback to the student after facilitating a discussion. An overview of pitfalls from prior semesters were briefly discussed along with the solutions implemented. Finally, the author briefly reviewed the technical and credential-building merits of developing a literature review course for a new faculty member.

In conclusion, student involvement in literature discussions teaches critical thinking, increases technical vocabulary, bolsters confidence, and aids in development of experiments. Outcomes of the Journal Club activity have also included increased student knowledge of the literature, decreased apprehension in younger students toward understanding technical publications, and a slight increase in productivity towards publication goals within the group. Including this weekly meeting as an independent study course for credit also encourages all students to read the articles prior to the meeting and enhances group discussions.

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