Using Technical Articles to Teach Entering Graduate Students the Role of Journal Articles in Research

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Abstract

Many entering graduate students are unaware of the role of journal articles in research and are not informed about the article submission process. Although this knowledge is important to their careers, it is rarely included in formal training. While technical articles are often used in graduate classes, they are most often used to convey technical information. In addition to discussing the technical points of a paper, the objective of this work is to incorporate training on the role of technical articles in research and the article submission process.

To implement this, students are assigned technical articles to read and are required to discuss them in class. Since studies have shown that students retain more information through active learning than through passive learning, class discussion is used to encourage reading and active participation. To aid students in understanding the role of technical papers, there are many concepts that are discussed including why researchers read articles, why the articles exist, the different types of articles and journals, and the criteria for publication.

This in-class discussion of technical articles has been implemented in a graduate level thermodynamics course in chemical engineering. Since thermodynamics is one of the required core courses for the first-year graduate students, it provides an opportunity to prepare entering graduate students for research. This approach was assessed using an initial survey at the beginning of the semester and a final survey at the end of the semester. Results of the assessment are presented.

Introduction

Traditionally, technical articles are assigned in courses in order to convey technical information. While this is often the main reason to have students study journal articles, educators have used articles to meet other teaching objectives as well. These include: 1) improving critical thinking by having the students review a journal article and summarize the main points as well as evaluating the value of the research [1, 2]; 2) using journal articles to improve technical writing skills [3]; 3) using articles for improving both critical thinking and writing skills [4]. To develop critical thinking, students were asked to evaluate the paper to determine the main results and whether the assumptions were realistic. Other educators emphasize that it is necessary to teach students how to do research. One research skill that needs to be taught is to learn how to locate previously done work on a topic and then critically evaluate the previous work [5]. One approach to this was to ask students to write summaries of selected journal articles and comment on any flaws in the reasoning. A similar approach was used in a graduate level chemical engineering kinetics class [6].

To be successful at the graduate level, students need to become familiar with the current technical literature to keep up to date [5]. The primary goal of this effort is to prepare students for research by expanding their information sources to technical journals and by helping them understand the role of technical articles in research. Since studies have shown that students retain more information through active learning than through passive learning [7, 8], class discussion is used to encourage reading and active participation.

Implementation

At the beginning of the semester, the class is told that technical articles will be assigned for reading and that they should come to class prepared to discuss each paper. The active learning is included by having a 15 minute class discussion on each paper during class. The instructor facilitates participation by giving the students guidelines as to what types of information they should look for in the articles, by asking questions during the discussion, by moderating the discussion to encourage all of the students to express their ideas, and by commenting on any major points that did not get mentioned during the discussion. Although all of the papers relate to the course being taught, they are also chosen to provide students with a sample of various types of papers. They range from classic papers on fundamental concepts to papers on recent developments [9-14] published between 1914 and 2004.

Since many students aren't experienced at reading technical articles, it is helpful to provide guidelines to facilitate discussion. Students are instructed to concentrate on:

- fundamental issue addressed (What concerns are the authors addressing?)
- motivation, perspective (Why are the authors writing this paper? How does this paper fit into other work done in the area?)
- main ideas (What are the key points? e.g. assumptions, methods used, limitations, and applications)
- relation to course (How does this paper fit into the course?)

For these articles, students do not need to read the paper for every detail unless instructed to do so for a particular paper. The main idea is to give students practice in reading the technical articles.

This approach was implemented in a graduate level thermodynamics course in chemical engineering. During the fall semesters of 2003 and 2004, there were 10 and 12 students, respectively. Generally, the graduate student class is small enough to allow all of the students to participate in the discussion.

Instructional Objectives

There are several primary objectives to be met in reading journal articles. These include:

- Help students realize that papers are an important source of current information
- Give students a better understanding of the role of technical articles in research
- Aid students in developing the ability to understand main points in technical articles outside their research area
- Introduce students to the paper submission and review process.

These objectives contribute to the overall goals of preparing students for research and encouraging life-long learning.

Class Discussions

At the beginning of the semester, the instructor explains that graduate students should become more familiar with journal articles. Students usually agree that during their undergraduate work they relied heavily on textbooks and handbooks and rarely searched journal articles for information. The purpose of the explanation is to help students understand the reason for the reading assignments.

The discussion is conducted so that volunteer responses are elicited. Since part of the grade depends on the discussion, a record is kept of who participated in the discussion. If some students are more reticent, the instructor can requests responses from someone who hasn't spoken yet or can call on a specific person. The discussion is largely guided by the questions given in the implementation section.

To aid students in understanding the role of technical papers, there are many concepts that can be discussed. A selected list of topics may include why researchers read articles, why the articles exist, the different types of articles and journals, and the criteria for publications.

Assessment and Discussion

Assessment was performed by using an initial survey the first day of class and a final survey at the end of the semester. The purpose of the first survey was to determine the students' level of knowledge entering the class, while the second survey determined how much the students learned from the class discussions. Both surveys were designed to assess the students' knowledge. The final survey had additional questions to determine the students' perception of what they had learned from the reading assignment discussions. In both surveys the responses were anonymous. In addition, both surveys were designed to be brief.

The goal of the initial survey at the beginning of the semester was to determine the background knowledge and any preconceptions or misconceptions that the students may have about technical articles. This included the purpose of technical articles as well as the procedure for publication. The general form followed the suggestions of Angelo and Cross [19] for a background knowledge probe and for a misconception/preconception check. Some of the survey questions were drawn from misconceptions that were expressed the first time this was taught in 2003. This survey provided a baseline for comparison with the second survey.

As shown in Table 1, the first set of questions addressed the importance of reading technical articles. The students were instructed to answer the questions using a rating of 1 to 5 as defined in the table. The initial and final survey results are the average ratings on each question. A comparison of the final survey results with the initial survey results shows that the students became more convinced that technical articles are important for conducting research and that they are the main source for current information.

Other questions that were asked required short answers. The purpose of using the short answer format was to avoid leading the students to any particular response. One question was "What are the criteria for getting a technical article accepted?"

The response for the work being novel or creative increased from 17 to 50 percent during the semester. Also, while several students answered “don’t know” on the initial survey, only one student answered “don’t know” on the final survey.

Table 1. Importance of Reading Technical Articles

Question	1	2	3	4	5	Initial Survey	Final Survey
1. What sources do you use for technical information?	books only	mainly books	books and articles	mainly articles	articles only	2.92	3.20
2. What sources do you use for current technical information?	books only	mainly books	books and articles	mainly articles	articles only	3.83	4.3
3. Rank the importance of reading technical articles for conducting research.	not necessary	slightly useful	useful	very useful	crucial	4.75	4.8

The purpose of the literature review in an article was addressed. Most students already realized that the literature review is used to provide background. In the initial survey 40% of the students stated that the purpose of the review was to give credit to previous researchers, while this response dropped to 10% in the final survey. In the final survey, there was one respondent who wrote that the literature review could show why a technical improvement was needed.

Another question addressed the length of time it takes for an article to be reviewed. During the class discussion the instructor mentioned that many papers give the submission dates and accepted dates. The initial survey showed that 42% of the students wrote ”don’t know” for this question, but none of the students used this response on the final survey. In general, on the initial survey most of the students thought the reviews would be received in less than 6 months, while the times became longer on the second survey. Discussion in class included the fact that this varies with the journal

Student perception of the technical article reading assignment was assessed in the final survey using the questions shown in Table 2. For these questions, the students were asked how much they agreed with the statements by rating their agreement on a scale from 1 to 5 (1 – strongly disagree, 2 – disagree, 3 – neither agree or disagree, 4 – agree, 5 – strongly agree). In general, the students thought that the technical reading assignments and class discussions helped their understanding of how to read technical articles and how to get a journal article published. Furthermore, most of the students recommended that this exercise be repeated the next time the class is taught.

Table 2. Student's perception of the technical reading assignments.

Statement	Average Rating
1. During this course, my ability to read technical articles improved.	4.22
2. I have a better understanding of the role of technical articles in research.	3.89
3. As a result of the discussions, I have a better understanding of the types of journal and articles.	4.11
4. I have a better understanding of the acceptance criteria and procedure for getting a journal article published.	3.67
5. I would recommend that the professor repeat the technical article reading assignments and discussions the next time the course is taught.	4.39

Concluding Remarks

Class discussion of journal articles required very little additional time to implement. Faculty members commonly use technical papers to provide more information on technical concepts. Although discussing the role of technical papers in research required some time, it provided graduate students with a better understanding of why they should read the recent literature. Having the reading assignments and class discussions account for 10 percent of the course grade motivated the students to read the assignments. In addition, class participation seemed to encourage the students to be prepared.

The survey assessment was supplemented by faculty observation during class discussion. It was clear from the students' observations and questions that they had read the papers and they were able to comprehend the main points. They commented on some of the differences in the types of articles. However, some of the concepts were new to them. For example, many of the students had not submitted a paper to a journal at this time, so they were not aware of the review and publication timeline. Most students didn't know that papers frequently list the date the manuscript was received and the date it was accepted.

Since this has only been implemented once, it is difficult to make generalized statements. The response from the students was that they liked reading the papers and discussing them in class. Many of the students regularly contributed to the discussions. Since this assessment has only been performed once with a class of 12 students, it has not been well tested. Future work will include repeating this technique and its assessment.

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