

A Novel Course Sequence on Critical Thinking for the Professional Development of Graduate Students

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Introduction

Faculty who direct graduate students share an interest in teaching them to disseminate the products of their research. Graduate students typically produce several products from among journal papers, conference proceedings, sponsor reports, or oral presentations, culminating with defense of a written thesis or dissertation. Faculty and students frequently struggle producing these products, and the struggle can be lumped under the broad heading of "learning to write."

This paper describes work in progress at the University of South Carolina (UofSC) wherein coursework offered in the College of Engineering and Computing (CEC) helps graduate students learn to publish their research. The coursework is not intended to replace subject matter courses in technical writing. Instead, the goal is to enable experienced faculty to effectively and efficiently support the learning of writing skills for the graduate students in their programs. This paper presents the pedagogical framework for this "writing" coursework, along with description of key teaching resources and representative assignments.

We approach the writing struggle with the view that other common faculty concerns (e.g. inability to comprehend and act on research literature, inability to develop independence) are fundamentally related to lack of critical thinking (CT) skills and their application in the field of graduate-level engineering research [1, 2]. The overall hypothesis of this effort is that the two-course sequence we will describe, which utilizes the Richard Paul/Linda Elder framework of CT [3], will effectively and consistently facilitate students' acquisition of information literacy and writing skills, and speed the development of intellectual independence.

The two courses are designed for just-in-time intervention to graduate students at key junctures in their programs of study. The first course is for new graduate students who have selected a research project and who are expected to begin developing breadth and depth of understanding thereof. Course 1 focuses on information literacy: finding, assessing, and critically reading the research literature relevant to their new project. Course 1 culminates in a written literature review. The second course, taken in year 2 of graduate study, is for students who have generated some findings and are preparing to disseminate their work in a professional venue. Course 2 focuses on writing in the standards of the discipline, using CT to guide the writing process. It culminates in a major but flexible writing assignment proposed by the student and advisor.

Course development began in 2010 after UofSC established a graduate program in Biomedical Engineering. The graduate curriculum specified coursework under the general heading of professional development and ethics, from which the subject courses evolved. While the courses are required for graduate students in Biomedical Engineering, students from other programs (chemical, mechanical, electrical, and computer engineering; computer science, and chemistry) have also enrolled. The subject matter, critical thinking as applied to the challenge of reading and writing technical literature, is universal and applies to any STEM area.

Critical Thinking Framework

It is commonly believed that American baccalaureate education instills CT abilities that could be brought to a graduate program [4]. Furthermore, it is generally expected that graduate students will further develop their reading, writing, and CT skills implicitly, either through coursework or as a natural outcome of the student/advisor apprentice relationship. Experience at both the undergraduate [5] and graduate [1, 6-10] levels cast doubt on these expectations. We have adopted an explicit approach [1] to the teaching and practice of CT in the context of the students' need to both read and comprehend literature of their field, and then to contribute to the literature through writing.

Three major approaches to understanding and teaching CT have been recently reviewed [11]. The psychological/behaviorist approach investigates how skilled thinkers behave and what actions and habits they adopt. CT is then taught as a list of behaviors to emulate [12]. An example of the behaviorist approach is the graduate course described by Hirschberg [13], where CT is promoted by requiring students to read the works of Nobel prize winners and to elucidate the thinking that led to their ground-breaking discoveries. The second approach to CT, from the field of education, focuses on identifying and assessing higher-order competencies. A Bloom's taxonomy framework is an example of this approach [14] that has been used for assessing CT in an undergraduate science course [15]. The Paul and Elder approach to CT [3, 16] is an example of the third or philosophical approach, which "emphasizes the qualities and characteristics of the person rather than the behaviors or actions that the CT can perform" [11]. Critical thinking is presented as a process that employs defined structures inherent in CT and applies universal intellectual <u>standards</u> to assess the quality and results produced by the process. Students improve the quality of thinking by systematic metacognitive reflection on their thinking.

Paul and Elder make CT operational by practice in three dimensions of critical thinking [3]. These are a set of <u>elements of thought</u> (purpose, questions, data and information, etc.), a set of <u>intellectual standards</u> (clarity, accuracy, precision, relevance, depth, etc.), and a set of <u>intellectual virtues</u> of a good critical thinker (intellectual humility, courage, honesty, empathy, etc.) We posit that the elements of thought map onto the intellectual content of a typical refereed journal article (and to other forms of research communications as well). Furthermore, we maintain that the intellectual standards map onto review standards used for refereed journals (and other writing, including research proposals). Finally, the intellectual virtues of a skilled critical thinker support

professional and ethical standards of the research and publishing enterprise (for example, acknowledging the work of others, restraint from data falsification or fabrication, and proper authorship [17]). Explicit instruction and use of the Paul/Elder framework helps students *first as readers* to understand and assimilate the content of research literature (Course 1), *then as writers* to present their work for publication (Course 2).

The three dimensions of CT are listed in Table 1 [3, 16]: the Elements of Thought, the Intellectual Standards by which the Elements are evaluated, and the Intellectual Virtues that characterize the skilled thinker (for us, graduate students). Table 1 also illustrates succinctly the explicit linkage between the Paul/Elder philosophical model and either critically reading or writing a refereed journal paper. The elements of thought comprise the content of a typical primary journal paper. Likewise, the intellectual standards correspond to the core review standards of journals and proposals. Finally, intellectual virtues include traits desired by employers (e.g. autonomy, perseverance, integrity) as well as traits essential to responsible conduct of research (e.g., integrity, fairmindedness). The virtue of intellectual empathy is particularly key to successful publishing, for cognitive empathy in particular is the ability to put oneself in the place of another, i.e. reviewers, journal editors, dissertation committees, and others who comprise the audience for research products. The text by Schimel [18], used for Course 2, is particularly helpful for students for developing empathy with their audiences.

Table 1. Summary of the Paul/Elder Model of Critical Thinking				
Elements of Thought	Intellectual Standards	Intellectual Virtues		
Purpose; Questions; Assumptions; Point of View; Data/Information; Key Concepts; Conclusions; Implications	Clarity; Precision; Accuracy; Relevance; Significance; Breadth; Depth; Logic; Fairness	Intellectual Humility; Empathy; Perseverance; Autonomy; Integrity; Courage; Fairmindedness; Confidence in Reason.		
Linkage with refereed writing and authorship				
Introduction (purpose, hypothesis or specific questions); Background (previous data and information, theories, concepts, prior knowledge base); Theory (concepts and assumptions); Results and Discussion (new data/information; answers to questions); Conclusions	Standards that experienced researchers expect when reviewing a journal article; standards that journal editors promote to their authorship and reviewers.	Responsible conduct of research and authorship; Fair, complete, and proper acknowledgment of prior work; Proper assignment of authorship; Prohibition of data falsification, fabrication, or plagiarism; Understanding review criteria and standards		

Course Descriptions and Representative Assignments

Course 1 is for first-year graduate students to develop their information literacy skills, here defined as the ability to find and critically evaluate relevant research literature, and to synthesize from this the knowledge structure upon which their individual projects build. Course 2, for second-year students, develops the students' critical writing skills, that is, their ability to transmit effectively their research findings to a variety of audiences while meeting the high standards required for publishing. Both courses are 1-credit (1 contact hour/week) so as to be minimally intrusive schedule-wise with other duties of the student. Both courses are offered as Pass/Fail.

Course 1 is for new graduate students who typically enter in the fall term, take three core disciplinary courses, and match with a faculty research advisor and thesis or dissertation project. In the spring of the student's first year, he or she takes additional courses but is also expected to become research-active. These aspiring researchers invariably have a (literal or virtual) stack of papers, books, reports, and other background to read and understand, so the spring term is "just in time" for both students and advisors. First-year students typically lack the skills and experience to read literature and develop the knowledge base on which their research projects build. Course 1, taken in the spring, provides the skills and students apply these skills in a final term project. The final term project is a critical review and assessment of between 15 and 20 journal papers relevant to a particular aspect their project. For example, a PhD dissertation may require mathematical modeling and simulation, development of a new experimental apparatus or protocol, acquisition and analysis of data, theoretical development, or design, construction, and demonstration of an apparatus. Students in Course 1 must identify some focused aspect for the term project; for example, an evaluation of different theoretical models and modeling results, or a review of experimental approaches. or a comparison of available data and interpretation. The idea is that if a student can learn to perform critical analysis of a narrow scope of literature, the same skills will be employed as the scope of information expands.

Desired outcomes from a recent syllabus for Course 1 include: 1. Finding, evaluating, and summarizing current literature in a sub-field related to the thesis or dissertation project; 2. Understanding and stating the meaning and significance of the research project for a variety of audiences; 3. Preparing a critical review of a small (15 to 20) but representative set of papers in the specific field; 4. Becoming more productive more quickly; 5. Becoming independent more quickly.

The role of the instructor as mentor/coach is crucial in Course 1. There are a certain number of lectures (live or as short video tutorials) on the Paul/Elder critical thinking model and its application in the critical reading and synthesis of literature. Additional lectures address professional norms such as proper methods of literature citation, plagiarism [19] and other unacceptable writing practices, using the guide by Roig [17]. Students are required to use citation management software (such as EndNote), and a librarian typically provides this training. There is no textbook for Course 1; instead, we provide instruction and handouts on the Paul/Elder CT model and assign supplemental reading.

Students are guided toward the final term project by completing several intermediate writing and discussion assignments. Intermediate writing assignments are brief, typically requiring fewer than three pages. The goal is to encourage direct, specific responses to the assignment, making the student's thinking as clear as possible. Development of more expansive text in the style of a journal article comes later (primarily in Course 2). Typical assignments include the following: 1. Develop a list of preliminary readings and keywords; 2. Write and present a 1-page description of the specific topic of the planned literature review; 3. Post, for class discussion, a recent research paper, and analyze it using the critical thinking framework; 4. Prepare and present critical summary and comparison of two key papers in the field. All student work is submitted electronically in the UofSC learning system (BlackBoard) and are in a shared folder so that all students can read submissions and participate in class discussions

The Paul and Elder framework lends itself well to the development of several templates that are provided to the student to direct their reading and writing. Table 2 illustrates how the first few elements of thought in the generic CT framework are used in preparing assignments; the assignments in the table are built around prompts such as those shown in the table. Several short writing assignments may be constructed by working down the "Prompts for Student" column, which help the student to think critically and specifically about their (still new) research projects. It typically takes two or three iterations to achieve the desired level of comprehension. After students demonstrate a good grasp of their project, the third column gives some prompts that guided students in critical reading. The last column suggests how the intellectual standards are used as students evaluate a given paper.

None of this is to suggest that CT is a linear process, or that the process is rigid. Quite the opposite is true; students must learn to re-evaluate their thinking and reading constantly and improve as they proceed in the course and in their research.

The most challenging task for the faculty instructor is to provide substantive, actionable feedback on student writing and critical thinking. Most faculty view this task as daunting and unappealing, particularly if they misapprehend their role in this as detailed proofreading and rewriting [8]. There are works that address the task of providing meaningful feedback on writing in an effective manner [8, 20]. Among the tactics we have adopted are the use of group reading and discussions of writing assignments (facilitated by BlackBoard postings), so that all students can learn from others. Rather than writing corrections on a paper or merely returning comments and corrections electronically, the instructor can provide audio-recorded feedback [21, 22]. The instructor reads and, in near real-time, records comments on assignments using an audio recorder (on a smart phone for instance). Typically 10 minutes per writing assignment is very adequate. Audio comments are uploaded into BlackBoard, along with any comments the instructor may insert into the original student document. This gives both instructor and student a good deal of time flexibility in giving and receiving feedback. The audio method is also more personal; students hear the tone and inflection of the instructor's comments. Based on informal feedback, recorded comments are more useful and much preferable to red-lining a paper.

Table 2. Prompts for Critical Reading and Thinking				
CT Elements	Prompts for Student	Prompts for Reading a	Intellectual	
of Thought		Paper	standards to	
			consider	
Purpose	Describe the field of vour research. What is	What is the field being addressed in this paper?	Is the general purpose and field of the paper	
	the broad purpose of	What are the overall goals	relevant to your	
	your research? What are	of the author's research	project?	
	opportunities and	group?	1 5	
	challenges in the field?			
Questions	List the specific	Identify the specific	Are the specific	
	objectives of your	questions, aims, goals, or	questions, aims,	
	project. What questions	hypotheses being	hypotheses of the	
	are you attempting to	addressed in the paper.	paper relevant to	
	answer? What is the		yours? Are the	
	hypothesis behind your		questions precisely	
	research?		stated?	
Key Concepts	What are the key	What are the key concepts	Are the concepts	
	concepts, theories,	used, or revealed, in this	stated clearly?	
	definitions underlying	paper? Does the paper	Sufficient breadth	
	your project?	clarify your	and depth?	
		understanding?		
Information	What kind of	What information is	Is the information in	
	information is needed to	contained in this paper?	the paper relevant to	
	initiate your research?		your research? Is it	
	what kind of data do		clear, accurate,	
	you intend to collect in		precise,	
	the process of your			
	research?			

Course 2 addresses the writing of the students' own research results. It is offered in the spring semester of their second year of graduate study, at which time they should have sufficient research results of their own for a significant writing goal. A Master of Science student might be engaged in writing their thesis or contributing to refereed publication, while a PhD student may be writing a refereed paper, a major research report, or a proposal. Some students may have already contributed to a major writing project, but generally the second year/second semester timing finds students ready for instruction in writing for refereed outlets. Students in Course 2 are already acquainted with the Paul/Elder approach and have applied it in the critical analysis of literature in Course 1. The strategy in Course 2 is to put the students in the role of author instead of reader; they must now write so as to meet the standards of the discipline and of the reviewers who will be adjudicating their work. In Course 2 the final project is a significant written product (e.g. thesis chapter, journal or proceedings draft) based on the student's research.

Desired outcomes of Course 2 from the most recent offering are as follows. 1. Learn and apply professional norms, procedures, and ethical rules in writing; 2. Demonstrate ability in

disciplinary and critical writing skills; and 3. Produce a high quality draft manuscript or other major writing product. Typical intermediate assignments for Course 2 include: 1. Identify and analyze the different audiences with which a student may communicate; 2. Identify target journals and summarize the criteria by which submissions are reviewed; 3. Deliver a presentation summarizing selected research results. The final project is a substantive draft of a manuscript submission or other major writing product. Students typically begin submitting drafts of their final project by mid-term.

As with Course 1, assignments are submitted via BlackBoard so that the class can view, comment, and discuss the work of their peers. Drafts are generated with critical thinking prompts (analogous to those illustrated in Table 2 for Course 1). A given assignment is intended to result in only a very few pages of writing; assignments are designed to accumulate, leading ultimately to the final term project. The textbook currently used for Course 2 is "Writing Science: How to Write Papers that Get Cited and Proposals that Get Funded" [18]. We have found that this text addresses the review process and clearly presents the viewpoint of various audiences; that is, how reviewers employ intellectual standards as well as journalistic protocols.

The instructor in Course 2 is ideally experienced in both publishing and reviewing scholarly work, as well as trained in the CT framework. There are lectures on the CT model as applied to writing and the review process. Students analyze the typical structure of papers in their target journals, and they relate these to the universal Elements of Thought in the Paul/Elder model (Table 1). There is also an explicit emphasis on understanding journal and proposal review criteria and how these relate to the universal Paul/Elder Intellectual Standards. Additional lectures address professional norms and the mechanics of paper submission, review, revision and publication. There are also discussions and readings on research ethics (falsification or fabrication of data), and on the ethics of authorship [17], matters that are related to the Paul/Elder Intellectual Virtues (Table 1).

Discussion and Reflection

These two courses have evolved over several years. The current state comprises the course syllabus, selected and required readings, lecture materials, a textbook, several templates or guides for students based on the Paul/Elder CT framework, a collection of typical assignments, and recommendations for discussing, assessing, and providing substantive feedback to students. The number of students so far has been relatively small, typically 10 to a maximum of 20 per semester of offering. While this accommodates the requirements of the biomedical engineering program, it is desired to reach more students in the future. We now reflect briefly on considerations that will affect future course development and possible expansion to more students.

A major consideration is the cost of the program in terms of both faculty effort and time required of the students. The typical state of affairs is that faculty work one-on-one with their graduate students in reading and revising written work. Several iterations may be necessary. Students and advisors often find this one-student-at-a time approach laborious, as strengths and weaknesses vary from student to student. But this is the approach that faculty advisors know, and the

coursework approach described in this paper may be perceived as too costly in terms of faculty and student time. Over the years, a major goal has been to keep time requirements to a minimum while still affective positive changes in the students' critical reading and writing skills. The onecredit, Pass/Fail format seems to minimally intrusive, and allows for flexible scheduling. Engineering faculty are not generally familiar with the details of any systematic critical thinking approach to writing, and some education and professional development will be required, along with independent assessment of the effectiveness of the approach. The availability of syllabuses, representative assignments, CT templates, and other course materials suggest that additional engineering faculty could adopt the approach with no more effort than normally required for a new course. The thought of reading the work of graduate students from other labs and other fields seems daunting, but experienced faculty writers and reviewers already have some of the skills necessary for this task. The CT model itself is field-independent; the elements of thought and standards are universal. As referenced in the course descriptions above, there are proven techniques for evaluating students work that do not require detailed editing and proofreading of each paper; indeed, to do so might actually be counterproductive.

In terms of time requirements on the students, it is important to note that the courses and assignments are based on the students' own research projects. The skills and assignments required are ones that they must ultimately perform anyway: reading and gaining insight from literature, writing up research results, and getting published. Thus the coursework described herein is not "extra" work; it should be considered an integral part of the overall graduate student educational experience.

There has been no formal educational research directed to determine the effectiveness of our approach. The driving forces for improvement have been needs as expressed by both students and faculty, standard course evaluation, and the instructor's own reading and reflection. The most recent UofSC standard course evaluations for BMEN 795 are given below and indicate generally favorable response to the course and agreement that skills have been advanced as a result of the course. On a 5-point Likert scale (5 being the most favorable) key results were as follows:

- The stated course objectives reflect what was actually taught: 4.67
- The assignments were meaningful and contribute to my understanding of the subject: 4.56
- The tests, projects, reports, and/or presentations were related to course objectives: 5.00
- Overall, how would you rate this course: 4.75
- As a result of this course, I am better able to identify, manage, and cite the research literature relevant to my field: 4.63
- As a result of this course, I am better able to read literature critically, and to construct a critical literature review: 4.25
- This course has helped me to be a more productive and independent researcher than I would have been otherwise: 4.63

While these courses have been offered in a 1-credit Pass/Fail format, variations in offering seem possible. Programs that have for-credit existing professional development or research skills courses could certainly utilize the approach. The ideas could also be incorporated into the format of research group meetings, with the model and templates providing a common framework for group feedback and discussion.

The overall belief behind these efforts is that using the CT approach encourages both faculty and student to focus first on the quality of the student's thinking, rather than matters of spelling and grammar. The latter are certainly important to meeting professional publication standards and must be addressed, but premature focus on spelling and grammar may cause both student and faculty to become bogged down in multiple cycles of proofreading and wordsmithing. Holistic consideration of the elements of thinking in research, and an explicit focus on intellectual standards rather than formatting standards should lead to improvement in the attainment of high-level skills in a graduate program.

References

- [1] R. Parker, "Skill development in graduate education," *Mol Cell*, vol. 46, no. 4, pp. 377-81, May 25 2012.
- [2] B. Goodwin, "Research says / Teach critical thinking to teach writing," *Educational Leadership*, vol. 71, no. 7, pp. 78-80, 2014.
- [3] R. Paul and L. Elder, *Critical thinking : Tools for taking charge of your learning and your life*, 3rd ed. Boston: Pearson, 2012, p. 493.
- [4] A. Lee, "How are doctoral students supervised? Concepts of doctoral research supervision," (in English), *Studies in Higher Education*, vol. 33, no. 3, pp. 267-281, 2008.
- [5] R. Arum and J. Roksa, *Academically adrift : Limited learning on college campuses*. Chicago: University of Chicago Press, 2011, pp. xi, 259 p.
- [6] G. E. Walker and Carnegie Foundation for the Advancement of Teaching., *The formation of scholars: Rethinking doctoral education for the twenty-first century*, 1st ed. San Francisco, CA: Jossey-Bass, 2008, pp. xxi, 232 p.
- [7] S. L. Gassman, M. A. Maher, B. Timmerman, and C. E. Pierce, "Pedagogical Techniques to Promote Development of Graduate Engineering Students as Disciplinary Writers," (in English), *2013 ASEE Annual Conference*, 2013.
- [8] A. Lee and R. Murray, "Supervising writing: Helping postgraduate students develop as researchers," (in English), *Innovations in Education and Teaching International*, vol. 52, no. 5, pp. 558-570, Sep 3 2015.
- [9] S. L. Gassman, M. A. Maher, and B. E. Timmerman, "Supporting Students' Disciplinary Writing in Engineering Education," (in English), *International Journal of Engineering Education*, vol. 29, no. 5, pp. 1270-1280, 2013.
- [10] M. A. Maher, D. F. Feldon, B. E. Timmerman, and J. Chao, "Faculty perceptions of common challenges encountered by novice doctoral writers," (in English), *Higher Education Research & Development*, vol. 33, no. 4, pp. 699-711, 2014.
- [11] E. R. Lai, Critical thinking: A literature review. Pearson, 2011, p. 49.
- [12] B. K. Beyer, "Critical thinking: What is it?," *Social Education*, pp. 270-277, April 1985.

- [13] C. B. Hirschberg, "A course in critical thinking for PhD students in Biomolecular Sciences and Biotechnology: Classical Experiments in Biochemistry," *High. Learn. Res. Commun*, vol. 6, no. 1, pp. 4-9, 2016.
- [14] D. R. Krathwohl, "A revision of Bloom's taxonomy: An overview," (in English), *Theory into Practice*, vol. 41, no. 4, pp. 212-+, Fal 2002.
- [15] A. N. Bissell and P. P. Lemons, "A new method for assessing critical thinking in the classroom," (in English), *Bioscience*, vol. 56, no. 1, pp. 66-72, Jan 2006.
- [16] R. J. Niewoehner, *Engineering Our Thinking. Critical Thinking for Technical Professionals*. Austin TX: Sentia Publishing, 2017, p. 203.
- [17] M. Roig, "Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing," Available: <u>https://ori.hhs.gov/avoiding-plagiarism-self-plagiarism-and-other-questionable-writing-practices-guide-ethical-writing</u>
- [18] J. Schimel, *Writing science : How to write papers that get cited and proposals that get funded*. Oxford ; New York: Oxford University Press, 2012, p. 221.
- [19] J. Gilmore, D. Strickland, B. Timmerman, M. Maher, and D. Feldon, "Weeds in the flower garden: An exploration of plagiarism in graduate students' research proposals and its connection to enculturation, ESL, and contextual factors," *International Journal for Educational Integrity*, vol. 6, no. 1, pp. 13-28, 2010.
- [20] J. C. Bean, *Engaging ideas : The professor's guide to integrating writing, critical thinking, and active learning in the classroom,* 2nd ed. (The Jossey-Bass higher and adult education series). San Francisco: Jossey-Bass, 2011, p. 360.
- [21] C. M. Anson, "In your own voice: Using recorded commentary to respond to writing.," in Writing to learn: Strategies for assigning and responding to writing across the disciplines., M. D. Sorcinelly and P. Elbow, Eds. San Francisco: Jossey-Bass., 1997, pp. 105-113.
- [22] C. M. Anson, D. P. Dannels, J. I. Laboy, and L. Carneiro, "Students' perceptions of oral screencast responses to their writings.," *J. Technical Bus. Comm.*, vol. 30, no. 3, pp. 378-411, 2016.