

Creating Innovative Writing Instruction for Computer Science Graduate Students

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Abstract - This paper describes the Academic Writing Course offered in the Computer Science Department at the University of California, Santa Barbara. We conceived the course to go farther than a generic writing course, and developed an innovative curriculum that specifically addresses the rigorous demands on Computer Science graduate students to produce research papers for acceptance at the best conferences. We focus on how the course design and execution address the challenges we observe in student writing, including the selection of content for a text, the organization of the content, the use of appropriate details and transitions, the discussion of data, rhetorical positioning, and readability, as well as the daunting process of drafting, redrafting, and editing. We also provide a qualitative assessment of the course's impact based on feedback from student and faculty evaluations that suggests that students who attend the course are not only better writers but more effective collaborators with faculty advisors, and thus experience a smoother overall composing, editing, and submission process.

Index Terms – collaborative writing, computer science writing, course planning, writing pedagogy.

INTRODUCTION

The persuasive and compelling communication of information is a fundamental requirement in the fast moving world of Computer Science. Hundreds of CS researchers vie each year for the limited number of opportunities to present their work at professional conferences. The golden ticket for one of these coveted spots on the conference agenda is the well-written paper. The stakes are high, as the papers selected can propel both the ideas and the authors to the visibility and standing required to be successful in this highly competitive field.

Excellent writing ability is also highly valued in the private sector. In its evaluation of the qualities that employers value in college graduates, the National Association of Colleges and Employers (NACE) reports that in addition to a strong educational preparation and good work ethic, “communication skills—both written and verbal—top the list of skills and qualities that employers look for in job candidates. In fact, year after year, the number one skill employers say they want to see in job candidates is good communication skills: the ability to write

and speak clearly.” [5] It is not clear, however, that our students are graduating with these essential skills, as the NACE report concludes: “Unfortunately—and ironically—the very qualities employers look for are the qualities they find lacking in many new graduates.” [5]

The faculty and students in the Computer Science Department at the University of California, Santa Barbara, understand the vital importance of excellent writing. The complexity and rigor of a CS graduate curriculum, however, leave little time for consistent attention to the polishing of writing skills. As most interaction between CS faculty advisors and students is focused on research objectives, the development of writing competence is addressed in an informal manner. Some professors, for example, offer assistance to their students by recommending writing reference texts and by developing helpful websites with hints about structure, organization, and grammar. (For example, Ben Zhao at UCSB provides writing references for students on his website¹; Henning Schulzrinne at Columbia University discusses writing style and grammar on his web pages².) The number one way that faculty advisors coach their students to become better writers is by reading and reworking multiple drafts of their students' texts. This labor-intensive editing process takes place one student at a time, one professor at a time.

A more formal approach to the teaching of writing was considered as a way to address UCSB's departmental goal of helping graduate students improve the quality of writing they produce in their courses and in their research work. The initial idea was to offer a writing course developed and taught by a CS faculty member, but faculty commitments to courses, research, and student advising made this plan difficult to carry out. A subsequent proposal was made to invite a linguist to develop and teach a course within the CS Department, with the hope that the CS faculty and students would support the venture.

To that end, the Computer Science Department at UCSB inaugurated a graduate level academic writing course in Fall of 2003. The guiding principle of the class was to develop a culture of excellent writing and excellent student writers within the CS Department. The course was designed to support students' technical preparation and research, and to prepare them to communicate complex ideas with the

¹ <http://www.cs.ucsb.edu/~ravenben/>

² <http://www.cs.columbia.edu/~hgs/etc/writing-style.html> and
<http://www.cs.columbia.edu/~hgs/etc/writing-bugs.html>

highest level of impact to an audience of readers in academia and industry.

We begin by describing the goals of the writing course and the course content. Next, we discuss some of the class activities that support the goals for the course. We end with a brief discussion of some of the challenges of a graduate writing course, student and faculty feedback, and concluding remarks.

COURSE GOALS AND CONTENT

We knew that our goal to create a culture of student writers entailed planting the seed that would grow into the collective conviction that excellent writing is a worthy value. We wanted to promote the idea that the acquisition of strong writing skills would produce better papers and make the writing task less frustrating and more efficient. Additionally, the course would have to benefit students who were competent writers as well as those who would need considerable work on their writing skills. Finally, as the writing course would be an additional commitment to an already heavy course and research workload for students, it would have to clearly support the department's requirements and program of studies.

One of the important objectives of the writing course was to introduce students to the core principles of academic writing, especially the ideas of rhetorical positioning and reader-oriented writing [3, 8, 9]. These principles would be roadmaps for the composing process as well as the foundations for the re-drafting and editing phases of writing. We wanted students to be able to identify excellent writing when they read it, to recognize and understand how a variety of different organizational structures could support a writer's purpose and intentions, and to master the types of texts within the discipline that graduate students are expected to produce at the highest level of competence.

A more concrete goal was to work on student writing-in-progress, and to develop in students both an ear for excellence as well as the necessary skills to make appropriate changes to their own writing as well as their classmates' writing [7, 11]. The ability to identify areas in texts that need clarification and editing, along with the acquisition of a toolkit of strategies for fixing problems in precision, logic, readability, and grammar, would be the concrete things that students could take away with them and exercise in their writing projects outside of the class. The development of a solid ear for excellent writing is a lifelong commitment for writers in all fields, and we hoped that the writing class would be the beginning of the development of this skill.

I. Organization and Content

The writing course was designed to address the challenges we have observed in student writing, including the selection of appropriate content for a text; the organization of the content so that the "story" is clear, logical, and thorough; the use of appropriate and sufficient details and transitions so that there are no holes in the logic and so that readers are

able to easily follow the discussion; clear and logical data commentary; and basic grammar. Additionally, we have observed that many student writers resist the process of drafting, redrafting, and editing a text, and have little experience analyzing their writing at the sentence level for precision in word choice and overall clarity of expression. The UCSB writing course would have to directly address these problem areas.

The writing course is a four unit course offered under the CS 594 rubric, *Seminar in Computer Science*, and meets twice a week for ten weeks for an hour and 50 minutes each meeting. The class size has a maximum of 15, includes native and nonnative speakers of English, and is attended by students from many of the research labs in the department. The ten-week class has been offered seven times over the past four and a half years, with approximately 25% of the students attending more than once.

The flexibility of the CS 594 series allowed us to experiment with large group as well as small group formats. We found that the course design that works well incorporates large group meetings along with small group sessions. In this arrangement, the entire class meets together for the first two or three weeks so that the community of writers can develop and so that we can discuss the important concepts of rhetorical positioning, audience, readability, and the basic principles of academic register. We then divide into two groups, each meeting once a week for the remainder of the term. The course has also been taught with a traditional arrangement, with all students attending all meetings each week.

An important point to mention in this discussion is that a writing class is not like other classes that CS students attend. There is not much content to master in a writing class. The learning process is not linear, and shifts in ability and confidence emerge after practice with a range of different rhetorical and language patterns. Writing students need contact with excellent writing, regular practice with composing that falls outside their comfort zone, development of habits of thinking about clarity and precision in word choice, and development of the confidence to draft, redraft, delete, throw things away and begin all over again if necessary. Because these essential skills must be repeatedly woven into class meetings, boredom casts its constant shadow in a writing course. It is important, therefore, that the course design offer variation in large group work, small group work, pair work, and one-on-one work to maintain freshness and interest, while also maintaining a clear focus on the basic ingredients that underpin the development of excellent writing.

II. Writing Course Topics

Flexibility in the content and sequencing of material and assignments has been an important part of the development of the writing course, especially as many students choose to take the course more than once and also because the students have different areas of specialization within CS. We acknowledge that different institutions will

develop their own writing standards, and will inevitably approach the design and content of an academic writing course in a variety of ways, both for undergraduate students [1, 6] and graduate students [4, 10].

The topics in the list below are covered in the writing course at UCSB:

- 1) Definitions of Important Terms and Concepts
 - Elements of a scientific paper including content, organization, and language, specifically precision, clarity, readability, and register
 - The rhetorical approach to writing and positioning [9] including audience, purpose, organization, style, flow and presentation
 - Reader-oriented writing and interest
- 2) Basic Rhetorical Patterns in Academic Writing
 - Moving from general to specific
 - Moving from problem to solution
 - Describing methods and processes
- 3) Creating a Research Space (CARS) [9]
 - Introductions
 - Data description and commentary
 - Results/discussion/conclusions sections
 - Abstracts
 - Literature reviews
- 4) Other Topics
 - Critiques
 - Bio-data statements
 - Formal letters
 - Analyses of excellent CS papers
 - Plagiarism
 - CS faculty guest speakers
- 5) Transitions; Grammar; Editing and Revising

In the next section we discuss class activities that support the course's concrete goals and address our philosophical ideals.

CLASS ACTIVITIES

We describe in detail three types of activities that, in addition to lecture and discussion, form the foundation of the classwork in the UCSB writing course. We discuss these specific activities because they address different and important features of the writing experience that we would like students to experience.

I. Journal Writing

We wanted to make a clear distinction for student writers between quickly written, unedited, and free-flowing composing versus the slower, stop-and-think, edited kind of composing. The reason for focusing on this distinction in the composing process is to introduce writers to the different outcomes derived from practicing with the two forms.

With journal writing, the free-flowing type of writing, students were given a non-technical topic at the beginning of each class session and were required to write non-stop for seven minutes without lifting the pen off the paper or

stopping to delete or correct on their laptops. Students were asked to count the number of words they had written at each sitting and to strive to write more throughout the duration of the course until they had reached their personal best text length. While some students were resistant to this exercise at the beginning of the course, for most the journal writing eventually became the favorite activity for most of them, in large part because students had tangible evidence of how much they could produce in a given amount of time and how this amount improved over time. Many students also grew to enjoy the freedom of composing text without any restrictions other than the topic and the designated time frame.

We wanted to demonstrate to students that they could apply this free-flowing type of approach to their academic writing, especially early in the composing process when they are developing an idea, and also when they need a way to work through the inevitable stopping points in their composing. It was also our intent to move students outside of their personal writing comfort zones and push them to work quickly and without any evaluation of organizational structure, word choice, or grammar. One of the lessons here is that composing and editing at the same time is not the best way to produce a polished text, and that after an initial composing process, the editing and redrafting processes can be started. This approach can be applied to the paper as a whole, or to individual sections of the paper.

II. Peer Editing

Peer editing is a collaborative writing exercise where two or sometimes three or more students review and make suggestions about each author's writing. The purpose of peer editing is not for a classmate to "correct" what another has written, or to take the place of the instructor, but rather to give clear feedback directly to an author as an authentic reader of the author's text.

Students are asked to bring two copies of their text to class – one copy for themselves to work with and one copy for their peer editor. Students are paired off and work together following a few simple guidelines: One of the authors reads her paper aloud to her partner, who can make notes if necessary on her own copy of the text. The pair then goes back over the text meticulously, guided by the reader's questions and comments. Depending on the text and the particular context, the reader may raise questions about logical ordering of the ideas; missing details and examples; confusing and awkward expressions; weak or omitted transitions; poor word choice; difficulty level of the content, and so on. The author responds and explains her writing choices and decisions, and works together with the peer editor to make any changes she feels are acceptable and that further the goal of the text. When the first text has been edited, the pair follows the same procedure for the second author's text. The instructor circulates and responds to any questions that students may have.

The peer editing process is valuable on a number of levels. A writer is able to see how another writer has

addressed a similar topic and also how the different organizational decisions made by different writers affect the readability and outcome of a text. The peer editing interaction is a way for a writer to learn how to explain and defend rhetorical decisions. If a writer does not know why she wrote something the way she did, then she can learn and practice how to explain her decisions during peer editing. Lastly, being a focused analytical reader is as important to being a good writer and editor as is the writing process itself, and peer editing is excellent practice in both of these essential skills.

III. Group Editing & One-on-One Conferencing

Both group editing and one-on-one conferencing are teacher-directed activities and focus on the analysis and editing of a student's writing-in-progress. In the group editing exercise, a student's text is projected on a screen in the classroom using a laptop/projector setup. The author reads the text aloud to the class. Instead of a single reader offering comments and feedback as with peer editing, comments are invited from any class member, with the instructor guiding the discussion. One of the students in the class works on the text at the laptop and incorporates all suggested changes. The recording of edits is projected on the screen in real time, and all students can follow the changes that are made to the original text. The author responds to questions and makes decisions about which suggested changes she will ultimately accept. The instructor serves as one of the primary readers and editors as well as the discussion moderator. When the group editing process is complete, the new draft is emailed directly to the author.

The group editing exercise is a daily activity in the writing class, and there is never a dull discussion about a student's text. While some writing will look completely different after a 20 or 30 minute group editing session, other writing samples do not endure as many changes. The comments and suggestions raise questions about ambiguity in meaning; unclear or missing transitions; or writing that is too dense or technical for the intended audience. In this last case, where the writer assumes that readers have more knowledge than they actually have, the writer usually has not provided enough context for the ideas presented, leading to problems with clarity. The group editing process is very helpful in sorting out this confusion, as the collection of reader comments can help the author to understand where the gaps are in the discourse. While group editing can become tiresome over a 10 week course, if handled well, students develop precise and proficient editing skills.

In one-on-one conferencing, students meet individually with the instructor two or three times during the course to analyze and edit their writing-in-progress. The individual meeting time is the most popular activity for students, as the discussion revolves around the text that the student herself chooses to bring to the meeting. The student's concerns about her writing process as well as her specific writing problems are discussed in the conference session. The instructor is able to point out patterns in each student's

writing style so that each individual can then broaden her range of rhetorical choices and habits. Sometimes more progress and learning can take place in a 30 or 45 minute individual conference than in several weeks of class time, as each session serves as an occasion for students to describe their personal composing process to a professional listener. And while individual conferencing is very labor intensive, the instructor comes away with a deeper insight into each student's writing style and writing challenges.

FEEDBACK

In this section, we offer comments from some of the writing course students and their faculty advisors. Due to space limitations, we have made a selection from all of the comments we received that we feel reflects the general nature of the feedback.

I. Student Comments – In Their Own Words

Students were asked to reflect on the journal writing exercise, peer and group editing, and individual conferencing.

1. Did you find the journal approach to fluency development helpful, and would you use a journal-type exercise in the future when you are preparing your writing work? Please explain your thoughts.

- “The journal approach for writing a technical text, though it sounds wrong, is a better approach than carefully choosing words and spending time to come up with a polished text the first time. When you cook a dish, you start with very simple ingredients and gradually make it richer. The same applies to the writing too. In a journal based approach, a draft can be composed fast and then multiple revisions can polish the text.”
- “I realized that I have a tendency to write and edit simultaneously. In my later texts, I have focused on writing first and editing afterwards which has led to a better flow within and between paragraphs.”
- “By being more spontaneous in journal entries I can select a suboptimal word on the spot, and leave a more accurate word choice for later reviews.”

2. What did you learn from the peer editing experiences and the group editing?

- “Peer editing has definitely been one of the most interesting aspects of the class. Stumbling upon badly constructed sentences from other peers, rather than only analyzing already perfected texts is, in my opinion, a necessary practice. Posing a challenging problem to the students rather than showing them an already crafted solution is a crucial exercise that stimulates their analytical skills and at the same time makes them feel more involved in the class dynamics.”
- “Trying to explain the content to my peer often yielded a much better way of phrasing my point. It is also a sure test of whether the big picture holds firm throughout the

passage and whether the critical points are highlighted enough.”

- “This course has helped me debunk some of the myths that had accumulated in my mind over time. In short, producing good writing can be a slow, iterative process, not to worry about that; rules may be broken, but they should be broken by choice; describing my complicated, technical thoughts the way I want them to be perceived, and with crystal clarity, in the standard structure of technical papers, is definitely possible.”
3. Were the individual conferences useful?
- “The individual conferences are one of the most helpful activities in this course. They help me identify specific weaknesses in my own writing, and when I pay attention to these weaknesses, they are not that hard to eliminate.”
 - “Conferences with the instructor have shown me that writing a technical article does not necessarily imply using complicated sentences or explanations. Hiding the basic ideas behind complicated details does not achieve the desired goal of reaching to the audience.”
 - “The most useful part of the class was the personal comments from the instructor. Meetings with the instructor highlighted very distinct issues with my writing that I could begin to address.”

II. Faculty Comments – In Their Own Words

Faculty members whose students had completed the course were surveyed to see if they had observed any changes in their students’ writing and editing abilities.

1. Are the students who complete the writing course better writers than before they took the course, in your opinion? Please feel free to provide specifics.
- “After taking the course, most of my students are much more capable of framing a problem, motivating its importance, and demonstrating how the problem can be overcome through their new techniques.”
 - “Yes. One particular example was _____, who after the course, and once he felt confident of his writing, was really on a roll, and published many impressive and significant papers, which were always well organized, at the correct level of abstraction and exposition.”
 - “In general yes. These days I find that I spend much less time correcting and rewriting sentences because of faulty grammar/awkward sentences.”
2. Are the students who complete the writing course better collaborators with you and their peers than before they took the course, in your opinion? Specifics?
- “The course is most helpful to students who are beginning their study. The writing course has laid the foundation from which I can develop and refine their writing to the desired level.”

- “Yes, but this is harder to quantify. They typically are better at expressing themselves on paper, and hence are better collaborators, but more in an indirect manner.”
- “Better collaborators? Certainly they’ve grown to be more independent and show more leadership in taking ownership of projects.”

3. Do the students who complete the writing course seem to experience a smoother overall composing, editing, and paper submission process? Specifics?

- “YES. Editing is a major overhead of the paper writing process, and the course definitely reduces this component significantly.”
- “In reality, my papers go through anywhere between 15 to 30 version updates before publication. Students that have taken the course are much more willing to let their words and thoughts flow to the page, which in turn helps engage their advisor as an editor and contributor.”
- “I find the biggest value in this course is discussing with my students some of the outcomes of the course. CS faculty themselves can also ALWAYS improve their writing. I’ve at least learned some things from my students and feel like my writing skills have improved. Part of this success is a sense among my students that writing is a topic for discussion. Raising awareness about writing is itself a success.”

CHALLENGES

We have observed that students begin the writing course with the best of intentions. They are attentive, focused, and thorough in their work. As the quarter progresses, however, and as work from CS courses accumulates, students must choose where to put their energies, and the writing class assignments and attendance generally suffer. While some of the writing course students, usually students in their first year of graduate study, keep up with the work throughout the quarter and attend classes and conferences regularly, many students have projects and paper deadlines that require their attention. We have experimented with reducing the required in-class time, as we feel that it is more important for students to have consistent writing class time throughout the quarter than it is to insist that they adhere to the 2 meetings/week structure with its accompanying attendance problems. The dropping off of attendance and the choice on the part of students to put their energies into their CS courses instead of the writing course is a reality that must be incorporated into any discussions and plans you may have to develop a graduate academic writing course for your students.

Another issue to mention is the makeup of the class. The UCSB writing class is open to both native speakers and nonnative speakers of English. It is made clear in departmental policy that the class does not take the place of required ESL courses, and that the class will not be remedial in its approach to academic writing. In our experience, there are no problems with this class makeup. In fact, the international students are often more committed to the class

and more diligent than some of the native speakers, as they understand in a direct way from their daily experiences the importance of developing excellent writing (and speaking) skills. The two groups have a lot to learn from each other about the organizational structure of professional papers, register, word choice, and readability, and they work well together in the class.

We would like to point out that the successful integration of native speakers and international students in a graduate writing class will depend to a large degree on the background and experience of the instructor. If the instructor has limited experience teaching second language students and therefore does not understand the typical language patterns, fluency challenges, and register issues that second language users present, then it is predictable that the class momentum and focus will be affected. The lack of experience of the instructor will have an impact on both the native speakers as well as the nonnative speakers.

CONCLUDING REMARKS

While the writing course at UCSB serves as a solid foundation for graduate student writers, there is a need for ongoing writing instruction and feedback. Two ideas have been proposed as a way of extending the work begun in the writing course. One idea is to have regularly scheduled sessions for students who have completed the course to work on writing-in progress, possibly with the assistance of the writing instructor in the beginning. There is some evidence that the group model is effective as an ongoing way for writers to obtain feedback and critique from an audience of helpful readers, even for experienced faculty writers [11]. The second idea for the UCSB context would be to offer a second course taught through one-on-one meetings between the students and the writing instructor, with a focus on each student's writing-in-progress. The individualized approach would be useful for students who have completed the first course, and also for students who are in the later stages of their graduate program where they are completing their theses.

The writing class at UCSB has found its place in the CS Department's schedule of yearly course offerings, a formal recognition of the important partnership between excellent technical preparation and the ability to communicate complex technical ideas in writing to a wide audience of readers. We are persuaded that formal writing instruction of the highest quality is a necessity and not a luxury for students of the sciences. We also propose that a discussion of writing – and speaking -- instruction should be a player in any dialog concerning innovation and practice in engineering education.

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