Teaching Peer Review of Writing in a Large First-Year Electrical and Computer Engineering Class: A Comparison of Two Methods

Mr. Mike Ekoniak, Virginia Tech
Molly Scanlon Scanlon, Virginia Tech

Molly J. Scanlon is an Assistant Professor at Nova Southeastern University where she teaches undergraduate and graduate writing courses. She received her PhD in Rhetoric and Writing from Virginia Tech. Her research interests include visual rhetoric, public rhetoric, and writing across the disciplines.

M. Jean Mohammadi-Aragh, Mississippi State University

Dr. Jean Mohammadi-Aragh is an assistant research professor with a joint appointment in the Bagley College of Engineering dean’s office and the Department of Electrical and Computer Engineering at Mississippi State University. Through her role in the Hearin Engineering First-year Experiences (EFX) Program, she is assessing the college’s current first-year engineering efforts, conducting rigorous engineering education research to improve first-year experiences, and promoting the adoption of evidence-based instructional practices. In addition to research in first year engineering, Dr. Mohammadi-Aragh investigates technology-supported classroom learning and using scientific visualization to improve understanding of complex phenomena. She earned her Ph.D. (2013) in Engineering Education from Virginia Tech, and both her M.S. (2004) and B.S. (2002) in Computer Engineering from Mississippi State. In 2013, Dr. Mohammadi-Aragh was honored as a promising new engineering education researcher when she was selected as an ASEE Educational Research and Methods Division Apprentice Faculty.

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Abstract
Despite recognition of the importance of communication skills in electrical and computer engineering curricula, instructors are often reluctant or unwilling to include writing assignments in their courses. Furthermore, when these assignments are included they often do not allow for formative assessment through feedback and revision, key components of contemporary writing pedagogies. Engineering instructors often feel they lack adequate expertise to provide feedback; in large classes there simply may not be enough time due to the faculty to student ratio. One way to address these constraints while providing meaningful writing assignments to students is to use peer review in place of instructor review. Still, the question of how to teach effective peer review to students remains. This study uses an experimental approach to compare use of a handout based on the assignment developed collaboratively by course instructors and an expert writing teacher with the addition of an in-class workshop conducted by the writing teacher. Both methods allow for inclusion of formative assessment in the writing process in a large class where instructor feedback would not be possible. The handout-only method benefits from less required class time and institutional support. Student peer review comments were qualitatively categorized using characteristics identified from the composition literature and the mean numbers of comments in each category were compared between groups. Drafts in the in-class instruction group averaged slightly more comments in categories identified from the literature as higher quality comments and fewer in the less important categories. However, in all but one category, the differences between groups were not statistically significant. A follow-up survey was used to gauge student perceptions on various dimensions related to the peer review process. Perceptions were generally more positive in the in-class instruction group, but again the differences were not statistically significant. These results indicate that the handout-only method may be adequate for teaching peer review to first-year electrical and computer engineering students and indicate the need for further research in this area.
1 Introduction

Effective written communication skills are essential for engineers, as is widely recognized in the field of engineering education and by US and international engineering professional and program accreditation organizations [1]–[3]. Since implementation of the EC2000 criteria, communication has been also been explicitly required by ABET accreditation criteria for engineering programs. Specifically, criterion 3g states that programs must demonstrate that their graduates develop “an ability to communicate effectively” [1].

While the ABET change in criteria push communication skills from the periphery to a central component of the engineering curriculum, the implementation of writing activities in engineering courses is often lacking. Best practices of writing pedagogy treat writing as a process rather than a product. This includes writing and revising drafts of work based on formative feedback rather than summative evaluative feedback of a final product. Incorporating revision in the writing process is recognized as an invaluable component of improving written work, but writing assignments in engineering courses neither acknowledge nor incorporate this process into the assignment. Engineering instructors may not feel qualified to effectively provide feedback or that draft feedback is unfeasible within the constraints of many engineering courses—i.e., instructor time and large student-faculty ratios.

One potential way to address these concerns is to use peer feedback. Recent work by Cho & MacArthur has shown that peer feedback can be as or more effective than instructor feedback when student writing is reviewed by multiple peers rather than a single peer. An open question, however, is how students can be trained to give effective peer feedback. Engineering instructors often partner with a writing instructor to develop assignments and/or provide this training.

The purpose of this study is to examine the results of two types of peer review instruction in a first-year electrical and computer engineering course. In two sections of the course, a writing instructor provided in-class training on peer review techniques through a short lesson, workshop, and instructional handout; in three additional sections students were provided the handout but no in-class instruction. Because not all engineering instructors who introduce writing assignments with peer review into their courses will have the time or institutional support to have a writing instructor provide in-class training, this research aims to compare the peer review results achieved in the two groups by answering the following research questions:
RQ1: Are peer review comments qualitatively or quantitatively different between the in-class instruction and handout groups?

RQ2: What are student perceptions of the helpfulness of peer review, and do they differ based on instruction type?

2 Background

The importance of building strong writing and communication skills in engineers has long been recognized. As professionals and experts, engineers must have the ability to communicate both amongst themselves and with broader society and policymakers. Engineering educators have recognized these needs almost from the beginning of formalized engineering education in the late 19th century, and recognition of the importance of communication skills amongst engineers has only grown over time [4], [5].

More recently, ABET’s EC2000 criteria formalized the need for engineering graduates to be effective communicators through student outcome criterion 3g, stating that graduates of accredited engineering programs must demonstrate “an ability to communicate effectively” [1]. It is up to individual programs how they implement and assess ABET criteria, and many programs meet the non-technical criteria through service courses taught by other departments, such as a technical communication course taught by the English department or by specialized but separate courses such as an engineering-oriented ethics class. However, there has also been extensive work on integrating communication skills throughout the engineering curriculum and courses, and that is the focus of this work [6]–[8].

Engineering faculty generally value written communication skills and recognize that they have a role in helping students to develop those skills. Many see their role as that of providing opportunities for students to write in their courses and receive feedback on the technical content and formal features of writing assignments; however, they often do not give students the opportunity to revise their writing based on that feedback. In other words, writing feedback to students is often summative rather than formative [9], [10, p. 1]. Nevertheless, research shows that providing meaningful feedback and opportunity for revision is a particularly important component of writing pedagogy [11].
Some engineering faculty are reluctant to incorporate writing into their classes because of the large time commitment involved in evaluating student writing, especially with pressures to cover ever more technical content in courses. Faculty also might be uncomfortable with their own ability to develop or evaluate meaningful and effective writing assignments [12, p. 485], [13, p. 2], [14].

One way to address the time constraints engineering professors face while still providing students the opportunity to build their writing competencies through formative assessment and revision is by using peer review, where students read and provide feedback to each other [12, p. 483], [15, p. 54]. An understandable concern with peer review is the notion that only a content expert can recognize the strengths and flaws in a novice’s writing and provide meaningful feedback.

Recent research by Cho & MacArthur showed that feedback from multiple peers (MP) in a psychology research methods class was more effective in improving students’ writing than feedback from a single expert (SE)—typically the instructor—or a single peer (SP) reviewer. When compared with single-expert and single-peer feedback contexts, multiple-peer (MP) feedback revealed improved student understanding of comments and included non-directive recommendations for revisions, which resulted in more complex repair decisions (global issues like organization and thesis focus vs. local issues like sentence-level errors and grammatical structure) and new content revisions as well as improved paper quality overall [16], [17].

As engineering educators, professional organizations, and government reports on the engineering profession have come to a growing recognition of the importance engineers’ communication skills, the teaching of these skills has steadily moved from the periphery to the center of engineering curricula guidelines. Yet the growing body of research in this area indicates that too often communication learning is still relegated to service courses or is taught in a manner that does not reflect current knowledge about writing pedagogy. Faculty may be reluctant to incorporate writing assignments into their courses or do it in an ineffective manner because of time constraints and large courses, especially at the lower levels. This research begins an investigation of the use of peer review to mitigate some of these concerns while incorporating contemporary writing pedagogy in a large first-year electrical and computer engineering course.
3 Methods

This study examines the results of a course-based intervention grounded in the literature described in the previous section. An existing writing assignment in a first-year electrical and computer engineering course assignment was modified to introduce best practices in writing instruction from the literature—formative assessment based on peer review and revision. Given the large size of the course and high student to instructor ratio, it was necessary for this intervention to use as few additional instructional resources as possible. Therefore, we wanted to determine whether in-class time had to be dedicated to training students on giving quality peer feedback or if a handout distributed through the course management system could be used instead. Additionally, we were concerned with how students would perceive the usefulness of the peer review process. In order to answer these research questions, an experimental approach was used in which two sections of the course received in-class training and three received only the handout. A follow-up survey was conducted to determine student perceptions of the intervention. The assignment, intervention, data collection, and survey are detailed in the following sections.

3.1 Setting

The study site was a large land-grant research university in the eastern United States. All first-year engineering students at the study site take a common course sequence preparing them to enter their chosen engineering discipline at the end of the freshman year, with students intending to major in electrical and computer engineering or computer science taking a second-semester course with an emphasis on computing and circuits. This course was the setting for this study, with data collection occurring in the 2012-2013 academic year. Course content included an introduction to ECE concepts including programming and analysis in MATLAB, and basic circuits and sensors culminating in a half-semester team-based engineering design project and report. In the first half of the semester, students engaged in a series of laboratory activities designed to build knowledge and skills across these ECE topics. In the second half of the semester, there were two major assignments: the team-based design project and an individual Contemporary Issue Report (CIR).

For example, in one unit, students were introduced during lecture to the concept of cochlear implants. Students learned about how the device itself works, including microphone, microcontroller, digital signal processor, implanted electrodes, etc. They also learned about and
discussed ethical issues surrounding cochlear implants from the perspective of both the medical engineering and deaf communities. In the associated lab, students would build on the previous week’s audio processing topic and implement a MATLAB model of the cochlear implant ultimately allowing them to process audio and listen to an approximation of what a user of the implant would hear.

3.2 Data Collection

3.2.1 Contemporary Issue Report assignment and Intervention

In the assignment students wrote a research paper in which they were to:

a) Investigate and describe a contemporary issue related to electrical and computer engineering or computer science,

b) Discuss the issue in terms of problem, possible solutions, and trade-offs, and

c) Discuss any ethical issues or societal impacts of the issue or solutions.

Students were provided with a handout describing the assignment, an example report written by the instructors (on the issue of cochlear implants discussed in the prior unit), a Microsoft Word template for the report, and a copy of the rubric used to evaluate the assignment. Providing the template and example report was intended to help familiarize students with the genre conventions used in academic writing in ECE; this familiarity is important because we do not just want students to become more effective at communication, but at communication within the discourse community of ECE [18, p. 18]. As is common in engineering classrooms, in the past the CIR was assigned in a one and done fashion in iterations of this course prior to this study: students submitted a final version of their report for grading without receiving any feedback on a draft and did not have the opportunity for revision. Feedback was provided by the instructors but was strictly summative in nature. This approach is consistent with Zhu’s [9] findings on integration of writing assignments in engineering classrooms. According to the anecdotal experiences of the instructors, the reports generally were of poor overall quality from both a technical and written communication perspective.

As an attempt to address these concerns and better achieve the course, program, and ABET outcomes, the assignment was modified to include formative assessment and revision based on the best practices of writing instruction described in section 2. Furthermore, in order to address RQ1, two types of peer review instruction were introduced. In the first type, an in-class
lecture, handout with instructions on giving quality peer feedback, and a short peer-reviewing workshop were lead by an experienced writing teacher. In the second, only the handout with instructions for providing quality feedback was distributed via the course management system. Because engineering faculty are can be uncomfortable “teaching writing” [12] and there will often be no institutional support for writing experts to teach students how to review each others’ work, the question of whether this second relatively low-resource form of peer review instruction can be effective is especially important.

In order to report potential findings from this experiment, permission was sought from the Institutional Review Board (IRB) to use student work products from the class for research purposes. The first-year engineering program requests blanket permission to use class work for research purposes from all incoming first-semester engineering students, and permission was granted from both the program and the IRB to use that consent for this research. In total, we received consent from 119 students participating in the course sections relevant to this study, corresponding to 83% of the total enrollment.

3.2.2 Peer Feedback Instruction

The primary experimental treatment in this study was form of peer review instruction. Students received one of two types of instruction: in-class plus handout or handout only. Both forms of instruction were developed collaboratively between course instructors and an experienced writing teacher. The writing teacher conducted the in-class workshop.

Handout

The peer review handout included three components: instructions for peer review, an example annotated paper, and the evaluation rubric for the final submission. The instructions explained that peer feedback can be as useful in revision as instructor feedback as long as it is high quality. High quality feedback was described as having three criteria; it is specific, encouraging, and helpful:

1. Specific feedback is not vague, explains what the problem was and where it occurred, and is grounded in the rubric criteria. For example: “I think you should switch the order of the third and fourth paragraphs” is more specific than “You need to work on your organization.”
2. Encouraging feedback doesn’t attack the peer, uses positive phrasing, and identifies strengths as well as weaknesses. For example: “Your previous transitions between paragraphs have been very smooth. This one could be stronger.” is more encouraging than saying “You lost me here.”

3. Helpful feedback was defined as following a provided list of guiding questions. For example: “Can you identify the piece’s main argument?” and “What might be missing from the paper? What else, as an interested reader, would you like to see in the paper? What else does the assignment ask for?”

Next, an example contemporary issue report from a previous semester with feedback following these criteria was included as a model for students commenting on their peers’ drafts. Finally, the handout included a detailed rubric. Students were informed that the rubric was identical to the one used for evaluation of the final CIR submissions and that they should refer to it when giving feedback to their peer. The full handout is included in Appendix A.

In-class Workshop

The in-class workshop consisted of about 30 minutes of instruction conducted by an experienced writing teacher. The first 10 minutes included a presentation of the material from the handout using identical or similar instructions, justifications, and examples. Students were then asked to pull up their CIR draft and rubric on their computers and to switch computers with the person next to them to practice giving feedback. As students commented on each other’s drafts, the writing teacher walked around the class three times to answer questions. The most common questions regarded use of the PDF commenting tools. Before concluding the workshop, the instructor ensured that each student had made at least one comment on his or her peer’s draft.

3.2.3 Student Survey

Student perceptions of the utility of peer review were measured using an online survey administered using the Qualtrics survey platform. The survey was sent to the entire class, but student responses without IRB consent were excluded from the analysis.

Students were asked to rate the following items on a 5-point Likert type scale (from Strongly Disagree to Strongly Agree).

- Peer feedback can help me improve my writing.
- Instructor feedback can help me improve my writing.
• Peer feedback can be as helpful as instructor feedback.
• Providing peer feedback to others was beneficial to me.
• Providing peer feedback to others helped me to improve my own paper.
• I think that including peer feedback in the CIR assignment is a helpful activity.
• I had a positive experience giving peer feedback on the CIR.
• I had a positive experience receiving peer feedback on the CIR.

Table 1: Participant Consent and Survey Response

<table>
<thead>
<tr>
<th>Peer Feedback Instruction</th>
<th>Enrolled</th>
<th>Consented</th>
<th>Survey Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Completed Survey</td>
<td></td>
</tr>
<tr>
<td>Handout</td>
<td>88</td>
<td>70</td>
<td>41</td>
</tr>
<tr>
<td>In-class + Handout</td>
<td>56</td>
<td>49</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>119</td>
<td>73</td>
</tr>
</tbody>
</table>

3.2.4 Confidentiality

Within each treatment group each student was randomly assigned two peer drafts for review. Course instructors distributed the drafts to the assigned reviewers and returned reviewed drafts to their original authors using the online course management system. To comply with the research protocol approved by the Institutional Review Board reviewed drafts and final papers were retrieved by the researchers and anonymized by removing student names from the report contents and file names. In order to maintain both document metadata (author, reviewer, research consent status, course section, and document type) and confidentiality participants were assigned a participant identification number. As the analytical framework used in this study requires analyzing comments in the context of the original text [19], only drafts with IRB consent from both the author and reviewer(s) were selected for analysis.

3.3 Analytical Framework

Student comments were coded using a typology based on Smith Taylor [20], [21] and Smith and Patton’s [22] work characterizing engineering instructor comments and Straub and Lunsford’s [19] characterization of expert writing teacher comments. Each comment was coded
along three axes: focus, mode, and tone. The focus of a comment identifies what the comment refers to in the original text; mode and tone refer to the qualities of the comment itself.

**Focus**

Categorizations of comment focus include form, content, and extra-textual. Form comments refer to the text at the word, sentence, or sub-paragraph level such as word choice, mechanics, and document design. They are generally about surface features of the text. Content comments refer to larger issues in the text such as organization, ideas, and development. Both Straub & Lunsford and Smith published definitions and examples of comment focus; in Table 2 the categories used in each study along with an example of a comment in that category. Table 5 describes the operationalized definitions of focus codes used in our analysis, along with representative examples of actual student comments for each code.

Most comments fit clearly into either form or content; however, in ambiguous situations meaning takes precedence. For example, the comment “in MLA citation, I think you need to point out the name of the resource in the paragraph” was coded as form while the comment “citation needed” was coded as content.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Category</strong></td>
<td><strong>Category</strong></td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td><strong>Example</strong></td>
</tr>
<tr>
<td>- Local Structure</td>
<td></td>
</tr>
<tr>
<td>- Wording</td>
<td>“Try to rework these sentences to avoid the repetition”</td>
</tr>
<tr>
<td>- Corrections</td>
<td>Changes one word to another; “Sharp word choice” “Comma splice” “Good use of quote”</td>
</tr>
<tr>
<td>- Conventions</td>
<td></td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
</tr>
<tr>
<td>- Ideas</td>
<td>“check on the reasoning behind your statements” “can you provide a definition?” “How does this personal narrative fit with your informative aim?”</td>
</tr>
<tr>
<td>- Development</td>
<td></td>
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<tr>
<td>- Global Structure</td>
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</tbody>
</table>
Table 3: Coding Scheme for Focus

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Comments that refer to features of the text at the word, sentence, or between-sentence level. These are comments about surface features that do not usually affect meaning. Also includes document design and layout. Direct edits fall into this category by definition. Can refer to the paper or sections as a whole if referring to surface features.</td>
<td>“Why is there a huge space here? Doesn’t look professional” “Run on sentence; Reword” “Reads awkwardly” “Formatting is confusing” “‘worldwide’ sounds better” “This sentence seems out of place” “Overall use more technical language and precise grammar”</td>
</tr>
<tr>
<td>Content</td>
<td>Comments at the sentence level and above or are about the meaning of the text. Can refer to specific words when asking for clarification or elaboration</td>
<td>“Do you think these paragraphs should be in the introduction part?” [highlighted sentence] “why, how?” “Explain key concepts earlier” “It’s a good paper but a little short. Add information on the history and development of pacemakers” [circled word ‘solved’] “completely?”</td>
</tr>
</tbody>
</table>

**Mode**

Mode considers the form, content, and voice of a comment. Straub and Lunsford [19] developed the concept of mode to better capture differences in meaning, teacher role, and control that are not accounted for when considering only superficial form and voice of comments. In this analysis, we used a modified version of the mode classification developed by Smith Taylor and Patton [22] with categories of authoritative, coaching, readerly, and edit. Operational definitions and characteristics of each code for mode are shown in Table 4 and relevant examples from actual student comments are shown in Table 5.

Table 4: Coding Scheme for Mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Definition</th>
<th>Subject</th>
<th>Agency</th>
<th>Role of Reviewer</th>
<th>Reviewer Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit</td>
<td>Reviewer directly changes the text for the writer</td>
<td></td>
<td>Reviewer</td>
<td>Correcting</td>
<td>High</td>
</tr>
<tr>
<td>Authoritative</td>
<td>Reviewer makes an evaluation or commands the writer to make a change.</td>
<td>First person</td>
<td>Second person (imperative)</td>
<td>Correcting</td>
<td>Directing</td>
</tr>
<tr>
<td>Coaching</td>
<td>Reviewer recommends a change or asks the writer a question.</td>
<td>Second person</td>
<td>First person (conditional)</td>
<td>Writer</td>
<td>Guiding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prompting</td>
<td>Questioning</td>
</tr>
<tr>
<td>Readerly</td>
<td>Reviewer takes position of audience, provides outside information, or summarizes without evaluating</td>
<td>First Person</td>
<td>Third Person</td>
<td>Audience</td>
<td>Reflecting</td>
</tr>
</tbody>
</table>
The mode reflects both the implied role of the reviewer and the degree of control the comment exerts over the text. This is illustrated by the following four examples about moving a paragraph to the introduction:

“Put this in the introduction”
“I think you should put this in the introduction”
“You might consider putting this in the introduction”
“Putting this in the introduction will allow the reader to more easily understand the rest of the paper.”

The first comment directly commands the author to make a change; it exerts a high level of control over the writing and would be coded as authoritative. The second and third comments are both suggestions on the surface; they exert a medium level of control. However, the phrasing “I think” shifts the agency to the reviewer while “you might” gives the writer agency; they would be coded as authoritative and coaching, respectively. The final comment takes the perspective of the audience and would be coded as readerly.

In some cases, more than one mode is present in a single comment. In these instances, the comment was coded at the first mode present, unless the comment taken as a whole was dominated by another mode. For example, in the comment

“Your report was very well composed, but you have many grammatical errors throughout. I would recommend reading the report aloud and when something doesn’t sound quite right you should fix those issues”

the middle section (a recommendation) gives some agency to the writer; however, the initial evaluation (authoritative) and final imperative (authoritative) make the comment authoritative overall.

Tone

Straub & Lunsford [19] distinguished between negative evaluations and praise; similarly, Smith Taylor [20] coded authoritative evaluations as either positive or negative. Smith Taylor and Patton [22] acknowledged that authoritative evaluations can be negative or positive but did not make the distinction in their analysis. Because neither of these approaches allows for distinguishing between positive and negative tone outside the evaluative modes, we chose to code tone separately from mode. Each comment’s tone was categorized as negative/neutral, positive, or “sandwich” (qualified positive).
Table 5: Example Comments by Mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Representative Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit</td>
<td>The Department of Energy is currently attempting to modernize the country’s electrical grid. Our current grid consists of 300,000 miles of transmission lines and outages cost Americans $150 billion per year. Advanced Metering Infrastructure is one of the technologies going into the Smart Grid. It provides consumers with the ability to use electricity more efficiently and enable energy providers to better</td>
</tr>
<tr>
<td></td>
<td>Abstract — Improperly in vision is a common aliment people have; whether it is something serious like cataracts or even poor vision, LASIK surgery can fix some of these ailments. LASIK surgery uses computer-</td>
</tr>
<tr>
<td></td>
<td>The charge passes through these components. Examples of such components are lithium/sodium, cadmium/nickel oxide and nuclear batteries. Combine.</td>
</tr>
</tbody>
</table>
| Authoritative | Good explanation of how the pacemaker relates to EE. Further details would strengthen. In this “how it works” you should stress more on the principle it applies and tell us how it works instead of the 
|            | It’s a good idea to explain the problem and mention the solution in the introduction. |  |
| Coaching   | Why give batteries a different name now "Power Source", after defining them in the paragraph above. Any encryption. May transition better. |  |
| Readerly  | Your abstract defined the issue that you are arguing clearly and your introduction highlighted U.S. dependence on energy as a serious issue. Very good, informative introduction. Brings the reader up to speed well and segues well into privacy. |  |
|            | The introduction does a good job of introducing all the background on the subject that is necessary to understand the related technical content of the paper. |  |
4 Results and Discussion

Comment Analysis

The mean number of comments meeting each criterion from the three axes described above was calculated for each of 80 student drafts (40 from each instruction type). To determine the statistical significance of differences in means between the groups, an independent samples t-test was calculated. Drafts from the in-class instruction group included slightly fewer comments overall. The mode of those comments included fewer edits and authoritative comments and more coaching and readerly comments. Mean number of content-focused comments was higher, while there were fewer form-focused comments. There were more positive and “sandwich” comments and fewer negative/neutral. The direction of these results is consistent with the in-class instruction group producing comments that are of a higher quality based on both the criteria from the peer review instruction and the three axes identified from the literature for the analytical framework. As shown in Table 6 however, the difference between groups was not statistically significant for most of the criteria. There was a significant difference in mean number of readerly comments between in-class instruction (M=1.63, SD=2.13) and handout-only (M=0.83, SD=1.08) conditions; t(78)=2.115, p=0.038.

Table 6: Comments by Mode, Focus, and Tone

<table>
<thead>
<tr>
<th></th>
<th>Handout</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Mode</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Edit</td>
<td>4.23</td>
<td>7.27</td>
<td>2.98</td>
<td>4.73</td>
<td>.365</td>
</tr>
<tr>
<td>Authoritative</td>
<td>6.68</td>
<td>4.31</td>
<td>6.23</td>
<td>5.81</td>
<td>.695</td>
</tr>
<tr>
<td>Edit+Authoritative</td>
<td>10.90</td>
<td>8.94</td>
<td>9.20</td>
<td>8.99</td>
<td>.399</td>
</tr>
<tr>
<td>Coaching</td>
<td>1.75</td>
<td>1.93</td>
<td>1.93</td>
<td>1.96</td>
<td>.686</td>
</tr>
<tr>
<td>Readerly</td>
<td>0.83</td>
<td>1.08</td>
<td>1.63</td>
<td>2.13</td>
<td>.038</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edit</td>
<td>4.23</td>
<td>7.27</td>
<td>2.98</td>
<td>4.73</td>
<td>.365</td>
</tr>
<tr>
<td>Form</td>
<td>3.28</td>
<td>3.37</td>
<td>2.50</td>
<td>3.14</td>
<td>.291</td>
</tr>
<tr>
<td>Edit+Form</td>
<td>7.50</td>
<td>9.23</td>
<td>5.48</td>
<td>7.29</td>
<td>.280</td>
</tr>
</tbody>
</table>
A slightly different way to look at these data is to consider the intersections of comment mode and focus. Table 7 shows mean number of comments in each mode, separated by the focus of the comment. Again, mean number of readerly comments emerges as the only statistically significant difference between the in-class (M=1.45, SD=2.08) and handout-only (M=0.70, SD=2.08) conditions, but only for comments with a content focus; t(78)=2.093, p=0.040.

Table 7: Intersections of Focus and Mode

<table>
<thead>
<tr>
<th></th>
<th>Handout</th>
<th>In-class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authoritative</td>
<td>2.58</td>
<td>2.15</td>
</tr>
<tr>
<td>Coaching</td>
<td>0.28</td>
<td>0.25</td>
</tr>
<tr>
<td>Readerly</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authoritative</td>
<td>4.10</td>
<td>4.05</td>
</tr>
<tr>
<td>Coaching</td>
<td>1.48</td>
<td>1.68</td>
</tr>
<tr>
<td>Readerly</td>
<td>0.70</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Note: Edit not included here because edits are authoritative/form by definition.

Survey

The results of the survey are presented here as diverging stacked bar charts. These charts align sets of responses around a neutral line, with the percentage of respondents who agree with each statement to the right of the line and the percentage disagreeing below. This style of chart
has been suggested as a more appropriate way to visualize responses to Likert-type questions than the alternatives [23].

**Figure 1: Perceptions of Peer vs. Instructor Feedback**

The results shown in Figure 1 indicate an overall positive perception of both peer and instructor feedback, as well as that peer feedback can be as effective as instructor feedback. Perceptions within the in-class instruction group were less negative on each dimension. The Pearson chi-square test indicated that the differences were not statistically significant.

**Figure 2: Personal Benefit of Providing Feedback to Others**
Student perceptions of the benefit of providing peer feedback to others (as opposed to receiving it) was more evenly split, as shown in Figure 2. The in-class instruction group indicated slightly higher agreement than the handout group but a Pearson chi-square test indicated that the differences were not statistically significant.

Finally, students were surveyed about their overall experience giving and receiving peer feedback as well as the overall feedback and revision process. Results shown in Figure 3 indicate overall positive perceptions in all dimensions. Students in the in-class group responded more positively than the handout group regarding their experience giving peer feedback and the overall utility of including peer feedback in the assignment, but slightly more negatively about receiving peer feedback. Again, the Pearson chi-square test did not indicate that the differences were statistically significant.

![Figure 3: Overall Perceptions of Peer Feedback Activity](image)

### 5 Conclusions

First, this work should not be interpreted as diminishing the importance of partnerships between engineering and communication instructors. While the writing instructor did not have direct interaction with the engineering students in the handout group, the handout was developed by that expert specifically for the context of this assignment and in partnership with the
engineering instructors in a fashion consistent with prior work on development of communication assignments in engineering courses [11].

The results of comment analysis suggest that using a handout for peer feedback instruction may be as effective as conducting an in-class workshop, as the differences between groups was not statistically significant for most evaluation criteria. However, the criterion that was significantly different between the groups, mean number of readerly comments, is noted in the literature as being particularly important for helping students make revisions [20]. Moreover, the direction of differences in means in other categories, especially when taken as whole, suggests that in-class peer feedback may have an effect even though it was not a statistically significant effect in this study.

The results of the survey of student perceptions of giving and receiving peer feedback were overall positive in both groups. The in-class group responded more positively than the handout group for most questions, but the difference was not large enough to be statistically significant for the number of students who responded to the survey. Because the chi-square test is highly dependent on sample size (and it was relatively low compared to the categorical differences present in the survey data), the difference should not be ignored. However, perceptions were overall positive for both types of instruction.

The major limitation of this study that will be addressed in future work is that the actual revisions students made based on the peer feedback received were not considered. As the literature indicates that the mode and focus of comments is important in the revision process, analysis of actual revisions in the context of the comment analysis could strengthen the conclusion that a well developed handout can be as effective as in-class instruction or might show that the lack of sufficient readerly comments does make an important difference in final drafts.

References


Why Peer Feedback?

Studies in education have shown that there is significant improvement in student papers when students have the opportunity to get feedback from their peers. Student’s papers improve not only in terms of writing, but also in terms of content. One study (Cho & MacArthur 2010) even proved that there are times when the feedback you receive from your peers is as helpful as the feedback you receive from an instructor or subject matter expert. Why? Perhaps because your peers know what it’s like to be writing the paper. They have also struggled with it and had to work through their ideas to put words to the page. You can share with one another how you overcame difficulties, found helpful sources, and corrected a certain paragraph that felt out of place in your argument. At this point, you are an expert on how to write for this assignment and you are in the best position to give your peer feedback, so long as it’s quality peer feedback.

Quality Peer Feedback

There are three important things to remember as you read over your peer’s paper.

1. Be specific
   Quality feedback is determined by the clarity of the feedback itself; give your peer specific comments instead of vague comments. Point to exact page numbers and paragraphs that were problematic, give examples of general problems that you found, be clear about what exactly the problem was, explain why it was a problem, etc. (Cho, Schunn & Charney 2006, Appendix B). The rubric for the CIR assignment is attached at the end of this handout. Reference it frequently as you read your peer’s paper.

   For example, saying “I think you should switch the order of the third and fourth paragraphs” is more specific than saying, “You need to work on your organization.”

2. Be encouraging
   When a peer gives you feedback on your writing, it is common to feel a little defensive, especially when you have put a lot of hard work into a piece of writing. However, try to hear feedback with an open mind. You and your peers are all trying to do the same thing: become better engineers. As you read your peer’s paper, remember how this might feel. Be encouraging. You have nothing to lose and they have everything to gain from your encouragement. Remember to comment on aspects of their paper that are strong at the same time as you are suggesting areas of improvement. Write comments that you would like to receive as you work to revise your paper.

   For example, saying “Your previous transitions between paragraphs have been very smooth. This one could be stronger” is more encouraging than saying, “You lost me here.”
3. **Be helpful**

Here are some questions you might ask yourself while you’re reviewing a writer’s paper. Notice that some of them ask you to focus on strengths and some ask you to identify weaknesses. The questions might also ask you to offer suggestions for improvement if you find areas of the paper that could use revision.

- Can you identify the piece’s **main argument**?
- What are the paper’s main **strengths**? What are the strongest parts of the paper?
- What sentences/ideas are **difficult** to understand? What sentences/ideas are **clear** and **easy** to understand?
- Are there **transitions** between paragraphs and ideas? If not, where might be good places for them?
- Are there sections in the paper that seem **unrelated** to the rest of the paper?
- Did you feel lost or **confused** at any point? How might the writer improve the areas that confused you?
- What might be **missing** from the paper? What else, as an interested reader, would you like to see in the paper? What else does the assignment ask for?
CIR Peer Feedback Examples

Attached is an excerpt from a student’s paper from last semester. We have also provided some comments on that paper to give you examples in the context of reading a peer’s paper.

Rechargeable Lithium-Ion Batteries

![Picture of a lithium-ion battery](image)

Abstract—With all of today’s technological advances, there is a high demand for greater energy sources. The lithium-ion battery, which powers items such as cellular devices and laptops, has been undergoing research lately to improve its overall charge capacity. The dashed goal is to increase the lithium-ion’s maximum charge, have it charge completely at a faster rate, and maintain its charge over a long period of time. Recently there was a breakthrough when a group of researchers and scientists developed a protocol that had the ability to charge a lithium ion battery 30-120 times faster than the same battery. This new study has opened up multiple possibilities with battery-powered technology such as replacing the battery of small electrical devices and even using it in future electrical vehicles. Unfortunately at the present time, there are still glitches and improvements with the battery, as well as expense problems, that will most likely postpone mass production for a few more years.

Index Terms—Lithium-ion battery, anode, cathode, electrolyte, charge

1 INTRODUCTION

Lithium-ion batteries are one of the most common batteries in use today. They can be found in everyday portable electronics, like iPods, laptops, and cell phones. These batteries are categorized as both primary (disposable) and secondary (rechargeable) batteries. Depending on certain parameters such as voltage requirements, environmental conditions, maintenance, and the battery’s lifetime [2]. The current problem with these batteries is that although they were a major breakthrough years ago in today’s fast-moving society, they take too long to charge and over a small period at time one full charge. Researchers are currently looking for ways to speed up the charging process and capacity in order to implement the technology in small electronic devices and future cars.

2 HOW IT WORKS

In order to talk about the future, it is imperative to talk about the present state and charging process of batteries. Every battery contains an anode, cathode, and an electrolyte. When the anode and cathode are connected by an electrical conductor, an electrical current is created by the electrons flowing from the anode to the cathode. Meanwhile, the electrolyte conducts positive current in the form of cations, which are positive ions. The materials used for these components affect the battery capacity and voltage in a
Your description of how the technology works is very clear. The inclusion of a diagram complemented your description. Nicely done!

The assignment asks you to discuss multiple/alternative solutions to the issue and the tradeoffs between them. You bring up the multiple cathode alternatives, but you don’t go into detail. I’m curious what the differences are.

I think you do a good job of presenting examples of upgrading that would mean something to your readers. We can all relate to a cell phone that doesn’t have a battery efficient enough to last all day.
4 POTENTIAL PROBLEMS

These new lithium-ion batteries are not very far out of our reach. As stated before, research and successful tests have already been conducted. Now, however, comes the perfection stage of the process. One battery was able to be made, but what about mass production for consumers? FutureTimeline.net predicts that the new battery will be widely used in laptops, cell phones, other small electronics, and electric cars by the year 2015. So why wait three years? There are a few issues with making this battery more common including expenses, size, and glitches with the battery.

As far as expenses, with every new and exciting technological advance, there is always an issue with money. When scientists consider the future of the product, they envision the battery in an electric car. As stated before, a part of this is due to the fact that the size of the protocol is too large to fit in a laptop or cellular device. Secondly, the idea of a cheap, environmentally-friendly electric car has been around for years, but due to technological constraints, a lack of research, and money, the idea has never appealed to the masses. The improved lithium-ion battery, unfortunately, is no exception. The research and technology has finally caught up, but money is still a problem. By the time the battery is installed in the car, although it may be great to charge it and drive within a minute, the battery itself costs as much over time, if not more, than a car that uses gas [4]. This makes the electric car seem like a great idea, but in reality, the price would not make it a middle-class success.

The glitches with this battery are similar to those of the modern lithium-ion batteries. These problems include overheating of the anode due to the battery powering and overproduction of oxygen due to too much charge on the cathode. These two problems have the potential to start an abrupt fire. Despite the vents and automatic shut off when the battery gets too hot, the risk still exists, and there have been multiple instances where this has occurred [3]. As the size increases, more energy will be spent on keeping the battery cool to ensure that a fire does not occur, taking away from the total charge capacity the battery contains.

5 CONCLUSION

The lithium battery has recently undergone some new advances that allow it to charge 30-120 times faster than your typical Li-ion battery. This is done by soaking the cathode in a graphite solution, allowing the battery to recharge as a whole rather than from the outside-in. Hopefully by the year 2015, this battery will be implemented in small electronic devices as well as electric cars.

REFERENCES

# CIR Peer Feedback Rubric

This rubric is identical to the rubric which will be used by graders to evaluate your final draft. Help your peer work through their strengths and weaknesses so that each aspect of their paper will meet excellent standards! Remember to offer suggestions to your peer.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Unacceptable</th>
<th>Marginal</th>
<th>Proficient</th>
<th>Excellent</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing Mechanics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used Template and submitted as PDF</td>
<td>Assignment instructions not followed</td>
<td>Some assignment instructions followed</td>
<td>Most assignment instructions followed</td>
<td>Report fully complies with instructions &amp; requirements</td>
<td>1</td>
</tr>
<tr>
<td>Grammar, mechanics, and spelling</td>
<td>Consistently inadequate grammar, mechanics, and/or spelling; Errors impair meaning</td>
<td>Many errors, which affect writing clarity</td>
<td>A few errors, which do not impair meaning</td>
<td>Consistently correct use of grammar, mechanics, and spelling</td>
<td>1</td>
</tr>
<tr>
<td><strong>Writing Quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>Organization lacks coherency; Language and sentence structure is poor; Report is difficult to read</td>
<td>Organization of some sections is coherent; Report requires effort to read and understand</td>
<td>Distinct units of thought in paragraphs; clear transitions between developed, coherently arranged paragraphs</td>
<td>Apt, seemingly inevitable sequence of paragraphs; appropriate, clear and skillful transitions between sentences and paragraphs</td>
<td>2</td>
</tr>
<tr>
<td>Conceptual</td>
<td>Confuses some significant concepts; does not respond directly to the assignment</td>
<td>Author restates or paraphrases ideas from other sources but writing does not clearly demonstrate author’s understanding</td>
<td>Shows good understanding of the ideas and methods of the assignment; goes beyond the obvious</td>
<td>Writing is original, shows clarity, and demonstrates depth of understanding; sophisticated analysis; fulfills, then exceeds the expectations of the assignment in some critical way</td>
<td>1</td>
</tr>
<tr>
<td>Support</td>
<td>Sources not cited / examples not given.</td>
<td>Inadequate sources: Provides some evidence/citations, but not always relevant, sufficient, or integrated into paper; undeveloped ideas or little analysis; limited use of textual evidence</td>
<td>Pursues thesis consistently; clearly develops a main argument with clear major points and appropriate evidence; makes effort to link rather than stack ideas;</td>
<td>Provides substantial, well-chosen evidence/citations (quotations or specific examples) used strategically; connections between ideas are evident; thesis consistently supported</td>
<td>2</td>
</tr>
<tr>
<td>Attribute</td>
<td>Unacceptable</td>
<td>Marginal</td>
<td>Proficient</td>
<td>Excellent</td>
<td>Weight</td>
</tr>
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<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>References</td>
<td>Sources not cited</td>
<td>Some sources cited; common reference format not used</td>
<td>Some sources cited in-text AND references listed in Reference section</td>
<td>Sources cited using a common format; sources are cited in-text and listed in Reference section; sources are sufficient</td>
<td>1</td>
</tr>
<tr>
<td>Technical Quality</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem</td>
<td>The problem is simply stated, and there is no introduction or explanation of the problem.</td>
<td>The description of the problem is vague; no discussion of how the problem is a contemporary issue</td>
<td>Problem identified and introduced, but introduction should be expanded to improve clarity</td>
<td>Problem is clearly identified and precisely introduced; author explains how the topic is a contemporary issue</td>
<td>3</td>
</tr>
<tr>
<td>Problem or solution linked to ECE/CS</td>
<td>No link to ECE/CS for problem or solution</td>
<td>The author states there is an ECE/CS link but does not explain the link</td>
<td>The link is presented and partially explained, but link is superficial.</td>
<td>The strong link to ECE or CS is clearly explained.</td>
<td>3</td>
</tr>
<tr>
<td>Solutions</td>
<td>Does not discuss a solution</td>
<td>Only discusses a single solution</td>
<td>Discusses multiple solutions</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Tradeoffs</td>
<td>Does not mention or discuss tradeoffs</td>
<td>Mentions tradeoffs but presentation does not demonstrate author’s understanding of tradeoffs and/or does not compare since only one solution is included</td>
<td>Discusses tradeoffs and demonstrates author’s understanding of tradeoffs with a limited comparison of solutions</td>
<td>Has comparisons of alternate solutions and/or description of tradeoffs; compares solution in terms of underlying principles (key concepts), strategies, or tradeoffs.</td>
<td>3</td>
</tr>
<tr>
<td>Ethics</td>
<td>Does not mention or discuss ethical issues</td>
<td>Mentions ethical issues associated with the problem or solution(s) but does not evaluate or explain</td>
<td>Brief discussion of ethical issues; discussion covers all relevant ethical issues but could benefit from an expanded discussion</td>
<td>Excellent evaluation or discussion of relevant ethical issues; conclusions are clear and logical</td>
<td>2</td>
</tr>
<tr>
<td>Societal Impact</td>
<td>Does not mention or discuss societal impacts</td>
<td>Mentions the impact of the problem or solution(s) on society but does not evaluate or explain</td>
<td>Brief discussion of societal impact; presentation is understandable, but could benefit from an expanded discussion</td>
<td>Excellent evaluation or discussion of relevant societal impact; conclusions are clear and logical</td>
<td>2</td>
</tr>
</tbody>
</table>
Contemporary Issue Report Assignment

This assignment is an individual assignment and is to be completed on an individual basis. While discussing the assignment is authorized and encouraged, copying text or ideas from any source is considered a violation of the Honor Code.

Sharing your report or sources, or reusing someone else’s report or sources in full or in part is not allowed. Honesty in your academic work will develop into professional integrity.

The faculty and students of will not tolerate any form of academic dishonesty. It is your responsibility to seek clarification if there is a question about how the Honor Code applies to this assignment. Suspected violations of the Honor Code will be processed and dealt with as recommended by the Honor Court. Remember to cite your resources and avoid plagiarizing or copying.

In addition, you are not allowed to write your report on Cochlear Implants, as that contemporary issue has been discussed in-depth during class. You will receive an automatic zero on your report if the topic is Cochlear Implants.

Contemporary Issue Report Guidance

The first two learning objectives for are:

1. Describe several contemporary problems—and the impact of their solutions on society—in various technical areas of ECE and CS, and
2. Compare the problems’ solutions in terms of their underlying principles (key concepts), strategies, and trade-offs;

In class, we have discussed a contemporary problem, deafness, and a potential solution, cochlear implants. We discussed some of the societal and ethical issues such as the impact of cochlear implants on the deaf community and the ethics of viewing a disability negatively. We also discussed other solutions, such as using sign language for communication.

Now it is your turn to discuss a contemporary issue! Each student will write a report that describes a contemporary problem within the technical areas of ECE and CS. Either the problem or the solution must have a direct link to ECE or CS. In the example case of deafness, the solution has a direct link (e.g., signal processing and electronics).

To identify a contemporary issue, you may want to search student magazines like
- ACM Crossroads (http://xrds.acm.org/), or

Your report must adhere to the template format provided in the Resources folder. In your report, you must

1. Introduce the problem;
2. Identify, introduce, and discuss the related technical areas of ECE or CS;
3. Discuss the impact of the problem’s solution(s) on society, including ethical considerations;
4. Compare the problem’s solution(s) and alternate solutions in terms of underlying principles (key concepts), strategies, and trade-offs;
5. Include appropriate references (in-text citations and bibliography); and
6. Use proper grammar and spelling.

A sample report is provided in the Resources folder: CIR Example – Cochlear Implants.pdf