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Work in Progress: Scaffolding Revision with Rubrics, Peer Review, and Reflection in a Technical Communication Course

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Introduction: Promoting Effective Revision of Rough Drafts
Technical communication is an essential skill for engineers. Unfortunately, many graduates of engineering undergraduate programs report that they do not feel prepared or confident in their technical communication abilities. In addition, although effective communication skills are required for success in all engineering disciplines, many programs do not teach technical communication for a variety of reasons, including lack of instructor experience or buy-in regarding the value of teaching technical communication skills.

Revising written drafts is an essential skill in technical writing. However, revision is time-consuming and can be overwhelming for students. Often students report that they don't know how to revise their drafts, even when they have a grading rubric available and are given explicit comments on their work. Unfortunately, time constraints and students' perceived lack of direction often mean that students do not make meaningful revisions to their rough drafts, which can be frustrating for instructors but more importantly is a missed learning opportunity for students to hone a valuable writing skill.

In this work-in-progress, we provide a novel approach for guiding students to effectively revise their writing assignments. The novelty of our work is twofold: (1) using grading rubrics on rough drafts to help students target specific areas of improvement, and (2) providing extensive scaffolding of the revision process.

Course Overview: Technical Writing for Biomolecular Engineers
We piloted our approach in a class of 35 undergraduates (juniors and seniors) in a technical communication course required for all students in our major.

The learning objectives of the course include:
1) Implement successful communication strategies based on audience, purpose, and context.
2) Integrate text and visuals to convey complex, technical information.
3) Revise documents for content, organization, and writing style.
4) Using library research skills and knowledge of citation practices, conduct self-directed inquiry to identify, critically evaluate, and cite relevant literature.
5) Provide feedback to others on their writing, speaking, and teamwork abilities.
6) Demonstrate ability to work in teams and manage team projects.
7) Design and deliver effective oral presentations.
8) Understand ethics and sustainability in engineering.

The students completed four major assignments where they used our scaffolded approach to revision: Job Documents, Research Poster, Lab Protocol, and Technical Report. (Detailed descriptions of all major assignments are provided in Appendix A.)

Using Grading Rubrics for Rough Drafts
Best practices in teaching writing call for frequent, low-stakes revisions of written work with formative feedback before submitting a final deliverable. The formative feedback is

"actionable," meaning that it is intended to guide students in the revision process, whereas the summative feedback received on a final deliverable is intended to rate student performance. Here we describe using grading rubrics to provide formative feedback for students on rough drafts.

Grading Rough Drafts with Instructional Rubrics

In technical communication courses, it is common practice for instructors to give full credit for completion of rough drafts, rather than grading rough drafts according to a rubric. We wondered whether giving students a grade on their rough draft would motivate and/or help them to make revisions on their written work. We were also concerned that students may be anxious or crestfallen when receiving a grade on their rough draft. Overall, we received overwhelmingly positive feedback from students on using grading rubrics for rough drafts (discussed below).

Grading rubrics are essential for instructors to provide fair and consistent grading. Grading rubrics have several benefits, including: making grading more efficient, providing consistency among graders of different sections, and letting students know how instructors determine grades. However, students report that they typically do not have access to grading rubrics before an assignment is graded, which is a missed opportunity for students to learn from the grading rubric.

We used instructional rubrics [1] as one of the ways to provide formative feedback for students on first drafts of assignments. Instructional rubrics describe in detail what constitutes a grade of excellent, satisfactory, or needs work in several dimensions of the assignment. Instructional rubrics include (1) dimensions or criteria, such as: content, organization, document design, word usage, formatting, and citation and (2) descriptions of student work in gradations or varying levels of quality.

Instructional rubrics describe specific examples that are easily understandable to students, such as including all sections of an assignment or consistently using a specific formatting style. Thus, instructional rubrics are both easy-to-understand and explicit enough to be informative. (For an example grading rubric, see Appendix B: Grading Rubric for Resume Rough Draft.)

In early offerings of the technical communication course, students received full credit for completing rough drafts (n=59 students). In the most recent offering, students received a grade based on a rubric instead of credit for completion (n=35 students).

It is important to note that the rough draft is worth 10 points and the final deliverable is worth 100 points, which is aligned with current best practices that call for low-stakes assignments during the writing and revision process with formative feedback before submitting a final deliverable with summative feedback.

The grading rubric is identical for both the rough draft and final deliverable of the assignment, except for scaling (i.e., a dimension worth 3 pts on the rough draft is worth 30 pts on the final deliverable). Therefore, any point deduction on the rough draft represents only a small deduction in the assignment, which is worth 110 pts total (rough draft 10 pts + final 100 pts = 110 pts).

Students submit their assignments electronically on Canvas by Instructure, Inc., which facilitates a platform for delivering personalized feedback on assignments, ensuring that each student receives tailored guidance in a private and easily accessible manner. Using Canvas, we are able to promptly offer students valuable individual feedback on assignments. The comments and scoring provided via the grading rubric aids students in their revision process, and also enhances the clarity and helpfulness of instructor feedback.

We want to emphasize the importance of providing a clear message to students that they must revise their drafts on their own, without solely relying on feedback from instructors or peer review. As students often wait to revise their work until they receive feedback, we encourage students to have agency over the revision process. Using their own discretion, they should be able begin revising their drafts before receiving individualized feedback.

In addition, we encourage students to make revisions beyond what is prescribed by the grading rubric. To help students begin revising before they receive individualized feedback on their drafts, we provide "broadcast feedback" (instructor shares list of common mistakes on drafts with the entire class) and many examples in class. Finally, we emphasize that for stylistic choices, students do not need to follow every suggestion they receive.

Scaffolding the Revision Process
As a scaffold provides temporary support in the building process, here "scaffolding" means providing a framework to support student learning as students revise an assignment. Our scaffolding approach involves breaking the assignment into manageable pieces (rough draft and final draft) and providing structured tools (grading rubrics, peer review, and reflection) to support student learning as the assignment is completed and revised.

Here we describe our approach of scaffolding the process of student revision of written assignments with grading rubrics, peer review, and reflection. This work-in-progress is the first time we have graded rough drafts according to a rubric, although we have extensive experience in using peer review and reflection to scaffold better writing outcomes for students [1-4].

Here we describe our approach to scaffolding the student revision process in three steps:

1) ***Grade based on grading rubric for rough drafts.*** We provide grading rubrics for rough drafts when the assignment is posted, and then give students a grade on their rough draft. Using a grading rubric on rough drafts is the novel aspect of our work-in-progress. (10 points in total assignment grade, graded according to rubric.) Students submit all assignments and receive individualized feedback electronically through Canvas. In addition to a score on the rubric, students receive comments on their drafts.

2) ***Peer Review in small groups.*** Students exchange rough drafts and provide written comments for each group member before class, using guiding questions provided by the instructor. During class, students discuss each draft as a group. (10 points in class participation grade, full credit given for completion.)

3) ***Reflection on peer review.*** After in-class peer review, students write a short reflection where they identify areas of improvement from peer feedback. In addition, students were asked to make revisions based on something they saw in another student's draft that they found helpful. (10 points in overall reflection grade, full credit given for completion.)

In addition, students receive "broadcast feedback" from the instructor during class. In broadcast feedback, the instructor addresses the entire class and asks students to check their own drafts for specific problems. Broadcast feedback includes a description of the most common mistakes found in rough drafts and also hypothetical examples of "good" and "bad" writing (e.g., content, organization, document design, word choice, figure design, and IEEE format). Examples of "broadcast feedback" provided to the class as a whole and representative comments comprising individual feedback provided on rough drafts are shown in Table I below.

Table I. Examples of feedback provided to students on rough drafts		
Assignment	**Examples of Broadcast Feedback**	**Examples of Individual Feedback**
Job Documents	*Your name should be the first thing on the resume, at the top of page and above contact info* *Put education section first (after objective)* *List graduation date as "Expected graduation June 2024"* *Left-align all sections* *List items in reverse chronological order*	*Name and date attended for high school is missing.* *The course name of the course you were a reader for is missing.* *You should detail the symbiote lab research you did, what lab is it?* *A section including references would also look good.*
Research Poster	*There should be more visual info than text.* *Be sure to include one graphic you create yourself.* *Use bulleted lists and short sentences. No long paragraphs.* *Use advanced organizer phrase. No naked lists!* *Use IEEE format for in-text citations and References section.*	*The sections on the right look good. I recommend reformatting the table in the center to take up less space.* *The introduction on the left is suffocated by the table. Having to have an arrow for the Data section title seems like a formatting problem instead of a necessity.*
Lab Protocol	*Include objective and cite protocol you are modifying for this assignment* *Align text* *Use consistent numbering system* *Cite manufacturer info for reagents and equipment when needed* *Use descriptive headings!* *Use IEEE format for in-text citations and References section.*	*You may want to make it very clear to keep everything cold throughout the experiment before snap freezing, that is key to making competent cells.* *You use "ul" instead of µl.* *Concentrations of reagents are missing.* *Specify the OD of the cells before pelleting.* *Could use a better description of the dry ice + ethanol method, could also mention that liquid nitrogen works too.*
Technical Report	*It will be easier to focus your report if you identify your audience as specifically as possible* *Use descriptive headings!* *Identify the topic sentence of each paragraph, and provide evidence to support the topic sentence.* *Use IEEE format for in-text citations and References section.* *IEEE format - tables and figures*	*Interesting topic. I think it's important that you pick a specific target audience, as researching human embryos raises a lot of legal and ethical dilemmas. Most institutions would be unable to research human embryos. Maybe mouse instead?* *Also, you should talk about the importance of RNA-seq data for analyzing the transcriptome at different development stages.* *Make sure your citations are ordered so that you can do proper IEEE in-text citations*

Overall, our approach to scaffolding revision includes both formative and summative feedback on the rough draft to aid in the revision process. Formative feedback includes instructor's specific comments on each student's rough draft, instructor's broadcast feedback, and peer review. Summative feedback is provided by the grade based on a rubric.

Student Survey Results: Grading rubrics helped students revise their rough drafts
We surveyed the students about their experience using grading rubrics throughout the course (survey questions shown in Appendix C). We administered the survey via Google forms, and 28 of the 35 students responded to the form.

Most students used the grading rubrics.
First, we asked students whether they used the grading rubrics for the rough drafts and final deliverable. We are very pleased that the survey results show that 78.6% of students and 89.3% of students looked at the grading rubric before submitting the rough draft and final deliverable, respectively.

Students reported benefits to receiving a grade on their rough drafts, although receiving a grade also made students anxious.
We asked students about their experience in receiving a grade on their rough drafts (Fig. 1). We asked students the following six questions prefaced with "Did receiving a grade on the 10-point rough draft rubric:"
1) Help you know how to revise your rough draft?
2) Help you write your final deliverable?
3) Affect how you peer-reviewed other students' work?
4) Make you more likely to use the 100-point grading rubric for the final deliverable?
5) Make you feel more confident?
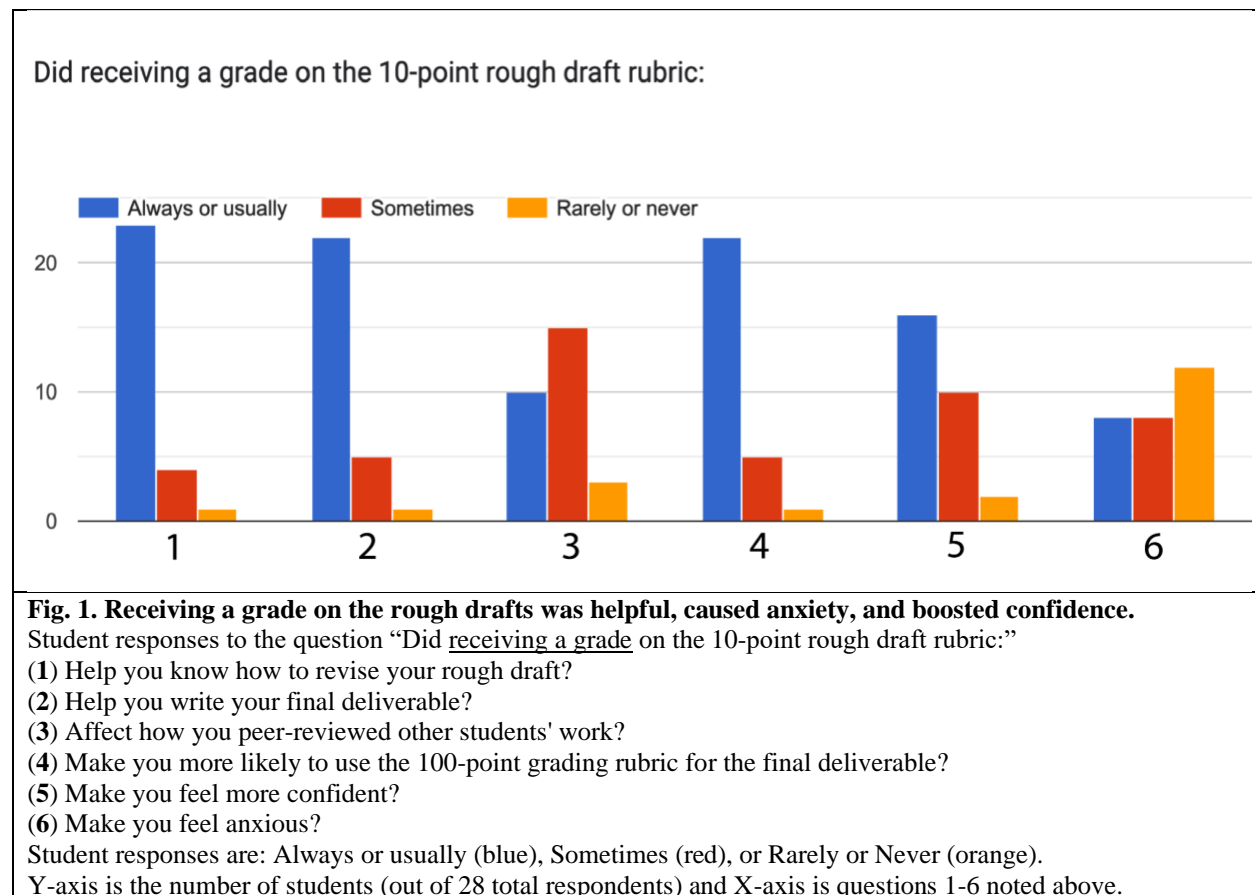6) Make you feel anxious?

The majority of students (at least 78.6%) indicated that receiving a grade on the 10-point rough draft rubric "Always or Usually" helped them know how to revise their rough draft and helped them write the final deliverable (Questions 1-2)..

We received mixed results on whether receiving a grade on the 10-point rough draft rubric affected how students peer reviewed other students' work (Question 3), with 35.7% of students responding "Always or Usually," 53.6% responding "Sometimes," and 10.7% of students responding "Rarely or Never."

The majority 78.6% of students indicated receiving a grade on the rough draft rubric "Always or Usually" made them more likely to use the 100-point grading rubric for the final deliverable (Question 4).

When asked whether receiving a grade on the 10-point rough draft rubric made students feel more confident (Question 5), the majority of students (57.1%) responded "Always or Usually," another 35.7% of students responded "Sometimes," and only 7.1% of students responded "Rarely or Never."

We were concerned that giving students a grade on rough drafts rather than giving full credit for completion might make students feel anxious, and we found that 57.1% of the students reported that receiving a grade made them feel anxious (Question 6).

Fig. 1. Receiving a grade on the rough drafts was helpful, caused anxiety, and boosted confidence.
Student responses to the question "Did receiving a grade on the 10-point rough draft rubric:"
(**1**) Help you know how to revise your rough draft?
(**2**) Help you write your final deliverable?
(**3**) Affect how you peer-reviewed other students' work?
(**4**) Make you more likely to use the 100-point grading rubric for the final deliverable?
(**5**) Make you feel more confident?
(**6**) Make you feel anxious?
Student responses are: Always or usually (blue), Sometimes (red), or Rarely or Never (orange).
Y-axis is the number of students (out of 28 total respondents) and X-axis is questions 1-6 noted above.

Overall, the quantitative results (Fig. 1) indicate the grading rubrics were useful to the majority of students in the revision process. The quantitative results (above) support the qualitative data from the survey (below).

Receiving a grade on rough drafts was somewhat stressful, but overall helpful for revision.
Representative responses to the short answer questions are highlighted below.

Question: How has receiving a grade on the 10-pt grading rubric on rough drafts helped you in this class?
Representative responses:
- *It helped actually see what I needed to improve on my writing.*
- *Gave me an idea of what I would get for the final deliverable if I turned it in as is.*
- *It was very beneficial for me. I liked how because it was a draft it would only knock me down to a 9/10 and it would catch my eye in the grades. It helped me so so much.*
- *Yes and no, I didn't like that it affected my grade, but it's certainly better than getting a worse grade on the final deliverable*
- *It made me more aware of the rubrics for final drafts*

Question: How has receiving a grade on the 10-pt grading rubric on rough drafts been unhelpful? Any suggestions for change?
Representative responses:
- *Very stressful for the drafts. It felt like I had final drafts due*
- *It feels a bit anxious but doable*
- *It was a little annoying getting points off but I think it helps people take the rough drafts more seriously.*
- *It's been helpful because proper feedback is provided where students make mistakes and where we can improve.*

Question: Do you think you would have approached your assignments differently <u>if you did not receive a grade</u> for the rough drafts? (In other words, if you were given 10/10 pts just for submitting the rough draft)
Representative responses:
- *If I were given a 10/10, I probably wouldn't have made any changes as I would assume it was already "perfect".*
- *Yes, because I would have had less incentive to make my rough drafts of a higher quality.*
- *Definitely would not have revised my final drafts as hard if this was the case*

Student Survey Results: Individual comments, broadcast feedback, and receiving a grade on the grading rubric were the three most helpful forms of feedback on rough drafts.
Finally, students rated the helpfulness of each type of feedback they received (Fig. 2 and Fig. 3). Students indicated "Very helpful," "Somewhat helpful," "Neutral or Unsure," "Not really helpful," or "Was actually unhelpful" to the following question:

"How helpful was each type of feedback you received on your rough drafts?"
1) Receiving a grade based on rubric
2) Individual comments from grader on Canvas
3) Feedback and examples Dianne shared on slides during class
4) Peer review comments from other students
5) Seeing other students' work through peer review

The majority of students agreed that individual comments on rough drafts was the most helpful form of feedback, with 78.6% of respondents indicating that individual comments from the grader on Canvas was "Very helpful" (Fig. 2).
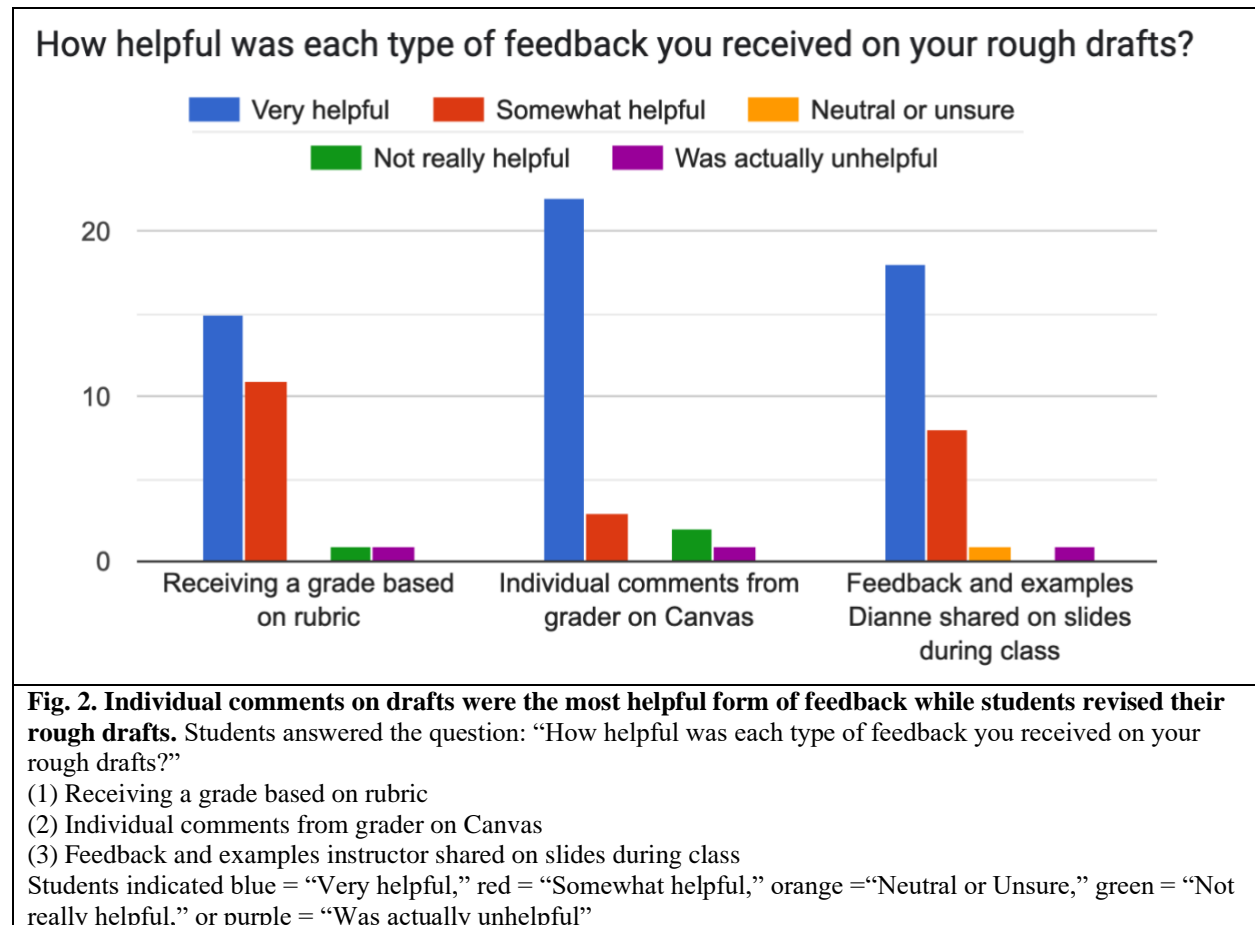
Broadcast feedback and examples provided in class by the instructor were the second most helpful form of feedback, with 64.2% of respondents indicating that broadcast feedback and examples were "Very helpful" (Fig. 2).

About half of the students indicated that receiving a grade based on the rubric was helpful, with 53.6% of respondents indicating that receiving a grade was "Very helpful" (Fig. 2).

Students reported mixed results for the helpfulness of peer review. Students reported that seeing other students' work through peer review was also helpful, with 64.2% of respondents

responding "Very helpful" (Fig. 3). Only 35.7% of respondents indicated that peer review comments from other students were helpful (Fig. 3).
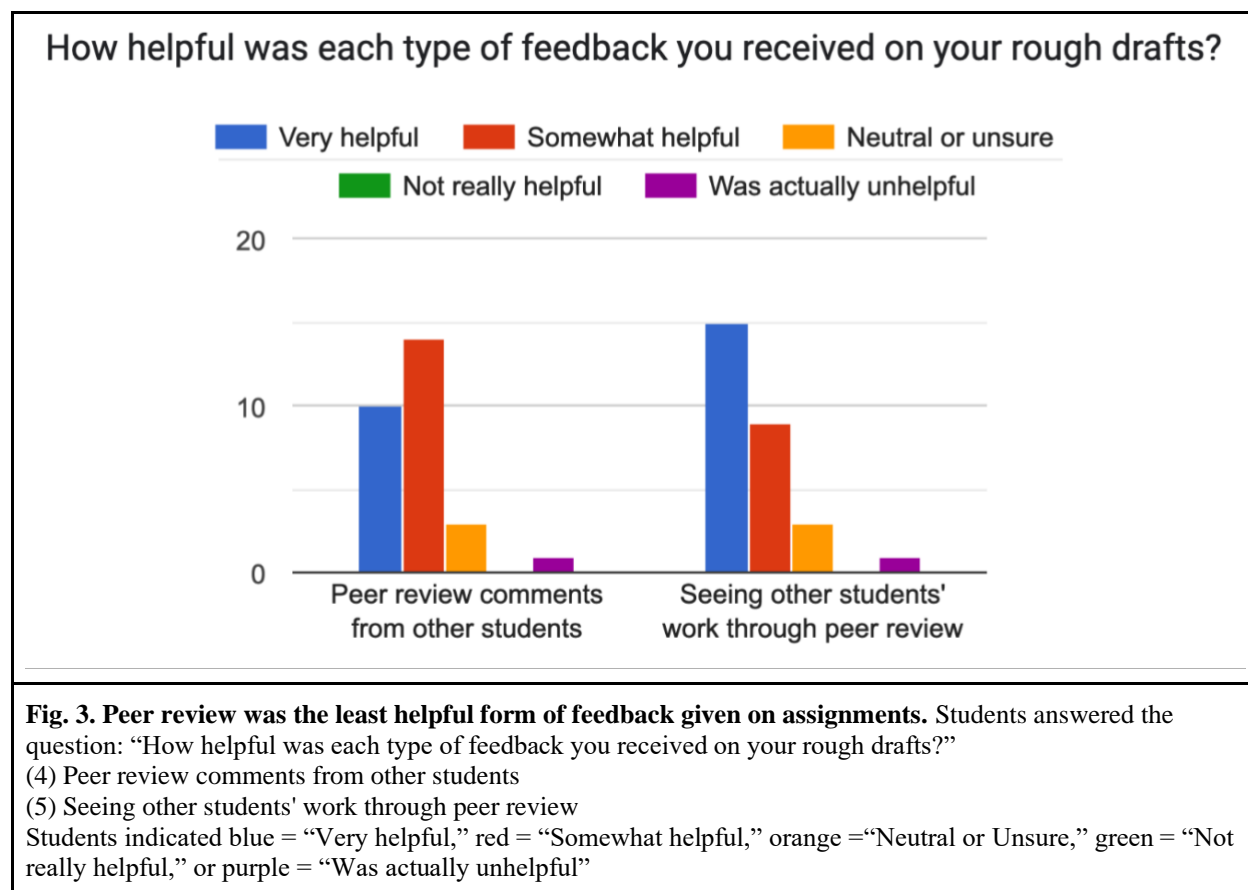

Fig. 2. Individual comments on drafts were the most helpful form of feedback while students revised their rough drafts. Students answered the question: "How helpful was each type of feedback you received on your rough drafts?"
(1) Receiving a grade based on rubric
(2) Individual comments from grader on Canvas
(3) Feedback and examples instructor shared on slides during class
Students indicated blue = "Very helpful," red = "Somewhat helpful," orange ="Neutral or Unsure," green = "Not really helpful," or purple = "Was actually unhelpful"

Our peer review process consists of the following four steps:
1) Students exchange drafts electronically 4 days before in-class peer review.
2) Submit written comments (annotate drafts and provide written answers to guiding peer review questions)
3) Students discuss each other's drafts in class
4) Students reflect on the peer review process, identifying revisions they plan to make due to comments they received and also anything they plan to change after being inspired by seeing a strength in another student's draft.

Based on instructor observations and student feedback, we can identify several reasons why the peer review process has variable results for students. The major problem we have identified is that students put different amounts of effort into reading and commenting on other students' drafts, which results in some students receiving very little or unhelpful feedback. Sometimes a student will not submit a draft, which affects not only that student (i.e., they do not receive feedback from peer review) but also the other students in the group who do not get the chance to provide feedback.

Second, the social element of peer review is challenging for students. Students report that they are uncomfortable providing constructive feedback because it seems negative. Students who have a draft of lower quality can be embarrassed for their peers to read their work.

Fig. 3. Peer review was the least helpful form of feedback given on assignments. Students answered the question: "How helpful was each type of feedback you received on your rough drafts?"
(4) Peer review comments from other students
(5) Seeing other students' work through peer review
Students indicated blue = "Very helpful," red = "Somewhat helpful," orange ="Neutral or Unsure," green = "Not really helpful," or purple = "Was actually unhelpful"

We have tried to mitigate these challenges in the peer review process, but we realize that we need to do more. First, in an effort to ensure that all students actually read other students' drafts, we ask students to exchange drafts 4 days before in-class peer review and submit written comments before class begins. We provide guiding questions for peer review in an effort to focus students' comments and to give reviewers the opportunity to make annotations on drafts. In future work, we plan to survey students about whether the guided peer review questions are helpful, and what we can do to make the peer review process more effective.

Conclusion
In this work-in-progress, we describe how we scaffolded revision of rough drafts with reflection, grading rubrics, and peer review. Overall, we received positive feedback from students on using grading rubrics for rough drafts.

We found that the majority of students (78.6%) indicated that receiving a grade on the rough draft helped them know how to revise their rough draft and helped them write the final deliverable (Fig. 1). The majority of students reported that receiving a grade on the rough draft caused anxiety (57.1% of students), but also provided a confidence boost (57.1% of students).

We were concerned that receiving low grades on the first draft (rather than full points for completion) would discourage students, but we found that overall the students were not discouraged because the first drafts were worth less (10 points) than the final deliverable (100 points). Students reported that losing a small number of points on the first draft motivated them to make changes because it drew their attention to areas of improvement.

We share our approach to scaffolding revision of written assignments with the intention of providing a translatable, easy-to-implement model for other engineering instructors, as our approach can be implemented in any course that includes major writing assignments.

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Appendix A: Description of Major Assignments

01 Annotated Bibliography   (5% total course grade)
Identify three scientific articles from primary literature (2 primary research articles and 1 review article). Write an annotated bibliography of these three sources that you could use while preparing a manuscript for publication in a scientific journal.

02 Elevator Pitch   (5% total course grade)
Give a 90-second elevator pitch (1) to a recruiter at a job fair about why you should be hired for a specific job, or (2) to incoming students at orientation about why they should explore your favorite area of research.

03 Job Documents   (10% total course grade)
Create a concise resume and cover letter to include in your job application materials.

04 Research Poster   (15% total course grade)
Create a poster about a current BME research topic with easy-to-understand text and visual elements, intended (1) to be shown at a poster session at orientation for new students who are interested in the BME major or (2) to describe your own research to current students at a student research symposium.

05 Lab Protocol   (10% total course grade)
Write a brief protocol intended for students in an introductory BME lab course. Write your protocol so that a student can follow it easily, reproduce the experiment, and get to the expected outcome.

06 Ethics Presentation   (20% total course grade)
In a team, give a PowerPoint presentation to the class about an ethical dilemma related to a biomolecular engineering topic. (Note: You may use the same topic for the Poster, Ethics Presentation, and/or Technical Report.) Identify what you think is the most ethical path going forward, with the goal of persuading your classmates that you have chosen the most ethical approach. You may repurpose any figures or content from your Poster.

07 Technical Report   (20% total course grade)
Write a comprehensive technical report intended to be given to the supervisor in a research group. Your supervisor will use your report to determine how to prioritize the lab's research efforts and allocate their hard-won grant funding. (Note: You may use the same topic for the Research Poster, Ethics Presentation, and/or Technical Report.)

09 Journal Reflections   (5% total course grade)
Please write brief reflections on what you are learning and your experiences in class activities.

10 Participation Points   (10% total course grade)
Throughout the course, you will complete short assignments to help you fully engage in course content. Participation is based on student interaction with course activities, not attendance.

Appendix B: Grading Rubric for Resume Rough Draft

Dimension		Points
Content		3
Excellent 22-25 pts	Includes all education and job experience from high school to present. Includes GPA for high school and [institution] (and any other colleges). Includes your expected degree and graduation date.	
Satisfactory 17-21 pts	Includes almost all content, but missing minor details.	
Needs Work 12-17 pts	Missing information (e.g., high school activities or GPA, current GPA, expected graduation date).	
Organization		3
Excellent 22-25 pts	Section headings help the reader navigate the document and highlight the most important info. Descriptive section headings. Items are placed in reverse chronological order: most recent info is placed first (above older info). Document flows and is easy to navigate.	
Satisfactory 17-21 pts	Some issues such as: Section headings are not descriptive, or Items not in reverse chronological order. Overall flow could be improved.	
Needs Work 12-17 pts	Major issues such as: No section headings, Items are not organized consistently, Lack of organization overall, Inconsistent format.	
Document Design		3
Excellent 22-25 pts	Adheres to PARC principles: Proximity: Related info is placed together. White space is used to separate sections or items. Alignment: Text and visual elements are aligned so the document is easy to read and navigate. Text and visual elements (e.g., bullet points) are aligned in a consistent manner throughout the document. Margins and indentation are consistent. Repetitive Elements: Visual elements such as bullet points are formatted consistently. Section headings have consistent font style and size. Text has consistent formatting in font and size. Contrast: Important info is emphasized with larger font, bold, italics. Any colors are presented in an aesthetically pleasing way that is not distracting.	
Satisfactory 17-21 pts	Some issues including: Section headings are not descriptive or Items not in reverse chronological order. Overall flow could be improved.	
Needs Work 12-17 pts	Major issues including: No section headings, Items are not organized consistently, Lack of organization overall, Inconsistent format.	
Style, Word Usage, Grammar, and Punctuation		1
Excellent 22-25 pts	Overall flow is easy to follow, and writing style is easy to understand. No errors in grammar, spelling, or punctuation.	
Satisfactory 17-21 pts	Overall flow is easy to follow, and writing style is easy to understand. Some awkward or incorrect word choices. Minor errors in grammar, spelling, or punctuation.	
Needs Work 12-17 pts	Flow and style are difficult to follow. Several awkward or incorrect word choices. Many errors in grammar, spelling, or punctuation.	

Appendix C: Student Survey Questions

We surveyed the students via a Google form as follows:

Students indicated "Yes / No / Don't Remember" to the following questions about the assignments throughout the course:
1) Rough drafts: Did you look at the 10-pt grading rubric <u>before submitting</u> your <u>rough drafts</u>?
2) Final deliverables: Did you look at the 100 pt grading rubric <u>before submitting</u> your <u>final deliverables</u>?

Students indicated "Always or Usually / Sometimes / Rarely or Never" to the question:
Did <u>receiving a grade</u> on the 10-point rough draft rubric:
1) Help you know how to revise your rough draft?
2) Help you write your final deliverable?
3) Affect how you peer-reviewed other students' work?
4) Make you more likely to use the 100-point grading rubric for the final deliverable?
5) Make you feel more confident?
6) Make you feel anxious?

Short Answer:
1) *How has <u>receiving a grade</u> on the 10-pt grading rubric on rough drafts helped you in this class?*
2) How has <u>receiving a grade</u> on the 10-pt grading rubric on rough drafts been unhelpful? Any suggestions for change?
3) Do you think you would have approached your assignments differently <u>if you did not receive a grade</u> for the rough drafts? (In other words, if you were given 10/10 pts just for submitting the rough draft)
4) Anything you recommend about the grading rubrics or other feedback students receive in this course?

Students indicated "Very helpful," "Somewhat helpful," "Neutral or Unsure," "Not really helpful," or "Was actually unhelpful" to the following question:
"How helpful was each type of feedback you received on your rough drafts?"
1) Receiving a grade based on rubric
2) Individual comments from grader on Canvas
3) Feedback and examples Dianne shared on slides during class
4) Peer review comments from other students