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Work in Progress: Understanding How ECE Senior Undergraduates Perceive Their Strengths and Weaknesses in Individual vs. Collaborative Writing

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This paper revisits research begun in a work-in-progress paper published by Barton *et al.* in the 2022 ASEE Annual Conference & Exposition proceedings [1] and presents additional findings relevant to that work.

Introduction and background

In [1], the authors asked junior- and senior-level engineering undergraduates representing all eight engineering departments within Mississippi State University's Bagley College of Engineering to self-assess their writing abilities via a questionnaire. In the questionnaire, administered during 2021, respondents described their writing abilities in terms of strengths, weaknesses, and workplace preparedness. Those responses were compared with results of a separate questionnaire administered to engineering faculty in which they were also asked to rate their junior- and senior-level students' writing abilities and workplace preparedness. The authors of [1] found that students rated their own writing abilities much more highly than engineering faculty rated student writing, with 77% of student respondents agreeing or strongly agreeing that they had the writing skills necessary to meet workplace expectations, compared to only 15% of faculty respondents who agreed or strongly agreed with that statement.

[1] did not analyze questionnaire responses by specific engineering program. In Part I of this paper, the author narrows the scope to electrical and computer engineering (ECE) senior undergraduate students' responses. Since the spring 2021 semester, 158 ECE seniors' responses to the questionnaire have been collected, or 41% of the total dataset. ECE students represent a particularly large percentage of the total respondents because ECE students are incentivized with extra credit in their GE 3513 Technical Writing course to complete the questionnaire.

At MSU, ECE seniors take Technical Writing in conjunction and alignment with the first course in their Capstone Design sequence. In that Technical Writing course, ECE students in fall 2023 participated in a separate survey in which students were asked to reflect on their writing strengths and weaknesses, both as individual writers and as collaborative writers working on team-based Capstone Design assignments. From a population of 69 ECE seniors, 62 responded, and emerging insights are provided in Part II of this paper. The questionnaire used, which contained four open-response questions, was not initially conceived to tie back to the research described in Part I of this paper; however, the data does provide useful context for Part I and the findings of the original work [1].

The goal of this paper is to offer better understanding of how ECE students self-described their strengths and weaknesses in solo and team-based writing so that deficits can be addressed more effectively.

Methods

In [1], the authors sought to understand better how engineering undergraduate students versus faculty perceived students' writing skills. The research involved two questionnaires—primarily Likert-scale-based or multiple-response-question formats—one distributed to engineering junior- and senior-level undergraduates and the other to engineering faculty who taught primarily junior/senior-level undergraduate students.

This paper uses data collected via that same survey, but over a longer period (spring 2021 to spring 2024), and the following analysis shifts the focus in two ways. In Part I, this paper summarizes solely ECE undergraduate seniors' responses to gain more insight into specifically how these ECE students perceived their writing abilities. Part II explores how ECE seniors in the fall 2023 Capstone Design course described their writing strengths and weaknesses—in their own words via an open-response questionnaire—to encourage teachers to adjust their instruction accordingly.

Part I: Likert-scale question results

In the survey, described in detail in [1], students were asked to rate their abilities in the following areas as VERY GOOD, GOOD, ACCEPTABLE, or POOR; or as STRONGLY AGREE, AGREE, DISAGREE, or STRONLY DISAGREE. Across all eight engineering departments, the 77% of student respondents who agreed or strongly agreed that their writing was workplace-ready identified grammar/mechanics as their weakest skill. Based on the following response summary of the 158 ECE seniors, they were similarly confident in their writing abilities:

1. Understanding the requirements of particular types of documents (e.g., lab reports, research papers, proposals, correspondence):
    - **Good or Very Good: 76% (120 respondents)**
2. Ability to convey complex ideas clearly and accurately:
    - **Good or Very Good: 73% (116 respondents)**
3. Ability to adjust content, organization, and style according to the purpose and audience:
    - **Good or Very Good: 73% (115 respondents)**
4. Command of the conventions of standard English grammar and mechanics, such as capitalization, punctuation, and spelling:
    - **Good or Very Good: 67% (106 respondents)**
5. I am confident that my current writing skills are adequate for workplace expectations:
    - **Agree or Strongly Agree: 80% (127 respondents)**
6. I am confident that my current writing skills are adequate for academic expectations:
    - **Agree or Strongly Agree: 76% (120 respondents)**

When given the multiple-response question, "Which of the following writing issues gives you the most trouble? Check all that apply." Fig. 1 shows that the ECE respondents perceived grammatical/mechanical errors and carelessness as their two most troublesome writing problems, compared to the findings in [1] that showed the overall respondents selected grammar/mechanics and organization.

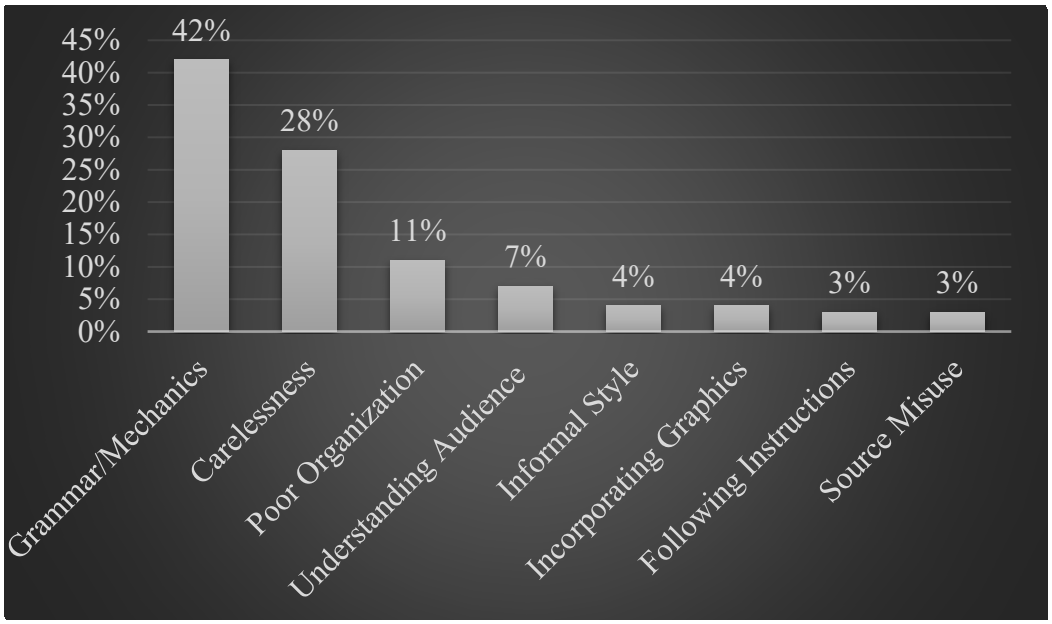

Fig 1. ECE student survey respondents self-identifying problem areas in their writing.

The abovementioned survey findings are broadly helpful, but more a detailed understanding can help teachers recognize and fill any instructional gaps that may become more apparent from a student viewpoint.

Part II: Open-response-question results

In the fall of 2023, an open-response questionnaire was administered to ECE seniors in a Technical Writing course required in conjunction with their first of two Capstone Design courses, with the intended goal being to help students reflect more deliberately on their writing growth. Much of the learning process happens in the reflection stage; a writer will not grow until they first learn to identify their strengths and weaknesses so that they may capitalize on the former and counteract the latter. The questionnaire was prepared via and posted in the class learning management system Canvas. The questionnaire contained four prompts:

- ***What are your strengths as an individual writer? Be specific.***
- ***What are your weaknesses as an individual writer? Be specific.***
- ***What are some strategies you could use to strengthen your individual writing next semester and beyond? Be specific.***
- ***What are some strategies your design team could use to strengthen your collaborative writing next semester? Be specific.***

A total of 62 ECE seniors responded. A full quantitative analysis is outside of this work-in-progress paper's scope, but herein the author lists emerging themes—some of them unexpected—in the students' words.

Emerging themes

1. Some respondents stated that their strongest communication skills are not in the actual writing, but in their adeptness with research methodology and/or data visualization. These respondents believed that their methodology, data analysis, and graphic design—helping to avoiding wordiness and overcomplication—should be weighted more heavily in the rubrics for Technical Writing assignments than the actual writing.

2. Numerous student respondents mentioned that they connect with what they described as the "story-telling" aspect of papers and presentations, e.g.:
   - "My strength comes in creativity. I have always enjoyed creative writing, so I guess I am more of a storyteller than a writer. I write lots of Dungeons and Dragons campaigns, short stories, and poetry for myself, but those are for my enjoyment. Therefore, I focus more on the feeling and the story than the grammar/mechanics."
   - "I have always known I was a creative writer. Words just come to me."

3. Several respondents recognized the long-established link that good readers make good writers, some specifically noting the power of reading to build their vocabularies. While some respondents admitted and lamented that a limited vocabulary makes their writing sound repetitive and affects flow, others thought that their strong vocabularies were a boon to their writing. Some recognized a need to utilize a thesaurus while writing. Others noted that they would like to find more time to read, hoping it would improve their writing, with some expressly noting they should do so for the purpose of broadening their lexicon, e.g.:
   - "I like to read a lot, so I think that has contributed a good deal to my writing, knowing what I like to see in good writing and trying to emulate that. It has also helped me to expand my vocabulary."
   - "I would […] say that I have a relatively above average grasp on vocabulary. Though, in [GE 3513] Technical Writing, it can be tough to explore the totality of my vocabulary as I am trying to make the documents that are being produced in that class as accessible and understandable as possible."
   - "I would like to try and read more to not only expand my vocabulary, but to also improve my writing skills in general."
   - "One of my weaknesses as a writer would be my lack of creativity and limited vocabulary. These things are mainly due to the lack of English classes that I had to take with my major, so I just fell out of practice when it came to writing. I also used to read a lot more when I was younger compared to the amount I due [*sic*] now. I still enjoy reading, but college consumes a lot of my time that would have previously been used reading. [….] Another thing I could work on is reading more to further develop my vocabulary."
   - "To help expand my variety in word usage and sentence structure, the most effective strategy is to read good writing. Reading books or articles by quality writers is the best way to improve writing without much thought. The words and styles they use automatically become incorporated in my writing."

4. A struggle that multiple respondents reported was recognizing hallmarks of formal versus informal tone, such as removing contractions, first and second person, and colloquialisms from formal writing, e.g.:
    - "We [the student's design team] have trouble writing in a formal tone…."
    - "I always forget that you are not supposed to use contractions [in formal writing]."

5. Respondents in general indicated that their whole Capstone Design team would have benefited from more grammar instruction. Respondents requested more review of both high-level concerns (specifically sentence construction and verb errors) but also minor errors such as modifier mistakes (i.e., dangling, misplaced, and squinting modifiers) and lack of parallelism. One respondent described grammar as a use-it-or-lose-it skill, saying that the skill was undertaught in their engineering curriculum and that students had in essence "lost" it, in the respondent's opinion, e.g.:
    - "My group and I had never heard of …[the] grammar issues introduced in this class."
    - I think that my weaknesses as a writer come from [not] having correct grammar."
    - "This class has given me the chance to revitalize my writing skills that have not been used in years."

6. Multiple respondents stated that they often did not spend enough time on their Technical Writing or Capstone Design assignments because they simply had too many assignments across all of their courses to balance at a given time. They said this quantity-over-quality problem affected assignments in all classes. As a result, they rushed through the drafting and revision process. Multiple respondents said that their work would improve if they were able to get more sleep. One student wrote, "I firmly believe that I am a very capable writer, but when I rush through assignments, my work is not indicative of my skills." Other respondents voiced similar sentiments—that they struggle to show their best work when they are overworked across their curricula, e.g.:
    - "I am busy and swiveling from all my different classes' assignments can be quite taxing for me from a mental perspective."
    - "I just don't spend enough time proofreading. In line with this, I also tend to rush through the writing process to move on to the next assignment."

7. Some respondents admitted that they struggled with creating a good writing process for themselves—one termed this as "white-page phobia," e.g.:
    - "I struggle to start with an empty page. [….] In short, I am not great at the planning stage of writing when it [the topic] doesn't just automatically click for me."
    - "I need a good writing routine."
    - "I will sometimes fall down research holes while writing, which can delay or derail the writing process."

8. Students also said page requirements had negative impacts on their writing:
    - "I end up having difficulty expressing my thoughts over a long format, and it makes me struggle to meet requirements for length of assignments."
    - "I think 'wordy' writing is [a] habit formed by many of us having word minimums for essays in our previous writing classes, but I've always had an eye for this."

- "I am not sure if it is because I grew up writing papers with word counts, but I tend to write wordier sentences instead of being concise." (The student termed this "word vomit" in their reflection.)

9. Surprisingly, some respondents noted that they do not see value or benefit from revising a paper in multiple draft iterations, even when the course instructor and/or an ECE student peer reviewer provided comments on those drafts. While one respondent wrote, "Perhaps the most important part about writing is being able to go back and rewrite," others admitted that they did not necessarily find value in editing their first drafts. One respondent said, "I think my tendency to produce good writing on a first pass often dissuades me from making later revisions. I typically don't see a reason for such a review since I've become accustomed to finding that my first drafts often outshine the average final draft." The respondent added, "However, I see how this could be more of a hinderance in fully applying my writing abilities than a benefit of them."

10. A common complaint, respondents repeatedly stated that they had difficulty or were uncomfortable with critiquing their teammates' writing on collaborative assignments, e.g.:
    - "It's easy to feel that I'm stepping on [teammates'] toes when I am proof reading other people's work and edit[ing], so I offer my suggestions as comments in our shared documents. This makes my criticism sound less critical and seems to be better received. I also offer to let people know when I have time to help out. That way we have those opportunities to work on things together, as opposed to feeling like we are all on our own for the individual parts. In the beginning, we had a tendency to lose points on many small things. Collectively, we were expecting that we would each take care of "our part," rather than treating the whole assignment as our responsibility. When our first assignment didn't go well, we changed that moving forward and every assignment improved as a result. As long as we keep that up, I feel confident that we'll continue to submit high quality assignments."
    - "Because I struggle to write my own thoughts sometimes, it can be even harder when it isn't my own thoughts."
    - "[A] difficulty I discovered this semester was the challenge of revising other people's writing."
    - One noted that "each person [on their writing team] has a different style of proofreading."

11. Respondents acknowledged that one of the challenges of collaborative writing was ensuring cohesion and flow among sections, in terms of transitioning smoothly between sections and finding one authorial voice. They noted that, while one voice produced a more pleasant document for the reader, it was difficult to blend multiple writing styles and writing processes. Some mentioned the importance of finding good collaborative-writing platforms or tools, e.g.:
    - "Collaborative writing was not natural and was actually difficult at first, but once we learned how each other works, the flow came naturally to our papers."
    - "I feel that our team tried to [*sic*] hard to copy one another's style while writing and, in the process, dimmed the quality of our papers. What I think we need to is [*sic*]

stick to our own individual writing styles and quit trying to sound like someone else while writing. While this would make our writing less uniform, I think the overall quality of the assignments would be better."

- "Writing as a team is hard."

Reflection

This paper's author was fearful that asking the ECE students to reflect about their writing journey might have been perceived as "busy work," especially given how harried they undeniably are during their Capstone Design semesters. However, the opposite happened: students were forthcoming and detailed in their responses, sometimes writing multiple paragraphs per question as if they had been waiting to be asked. The author is inclined to do these types of reflective assignments more often.

Although data collection and coding are continuing, these emerging themes highlight some exciting initial opportunities. Firstly, with numerous students self-identifying as creative writers, several creative writing techniques could translate well into a technical writing or engineering classroom, as explained in [2]–[6], if students were explicitly taught these strategies. Secondly, a good writing process often is habit-based and involves quantifiable measures or daily targets; encouraging students to find a writing process that suits them—e.g., something as basic as setting a daily word quota—could be a strategy to which engineering students might respond well and could benefit them in many courses and their professional lives. Based on these questionnaire results, this author has begun habitually asking engineering students in the Technical Writing course to share their writing processes or tricks to being productive writers. Many of these students, as college seniors, have no writing strategies—they either struggle to tackle a blank page or they wait until the deadline nears, when the writing is motivated by pure panic. For students struggling to develop a writing process that works well for them, a class discussion in which other students share tips can be revelatory. Teachers can also share strategies by established authors, such as those described by the authors interviewed at famouswritingroutines.com. (An idea would be to assign students to listen to one interview apiece and report back to the class.) Instructors may also share strategies they personally incorporate into their own writing processes. (One of this author's best strategies is using voice-to-text programs to help students overcome "white-page phobia"; by using voice-to-text, a student can brainstorm aloud and quickly populate a page with rough copy. This author also sometimes assigns students to be "accountability partners" in terms of writing, requiring them to send a paragraph of rough copy per day for a set number of days to their writing partner via private class channels, which the instructor could spot-check for a grade.) Thirdly, the allocation of more time for reading, such as by assigning reading-based homework or establishing a flipped/partially-flipped classroom, could help students build their vocabularies and refresh their grammar and mechanics. While the ECE student respondents recognized that their technical curricula are very full, they seem open to returning to some old-fashioned reading assignments. Instead of perceiving reading as "busy work," as this paper's author would have assumed, several respondents said they would welcome more reading in their day as long as the homework load were adjusted accordingly.

Some of the themes that emerged—such as students entering their senior year of college without any concept of a workable writing process or students not seeing benefit in the iterative drafting process—were surprising. However, this author, as a writing instructor, was heartened to hear of students' struggles with writing collaboratively and with giving fair criticism on their classmates' and teammates' drafts. They are correct: collaborative writing *is* hard, and it is supposed to be hard. Collaborative writing is a different skillset than solo writing, requiring compromise and diplomacy, yet it is also a worthwhile exercise. Likewise, giving thoughtful criticism on work by one's colleagues or co-authors—in a way that highlights assets and deficits—is a task that requires finesse in any academic or workplace setting. The fact that students are struggling in both areas is an encouraging sign that they are engaging in the processes authentically. If students did not struggle, this author would suspect that it is because they are not truly invested. However, reading these student reflections has led this author to begin researching peer-review techniques that could help lessen these pain points.

Summary and future work

The themes explored in Part II helped the author identify some interesting instructional opportunities in her classroom that were not evident from looking solely at the quantitative survey data described in Part I. In this paper, the author chose to shift the research focus explored in [1] away from comparing faculty and student perceptions of student writing and more toward gaining a deeper understanding of how students perceived their work and growth. Further quantitative and qualitative analysis of the data is planned, and similar surveys could be administered in all eight departments, with a comparison of the findings among departments. Additionally, the data herein is drawn from only one cohort of ECE seniors. It would be helpful to study multiple cohorts. Finally, study of the effects of specific interventions to ascertain whether they significantly improve student writing would be valuable.

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