



Dispelling Student Myths about Writing in Civil Engineering

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This paper describes a specific classroom application from the Civil Engineering Writing Project. The project, funded by the National Science Foundation's Transforming Undergraduate Education in STEM program, aims to integrate the teaching of writing skills into undergraduate civil engineering courses. For decades employers have encouraged engineering programs to pay more attention to the development of workplace writing skills.^{1,2} Previously, however, no large-scale studies had sought to analyze the writing of engineering practitioners or identify practitioners' specific concerns about student writing. No teaching materials addressed writing skills from the perspective of civil engineering workplace practice.

Believing that teaching innovations are most likely to be effective if they are based on sound empirical evidence, we first investigated how student writing differs from successful practitioners' writing. We analyzed over 400 documents from 70 firms and agencies and 400 papers from students at five universities, covering a range of sub-fields and document types. The project uses mixed-method techniques³ that combine quantitative linguistic analysis of the writing and qualitative analysis of interviews with practitioners and students. We then develop teaching materials that target specific weaknesses. The project team includes applied linguists (who study writing in different communication contexts), engineering faculty, and engineer practitioners in the local community, so multiple perspectives are brought to the identification of student needs and the new teaching materials.

Comprehensive descriptions of the project and teaching materials can be found elsewhere.^{4,5,6} This paper focuses on a single thirty-minute workshop. Unlike most of the teaching materials, which focus on specific writing skills, this workshop targets student beliefs – specifically, erroneous beliefs that underlie writing weaknesses. The workshop is entitled *Three Myths about Writing in Civil Engineering Practice*.

Overview of Workshop Development and Use

During interviews for the project research, many students expressed the same three mistaken beliefs about writing in civil engineering. These beliefs corresponded to some of the most ineffective characteristics of the student writing and were in direct conflict with the practices of the engineering practitioners. The beliefs were common even among graduating seniors who had taken technical writing courses and written numerous papers in their engineering courses. The three myths are the following:

1. *You can make your writing more professional by using long sentences and fancy words.*
2. *Writing is a matter of “impersonal style,” completely separate from engineering.*
3. *Rules of English grammar and punctuation don't matter for civil engineering practice.*

With these ideas widespread and persistent, we decided to take a direct approach to countering them. We developed a workshop that does not take a great deal of class time but alerts students to the erroneous beliefs, illustrates their harmful effects on writing, and introduces beliefs and practices more consistent with engineering practitioners' writing. The workshop demonstrates to students that effective writing and effective engineering practice are interconnected. More specifically, the workshop incorporates the following:

- quotations from students that reflect the myths and samples from student papers that exemplify how the myths lead to ineffective writing
- quotations from practitioners that reflect the opposite beliefs and samples of practitioner writing that illustrate effective writing
- results of quantitative analyses that show the differences between student and practitioner writing
- short practice activities in which students revise ineffective passages from papers written by previous students.

In the best circumstances, the workshop serves as the kickoff for the more in-depth writing materials that will be used during a term. However, even if an instructor decides not to use any other writing materials, the students at least gain a greater awareness of these misconceptions.

The workshop has been used for multiple years at Portland State University, where the Civil Engineering Writing Project is based. It has been used most commonly in a required junior-level seminar about the civil and environmental engineering professions and in a first-year elective course that provides a general introduction to the field. Because these courses feature guest speakers, the instructors typically ask the principal investigator of the project (a linguist) to conduct the workshop. However, instructors can easily present it on their own.

Content of the Workshop

Myth 1: You can make your writing more professional by using long sentences and fancy words.

In the workshop, coverage of this myth begins with quotations from student interviews. When students were asked to explain why they used long, complicated sentences that were often difficult for readers to understand, typical comments were the following:

“It looks better if it’s longer.”

“Make it fancy.”

“I kind of felt like I had to sound professional and smart. I mean, you want to sound really knowledgeable about things, and it seems like the easiest way to do that is to be wordy.”

We then display a quantitative analysis of the proportion of complex sentences in student and practitioner writing (Figure 1). Complex sentences are much more common in student writing; students used complex sentences almost 60% of the time, while practitioners used them less than 25% of the time. In other words, most practitioner writing is composed of simple sentences – the opposite of what most students envision for “sounding professional.”

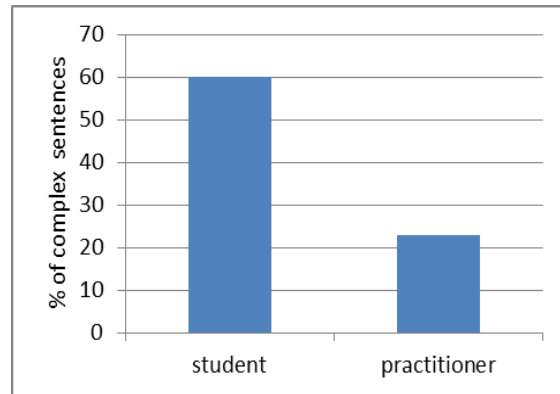


Figure 1. Percentage of complex sentences in student and practitioner reports and technical memoranda

We then display examples of student and practitioner writing to illustrate typical sentences by the two groups:

Student Writing: Complicated Sentence Structure

- A. This particular modeling detail does not seem to greatly affect the output of the simulation because although it appears unrealistic, it does not affect the flow of traffic greatly and only seems to occur on occasion. *[Traffic analysis paper]*
- B. The Portland Streetcar route through and platform in the recently completed Portland State University Urban Plaza has been an unmitigated success. *[Capstone design report]*
- C. As shown in the graph below, where all three diagrams have been put in one graph together, it could be recognized that the subject of the first and second test are most likely to be ductile... *[Materials course lab report]*

Practitioner Writing: Simple Sentence Structure

- D. The project's primary purpose is to improve safety by realigning the highway with a flatter curve at Sampson's Curve (MP 12.5). At this curve between 2001 and 2005, there were 20 crashes, including one fatality and 13 injuries. *[Bridge replacement report]*
- E. The rainfall depth was obtained from the City of Franklin, County of Tumwah. For the 25-year storm event, 24-hr rainfall depth is 4.0 inches for the site. *[Stormwater report]*

From these examples, students see that a desire to be fancy or sound smart typically only causes confusion for readers. Practitioner sentences, on the other hand, are easy to understand because they convey one main idea per sentence. In example E, for instance, the writers could easily have combined the information into a single sentence. Instead, they use one sentence to tell the source of the data and one to state the data. To explain why practitioners often prefer these simpler sentences, we share quotes from interviews of practitioners:

"Clients want to be able to read fast or skim."

"Simpler sentences are more concise. And they are less likely to be ambiguous or be misinterpreted."

The workshop then moves on to a revision activity. Students work individually or in pairs to revise two of the student writing examples. They then compare their revisions to suggested answers:

Original	Possible Revision
As shown in the graph below, where all three diagrams have been put in one graph together, it could be recognized that the subject of the first and second test are most likely to be ductile.	As shown in Figure 1, samples 1 and 2 exhibited ductile behavior. or Samples 1 and 2 exhibited ductile behavior (Figure 1).
The Portland Streetcar route through and platform in the recently completed Portland State University Urban Plaza has been an unmitigated success.	Within one month of opening, the streetcar stop in Portland State University's Urban Plaza was serving (number) passengers each day.

The group discusses specific techniques used in the revisions: expressing one main idea per sentence, referring to figures and samples only by number, using specific words like *exhibited*, and being precise about information rather than using an ambiguous term like *unmitigated success*. The revisions illustrate that revising is not just a matter of changing a word or two, but instead often involves restructuring whole sentences and rethinking content.

This section ends by suggesting that students replace the “long and fancy” myth with more accurate information about writing in civil engineering practice: Effective writing conveys information in concise sentences with precise words. Usually each sentence conveys one main idea.

Myth 2: Writing is a matter of “impersonal style,” completely separate from engineering.

This section of the workshop begins with quotes from graduating seniors who were asked what they had learned about writing in civil engineering. The most common answers were:

“No *I*, no *we*, no *you*.”

“Make it impersonal.”

“You need to use objective language.”

These beliefs are contrasted with extracts from practitioner writing. The examples often shock students because the engineering practitioners refer to themselves:

Practitioner Writing

- A. During the site visit, we observed that a ± 110 -foot long section of road was cracked and had sagged ± 6 to 12 inches... *[Site visit memo]*
- B. The study team conducted a review of existing bridge inspection records provided by the railroads and passed to the study team by the [State] Department of Transportation. *[Bridge assessment report]*
- C. Shaft stabilization will be required. We recommend at least 20 feet of temporary surface casing. *[Foundation report]*

- D. On August 15 and 19, 2013, we drilled five exploratory borings with a portable drill rig using solid stem auger techniques. An additional boring was drilled September 18, 2013, northwest of the [*Geotechnical tech memo*]

The point is not that civil engineering writing “should” refer to people any more than it “should not” use *I*, *we* or *you*. Instead, choices in writing need to come from the communication needs of the context. In lab reports that students write for courses, the agent for the actions is usually understood (the students), and passive voice with no mention of humans may be most effective. In documents for clients, however, responsibility must be clear. For example, practitioners are explicit about what they observed versus what a client told them. They are overt about which actions they are accountable for. At the same time, they do not refer to people needlessly. In example D, after responsibility is established with *we drilled*, the passage continues in passive voice because the borings themselves become the focus (*An additional boring was drilled....*).

The practitioner samples are also used to show that sentences with human agents are not automatically subjective. *We observed* and *we drilled* are as objective as passive statements (*was observed*, *were drilled*). Stating *We recommend* in active voice emphasizes that the engineers are using their professional judgment, but using passive (*At least 20 feet of temporary casing is recommended*) would not make the content any less of a judgment.

To make student writing problems concrete in this section, we illustrate where students have gone wrong trying to be impersonal. We also include an example where they have referred to themselves inappropriately (example C):

Student Writing

- A. References found relating to the compaction of soils where the nature of the clay mineral changed after drying compared to using soils without initial drying was not clearly found. [*Geotech course tech memo*]
- B. The experiment generally reinforced established properties of concrete. [*Materials course lab report*]
- C. In analyzing the alternative systems, we felt that the rain barrel system met our three requirements. [*Capstone design report*]

We ask students to describe the problems they see in these sentences, emphasizing the meaning that is expressed. In A, the passives combined with complicated sentence structure cause the writer to contradict himself (the references found were not clearly found!). Example B is nonsensical. The writer probably meant that doing the experiment reinforced what he had learned from the book or lecture, but an experiment cannot reinforce properties of concrete. The meaning of C is problematic because the writers’ feeling had nothing to do with the analysis. Avoiding *we* and using passive voice (*it was felt that the rain barrel system...*) does not make the sentence appropriate; *felt* is simply the wrong meaning here. In addition, use of *our* in *our three requirements* is too personal if the requirements are based on design criteria, as they should be.

Again students work individually or in pairs to revise two of the problematic sentences. Then the class discusses sample answers:

Original	Possible Revision
The experiment generally reinforced established properties of concrete.	The results of the experiment were consistent with properties of concrete (Mamlouk and Zaniewski, 2006). or The experiment reinforced the information covered in class about the properties of concrete.
In analyzing the alternative systems, we felt the rain barrel system met our three requirements in addition to being the most cost effective.	We analyzed each alternative using the design criteria. The rain barrel system met the three requirements and was the most cost effective.

We highlight specific techniques in the revisions, such as referring to a source (*Mamlouk and Zaniewski, 2006*), using accurate and precise language (*information covered in class* rather than *established*), and eliminating the verb *felt* and instead stating the action (*we analyzed*). The revisions also make simpler sentence structures (e.g. using two sentences instead of one and writing *and was* instead of *in addition to being*).

We conclude this section by suggesting students eliminate the myth that engineering writing is just a matter of using an impersonal style. Effective writing comes from expressing accurate and precise information in a way that is easy for readers to understand, not from trying to conform to a stylistic rule like “no *I*, no *we*, no *you*.”

Myth 3: Rules of English grammar and punctuation don't matter for civil engineering practice.

For the third myth, we start with results of a quantitative analysis of grammar and punctuation errors in student and practitioner writing (Figure 2). A typical double-space typed page has about 250 words on it, so the figure shows that junior-level lab reports average almost 7 errors per page. The senior-level reports have almost 4 errors per page even though they were written by teams and multiple students could proofread them. The practitioner papers have about 1 error in 250 words, most often with commas.

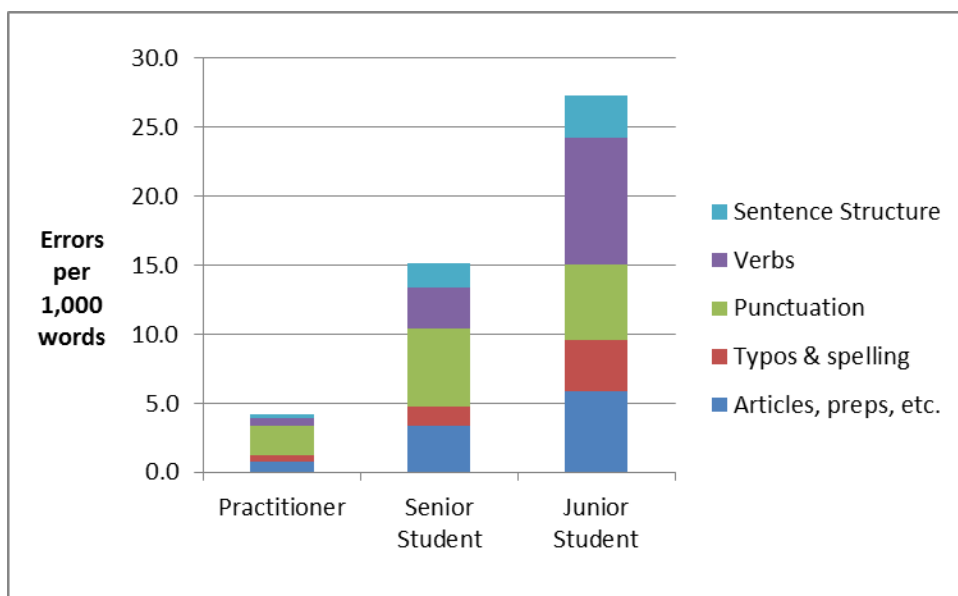


Figure 2. Frequency of errors in practitioner reports, senior-level student reports, and junior-level lab reports. (Complete coding scheme available at http://www.cewriting.ling.pdx.edu/research/error_analysis.html)

In interviews, the civil engineering practitioners reported that they do not work with technical writers on reports. They follow standard written English on their own (even though they regularly claim they “do not know grammar”). We share with students the reasons practitioners gave for being as careful as possible to avoid grammar, punctuation and typographical errors:

“Errors convey carelessness. Who wants a careless engineer?”

“They make the firm look unprofessional.”

“They run the danger of changing meaning. And even if they don’t, they can make reading slower.”

We also share what one practitioner added about job applicants, to emphasize the serious consequences of errors:

“I quickly eliminate applicants if their resumes and cover letters have mistakes.”

The message for students is that they lose credibility if their writing has many errors. They risk being perceived as unprofessional or careless.

Effective editing and proofreading requires being able to identify errors and correct them, so the practice activity for this section has students practice that. We ask them to do this activity individually so they can assess their own knowledge. If time allows, they can then discuss in pairs before we show the answers. We vary the items used in the workshop but always cover the most common types of errors. These include incorrect verb forms in lab report methods sections, incorrect sentence punctuation, misuse of commas and semi-colons, omission of articles, and sentence structure problems such as dangling modifiers, as in these examples:

Original (Revise only grammar and punctuation errors for this practice)	Correction
1. The width and the thickness of the specimen were measured using a Vernier caliper. Secure the specimen in the MTS load frame. A laser extensometer is then placed into position to measure the deformation of the specimen.	The width and the thickness of the specimen were measured using a Vernier caliper. The specimen was secured in the MTS load frame. A laser extensometer was then placed into position to measure the deformation of the specimen.
2. The ultimate compressive strength and modulus of elasticity did not vary greatly between the samples, however variability occurred between the tested samples and published values.	... between the samples. However , variability... or ...between the samples; however, variability...
3. As stated in ASCE's Code of Ethics; "Engineers shall hold paramount the safety, health and welfare of the public...."	As stated in ASCE's Code of Ethics, "Engineers..."
4. Slope of stress-strain curve in Figure 1 shows [...]	The slope of the stress-strain curve in Figure 1 shows...
5. As a civil engineer, the strength of concrete is highly affected by the curing time.	As a civil engineer, I know the strength of concrete is highly affected by the curing time. or Civil engineers know the strength... or The strength of concrete is affected by the curing time ([add reference]).

A short workshop is not the place for a full review of English grammar and punctuation. Rather, our point is for students to see if they can recognize and correct these errors. If not, we recommend they get help now, emphasizing that the effort now will pay off throughout their careers as civil engineers. We provide them with a list of resources⁷ and proofreading tips⁸. We close this section of the workshop by re-emphasizing that the myth of engineers not caring about English grammar is wrong. In fact, practicing engineers seek to display careful work and attention to detail in writing just they do in calculations.

Workshop Closing

Depending on time, we sometimes conclude the workshop with a revision activity that uses a longer passage from a student paper. One assignment in the junior-level seminar is to write an essay on an aspect of the civil engineering profession, so we often use an essay example in that course. The activity shows that, although the task is more academic than typical practitioner writing, the same principles for effective writing apply. Students see the original without highlighting, work on a revision, and then compare their revisions to the following:

Original	Possible Revision
<p>It is the ethical responsibility of practicing civil and environmental engineers to incorporate sustainable approaches into his or her profession whenever practicable. The ever-increasing awareness of sustainability and environmental issues by the general public lends itself to stakeholders who are often willing to sacrifice financially in order to incorporate sustainable approaches into a project, even if traditional development approaches are monetarily cheaper. ...</p>	<p>Civil and environmental engineers have an ethical responsibility to incorporate sustainable approaches into their practices. The public’s increasing awareness of sustainability and environmental issues means stakeholders are often willing to choose a more sustainable approach even if it is more expensive. ...</p>

An alternative closing is to remind students of a fourth myth: that effective writing is produced by people who were born as good writers. The truth is that, although no one becomes a civil engineer because of strong writing skills, many civil engineers do become effective writers. We emphasize that writing is a process. All engineers write multiple drafts, get reviews from their colleagues, and work on their writing. One principal of a firm shared, “...my draft goes through my own three or four revisions before I’m satisfied enough to get somebody else’s opinion on it.” Then he does more revising. Like this engineer, students can improve their writing by putting effort into revising.

The workshop closes by reviewing resources on campus and materials in the Civil Engineering Writing Project that students can use to improve their writing skills.

Conclusion

The workshop can be adapted in many ways. When conducted in thirty minutes, the workshop requires a fast pace, and a longer session can incorporate more revision practice. Courses that provide early introductions to the profession can include more information about how much time civil engineers spend writing. If instructors want to emphasize the writing process, the fourth myth – that good writers are born as good writers – can be expanded during the workshop rather than only mentioned in the conclusion.

No matter how long it is, a single workshop is unlikely to result in greatly improved writing. However, comments after the workshop suggest it does meet its goal of raising awareness and countering the common misconceptions of previous students. Typical student reflections include:

The information that made the biggest impression on me was that more and flowery does not help, but in fact hinders.

I realized how simple yet effective CE writing is.

The thing that impressed me most today was how poor my grammar [sic] and editing skills are.

I think the biggest challenge for me in writing for CE will be to ignore the temptation to sound fancy and smart.

The information that made the biggest impression on me was how P.E.'s make use of I, you, we in their writings.

I realized I make the same mistakes that other people do.

I think the biggest challenge will be staying consistent in revising and reviewing all written work. Time constraints, laziness, and pride are the three components of failure in my technical writing skills.

The information that made the biggest impression on me was that engineering writing is different from literature writing and can cost me a job.

Given comments like these, the workshop seems well worth thirty minutes of class time. More information is available on the project website (<http://www.cewriting.ling.pdx.edu/>), and the workshop powerpoint slides can be obtained by writing the project principal investigator, as listed on the website contact page.

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