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Where Grammar, Content, and Professional Practice Meet: The Case of the Passive Voice

Dr. Susan Conrad, Portland State University

Susan Conrad, Professor of Applied Linguistics, is the head of the Civil Engineering Writing Project, in which engineering faculty, engineering practitioners, and writing specialists collaborate to improve writing instruction in civil engineering courses. She has written numerous articles and books about English grammar, discourse, and corpus linguistics.

Kenneth Lamb, California State Polytechnic University, Pomona

Kenneth is an Associate Professor at Cal Poly Pomona. Kenneth is a licensed Professional Engineer in Nevada with experience working on a variety of water, storm water, and waster water systems projects. He holds degrees from the University of Nevada Las Vegas (BSCE and PhD) and from Norwich University (MCE).

Mr. Timothy James Pfeiffer P.E., Foundation Engineering, Inc.

Mr. Pfeiffer is a senior engineer and manager at Foundation Engineering in Portland, Oregon.

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1. Introduction

This paper addresses one aspect of a widely discussed need in engineering education: improving students' preparation for writing in the workplace. This need has been acknowledged for decades [1], [2], and numerous articles discuss ways of addressing writing, such as improved assignment types and assessment rubrics [3]-[5]. However, most engineering faculty continue to believe that grammar skills are the responsibility of English departments or writing centers. As a previous ASEE paper put it, issues related to sentence structure, grammar, and syntax are part of the "rule-based" component of writing that others can address: "Students usually have access to good tutoring services and they should be encouraged to use them" [5].

In this paper, we argue that civil engineering programs do a disservice to students if they view grammar only as rules that others should teach. Using the example of the passive voice, we present evidence from a five-year project about integrating writing instruction into civil engineering courses and show that (1) for experienced engineers in industry, even grammar choices are integrated with the content and practice of civil engineering, requiring judgments for the context of professional practice; (2) relatively short teaching materials can be integrated into existing civil engineering courses to help students start building their judgment about effective grammar choices for typical civil engineering workplace contexts; and (3) these materials have resulted in statistically significant improvement in students' writing.

The choice between passive and active voice makes a useful case study for several reasons. First, most faculty are familiar with student writing where, as in these examples, the use of passive voice for main verbs (underlined) contributes to ambiguous content:

1. Along with the hydrologic analysis included herein, a geotechnical investigation for the project site was also performed.
2. 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.

In 1, it is impossible to tell who did which job, and in 2, the sentence is so tangled the writer actually says that the references found were not found. Such sentences are usually obvious and anecdotal evidence of them abounds [6], but there has been little systematic analysis of student problems using passives. At the same time, advice about how to use passives is a morass of contradictions. Some publications describe the passive voice as boring, deceptive and best avoided [7]; others describe passives as important for the scientific method [8] and for keeping writers from sounding "obnoxiously egocentric"[9]. Publications rarely explain factors to consider in choosing between active and passive voice. For example, many engineering students are taught a rule that engineering reports use passive voice to describe methods, without any reference to the context of the report (e.g., a lab report for school versus a design report for a client) [10]. On the other hand, an industry magazine advises engineers to use active voice [11]. Technical writers sometimes refer to a study that found administrators prefer active voice and

subjects that are human agents (the "doers" of the action, e.g., "we evaluated the design") while engineers prefer agentless passives (e.g., "the design was evaluated") [12]; they suggest to engineering students that they use active voice when writing for administrators and passives when writing to other engineers [13]. However, this finding came from one survey with decontextualized examples. Even if it were generalizable, the distinction would be difficult to apply in civil engineering since civil engineers often have mixed audiences: regulators who have an administrative function but are also engineers, immediate clients who are engineers but who may pass the documents on to administrators, and groups that include engineers and non-technical personnel. Finally, and most importantly, the choice between active and passive voice can be crucial for communicating effectively in civil engineering. One factor in structural failures has been documents that were ambiguous about who was responsible for certain actions [14]; since passive voice sentences often omit the agent for the action, the decision to use them at the wrong point can have serious consequences.

In focusing on this grammar feature, we do not mean to imply that more global writing issues, such as argument structure and effective organization, are unimportant. As discussed elsewhere, including in our own work [15], they certainly are. But here we seek to show that discrete language choices are also important, and that even if English departments help students learn rules of standard written English, engineering faculty still need to help students integrate that instruction with concerns of civil engineering practice.

The paper proceeds as follows. Sections 2 and 3 cover background for the study of teaching the choice between passive and active voice. First we cover background about the larger project to contextualize the study, and then background from a previous stage of the project that investigated differences in practitioner and student use of passives. Section 4 covers the teaching intervention study. It presents the research questions, the design of the teaching materials, the piloting process, the assessment procedures, and the results of the intervention. Section 5 concludes with a discussion of the findings and implications for other programs.

2. Project Background

This study is part of a larger project, funded by the National Science Foundation, whose purpose is to improve the preparation of undergraduate civil engineering students for writing in industry: the Civil Engineering Writing Project (www.cewriting.org). The project has two phases: the goal of the first phase was to investigate the characteristics of typical civil engineering student writing that would be ineffective in the workplace; the second, current phase develops teaching materials to address those weaknesses, pilots them in courses, and assesses their effectiveness. The project has been described in detail elsewhere [15]-[19]; here we provide basic background to contextualize the study of passive voice.

The project has taken place at four universities in the United States: Portland State University, Cal Poly Pomona, Howard University, and Lawrence Technology University. All offer ABET-accredited degrees in civil engineering and seek to train students to become effective practitioners, but they differ greatly in size, entrance requirements, and typical student ethnic and academic background. The project team includes civil engineering faculty members, civil engineers working in firms and agencies, and applied linguists (who study how people adapt

English for different contexts). This collaboration allows us to incorporate differing perspectives on writing, on academic and industry contexts, and on student needs.

In the first phase of the project, we analyzed approximately 400 student papers from civil engineering courses and 400 workplace documents, covering ten types of texts (for example, design reports, technical memoranda, proposals, e-mail messages). The analyses compared organization, grammar choices, and grammar and punctuation errors in the practitioner and student papers. We used computer-assisted, quantitative techniques and functional interpretations of language in context, as described further elsewhere [18], [19]. The text analysis was supplemented with interviews of faculty, practitioners, and students, using open-ended questions and discourse-based interviewing, in which interviewees are shown sample text extracts and asked to comment on them. The interviews were particularly useful for understanding practitioners' and students' intentions behind their writing choices and for identifying student writing characteristics that most concerned the practitioners. The findings for passive voice are reviewed in the next section.

The second phase of the project investigates the following general hypothesis:

> The writing of students who receive explicit instruction tying writing to civil engineering content and practice will exhibit vocabulary, grammar, and organization that more effectively meet the concerns expressed by practicing engineers for accuracy, precision, liability, credibility and client expectations.

In this second phase, applied linguists and engineering faculty have collaborated on written materials that address the most important student writing weaknesses identified in the first phase. Rather than providing rules such as "use passive voice for methods," the materials explain the different functions of active and passive voice and highlight engineering practitioners' primary concerns, thus helping students to build judgment about how to choose between passive and active voice. Drafts of units are reviewed by at least two practitioners to check that advice is consistent with workplace practice or that differences between writing in academia and writing in industry are made explicit.

The project includes three types of materials. The "genre units" describe the purpose, organization, sequencing, and formatting for specific types of papers, such as field observation memoranda or geotechnical foundation reports. The "language units" address how to choose effective grammar and wording (e.g., effective sentence structures, accurate and precise word choices, language in e-mail, etc.). The "mechanics lessons" cover the 10 most common errors in standard written English and punctuation that students made in the phase 1 research. The teaching materials are designed to be integrated into civil engineering courses that already have relevant writing assignments (e.g., the "field observation memo" genre unit is typically used in first-year courses that require students to take field trips and observe construction sites or other projects). Passive and active voice are covered in a language unit that is described further in section 4.

The materials are used in civil engineering courses at the four universities, with faculty free to use them as they choose (for example, assigning them for homework, using class time for some

activities, or using class time for a writing workshop). The materials' effectiveness is assessed by comparing pre-intervention papers, written during phase 1 of the project, to papers written after the use of the materials (post-intervention papers). We conduct a variety of linguistic analyses for different characteristics (see [17], [18]); the specific analyses for passive voice are described in the next section. In addition, civil engineering practitioners conduct holistic scorings of samples of student papers so we investigate whether there is overall improvement in addition to any specific language changes. Students' reactions to the materials are also gathered through surveys, reflective writing, and interviews.

3. Practitioner and Student Use of Passive Voice

In phase one of the Civil Engineering Writing Project, we investigated the use of passive voice in 60 workplace reports, 60 student reports and 50 journal articles. The student reports mimicked the workplace context: they were written to specific clients for specific projects (usually real people and real projects, such as in capstone design courses). The journal articles allowed for comparison with the professional academic context, which does not have a specific client and usually addresses a general concept or condition, not a specific project. Writers' reasons for choosing active or passive voice were covered in interviews with 16 practitioners, 22 students, and eight faculty. The major findings were as follows (full details are reported in [19]).

Practitioner reports contained statistically significantly fewer passives than the student reports or journal articles although passives were still more common than in many domains of English, such as newspaper reports or conversation. There was no significant difference between the student reports and journal articles. In other words, even though the student reports mimicked the workplace context, students used passives with the frequency of journal articles.

Practitioners' lower frequency of passives corresponded to specific concerns identified in interviews. First, practitioners reported that it was important to be unambiguous about who was responsible for conducting actions, observations and judgments. Lack of ambiguity was attributed with reducing misunderstandings, keeping clients happier, and avoiding unintentional liability for the firm. Correspondingly, many practitioner documents had methodology descriptions that started by using active voice and an individual or group name and then continued in passive (example 1 in Table 1). Some practitioners emphasized that they were hired to make subjective professional judgments based on observations and analyses, and they often used active voice and human agents to state those judgments; active voice "recommend" was especially common (example 2 in Table 1). Other verbs especially common in active voice were *anticipate, assume, calculate, complete, conduct, expect, observe* and *visit*. In other cases when the agent was unknown or unimportant, such as in descriptions of structures, passives were the typical choice (for example, "this 184' long bridge was constructed in 1952").

Practitioners also emphasized their concern to make reading easy for clients, which kept clients happier (and more likely to hire them again) and also decreased the likelihood that information would be misinterpreted when read quickly. Several questions in the discourse-based portion of the interviews were designed to identify the specific characteristics that characterized easy-to-read texts in practitioners' view. They were consistent with characteristics that are regularly discussed in linguistic studies [20], [21]: subjects of sentences are short, they are immediately

followed by their verbs, and sentences follow a known-new information structure (that is, already-mentioned or known information occurs first, usually in the subject, and new information occurs later in the sentence). These characteristics can occur in both active and passive voice sentences, as in example 1 in Table 1. In other cases, illustrated in example 3 and the second sentence in example 2, sentences have inanimate subjects with active voice verbs. In all these cases, the decision has to do with effective subjects for the readers and context, not with a rule about using or avoiding passive voice. As one practitioner explained it, "My goal is to make it easy for the reader. If the verb is at the end, you have to wait to the end to see it to understand [the sentence] – so if the sentence is long, it basically means reading the sentence again. Nobody wants to have to read a sentence twice to understand it."

Table 1. Practitioner concerns in choosing passive or active voice

Practitioner concern	Examples from practitioner reports (subject + active voice <u>underlined</u>, subject + passive voice in *italics*)
State responsibility explicitly for observations and judgments	1. On August 15 and 19, 2003, <u>we drilled</u> five exploratory borings with a portable drill rig using solid stem auger techniques. *These borings were drilled* to provide data for retaining wall and signal pole foundation design. *The boreholes were drilled* to depths ranging from ±2 to 6 m. 2. <u>The design team recommends</u> construction of Access Road A. <u>This roadway helps</u> control access onto Western Road and <u>reduces</u> the impact to adjacent property owners.
Fast reading (short subjects followed by verbs)	3. <u>This estimate assumes</u> the reuse of five former military buildings [Compare to the passive: In this estimate, *the reuse of five former military buildings is assumed*.]

Students often used passives in ways that disregarded the concerns expressed by practitioners. Passive voice sentences regularly made it impossible to know who was responsible for actions. Example 1 in Table 2 comes from a paper where the agents for the writing, analyses, and recommendations are never stated. Example 2 in Table 2 illustrates a common student problem – using a passive so it sounds like someone other than the writers were responsible for an action (in fact, in example 2 the writers of the paper made the assumption based on the information they received). In interviews, the vast majority of students said they deliberately tried to use passives and not to refer to humans, commenting, for example, "I definitely try not to say I did this, or he did this, or you did this, or anybody did this, because I feel like it's not important who's doing it" – a statement consistent with the use of passives in the journal articles but not the practitioner reports.

Table 2. Student weaknesses using passive voice

Student weakness	Examples from student reports (subject + passive voice in *italics*)
Agents for actions and judgments unclear	1. *A geotechnical study was conducted* on the subsurface conditions at the proposed site in order to determine the feasibility of the development. *An engineering recommendation was made* after *the analysis was completed*. 2. According to Dr. Larry Simpson from a personal interview, *the assumption was made* that the weakest soil in that area is silty sand.
No concern for ease of reading (long subjects with verb at end of sentence)	3. *Many westbound through vehicles yielding to oncoming southbound right-turn vehicles were observed*. 4. *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*. 5. After *analysis of the fine aggregate was conducted, it was shown* to meet all of the standards … [Compare inanimate subject + active voice: Based on the analysis, the fine aggregate meets the standards…]
Attempts to make subjective ideas sound objective	6. By isolating the expected effects, *it was hoped* that.... 7. *This is believed* to be the cause of a handful of merging and sideswipe collisions....

None of the student interviewees expressed concern for making reading easy for their audience. This lack of concern was reflected in numerous sentences that had long subjects with verbs at the end, illustrated in Table 2, examples 3 and 4. In some cases, using an inanimate subject and active voice verb was an easy alternative to make a sentence easier to read (example 5 in Table 2).

Perhaps the most troubling belief expressed by students was that passives were appropriate for writing in engineering because "you need to use objective language," as one student put it. Rather than distinguishing the meanings expressed by the verbs, many students considered sentences such as "we observed..." or "we calculated..." too subjective because they referred to human agents. At the same time, their texts used passive forms of verbs such as "believe" and "hope" (examples 6 and 7 in Table 2) in a futile attempt to increase their objectivity.

In sum, it was clear from the phase 1 investigation that students could benefit from instruction that connected the choice between active and passive voice to circumstances of engineering practice. Many student beliefs were diametrically opposed to practitioner concerns, and their

frequent and ineffective use of passives decreased the effectiveness of their writing. Students also tended to believe absolute rules about using passives, rather than choosing effective subjects for sentences and effectively integrating active and passive in the same paragraph. Student comments also made clear that they needed specific techniques for revisions. A small minority of students said they tried to use active voice, but they found it difficult. One student explained, "I have tried to go through and rewrite it, to not be passive, and, oh my goodness, it seems impossible for me...I'm like 'I don't know how to reword this,' so I just write it in passive."

4. The Intervention Study

The study of passive voice investigated the following research question:

> After explicit instruction addressing the choice between active and passive voice in civil engineering writing, is there a statistically significant decrease in the frequency of passive voice in student papers and a statistically significant increase in the passives' effectiveness?

In addition, the papers written after use of the passive unit were included in an analysis of holistic effectiveness, checking whether papers improved overall, regardless of individual grammar features.

4.1 The Teaching Materials and Intervention

The unit about passive voice has five components. All of the components use examples from real civil engineering workplace documents or student papers.

- The first component teaches students to differentiate active voice, passive voice, and sentences that are neither active nor passive (i.e., in grammar terms, verbs that are not transitive, as in "Several historic residences are adjacent to the bridge").
- The second component teaches students how to choose between active and passive voice for effective writing in civil engineering. It explains that readers understand sentences more easily when the grammatical subject is short, known information. It also identifies circumstances when active voice is especially useful, such as establishing responsibility, and when passive is especially useful. Using examples from practitioner documents, it explains why active or passive was effective for particular sentences and illustrates paragraphs that use both active and passive voice effectively.
- A "myth buster" box explains that a passive voice verb does not automatically make content objective. Using examples such as the passive "it is believed" and the active "we calculated," it explains that the meaning of the verb is more important for differentiating between objective and subjective information.
- The next component covers four techniques for revising the most common ineffective passives in student papers: (1) Establish the agent for observations, assumptions, recommendations and other judgments explicitly; (2) Change long subjects to short subjects, which often requires changing the verb from passive to active; (3) Change passive sentences with "empty it" subjects (e.g., "it was observed that...") to an informative subject; and (4) Try using an inanimate subject with active voice, especially

instead of "empty it" passives. Each technique is demonstrated and explained with example revisions of real student sentences, and then students practice using the technique to revise other sentences.

- The final section provides additional practice in revising ineffective passages from previous student papers, with students selecting any of the techniques that are useful.

The new unit was used at three universities in existing civil engineering courses in 2015-17. Some assigned the unit for homework and discussed questions in class and a few used some class time for revision activities. Preliminary comparisons of individual courses found no patterned differences, and the courses were thus grouped into single pre-intervention and post-intervention groups. Over time, we hope to be able to investigate differences due to the amount of class attention given to the unit.

4.2 Assessment Methods

To investigate whether students' use of passive voice improved, we analyzed papers that matched the kind of tasks that engineers do in practice, such as design reports, technical memoranda reporting analyses, and field observations memos. In addition, we used a task from a technical communication course within a department of civil and environmental engineering, taught by engineering faculty, in which students described data in a table or figure. Table 3 provides an overview of the papers in this analysis. The post-intervention papers were written anywhere from 1 to 12 weeks after the unit was used. The courses were taught by seven different instructors. Since some of the papers (especially fourth-year papers) were written by groups, we made no attempt to analyze papers based on the writer's native language or other demographic characteristics.

Table 3. Student texts in the analysis

Group	Number of texts	Sources of texts for both analyses
Pre-intervention	81	3 universities 7 courses (multiple sections) 3 levels (first, third and fourth year in four-year Bachelor's degrees)
Post-intervention	117	Types of assignments: Technical memoranda reporting analyses; design reports (for structures, foundations, water systems, roadways); cover letters; field observation memoranda; traffic analysis reports; commentary on figures and tables.

Two analyses addressed the research questions about passives. First, we compared the frequency of main verbs in passive voice. This comparison used the complete set of texts in Table 3. The analysis used techniques from corpus linguistics, a field within applied linguistics that uses computer-assisted analyses of language features. The texts were run through a grammatical

"tagging" program that identified numerous grammatical categories, including passive voice. The tags were checked for accuracy. (See further details in [19]) The frequency of passives in pre- and post-intervention texts were compared with an analysis of variance.

The second analysis consisted of judging the effectiveness of the passive voice verbs. Applied linguists coded each passive voice verb as effective or not effective, using the factors discussed above. Analysts considered the following questions and the overall impact of the passive versus an active voice alternative: Was the subject of the sentence known information? Was the subject relatively short compared to the rest of the sentence? Was the agent for the action already mentioned, unknown, or unimportant? Was the agent for a judgment already clear? Was the sentence generally easy to understand or did the passive contribute to making the content hard to follow, ambiguous, or inaccurate? Two raters judged the texts. Disagreements were resolved through a third rater's judgments and discussion. Counts were then made of the number of effective and ineffective passives in each text. Because the judgments are quite time-consuming, about half of the texts (N = 95) were coded for effectiveness. Pre- and post-intervention papers were compared statistically with a Mann-Whitney U test, a non-parametric test equivalent to a t-test, since the distribution was not normal. This test takes into account individual variability; that is, statistical results will not be due to only a few students, even if those individuals improve greatly.

In addition, about 10% of the papers were judged for their holistic effectiveness. For this analysis, engineering practitioners judged papers on a 1-5 scale from "not effective" to "effective." They were given basic information about the task (for example, that it is a tech memo reporting observations from a site visit). They were asked to score the overall effectiveness based on what they know to be effective writing in the workplace, not focusing on any particular aspect of the writing. Scores for pre- and post-intervention papers were compared statistically with a Mann-Whitney U test.

The Type I error threshold for all the statistical analyses was set at .05, which is standard for linguistic studies [22].

4.3 Assessment Results

All three of the assessment measures found a statistically significant difference between the pre- and post-intervention papers. First, the post-intervention papers had a lower frequency of passive voice verbs. As Table 4 shows, not only was the difference significant, but almost 30% of the variation in frequency was accounted for by the pre- and post-intervention categories (R squared = 0.29). Second, the passives in the post-intervention papers were more effective than the passives in the pre-intervention papers ($U = 116.5$, $p<.001$, $r = .77$). The r value reflects a large effect size [23]. Third, the overall effectiveness of papers also increased after the use of the materials, as judged by the engineering practitioners ($U = 10.0$, $p < .05$, $r = .6$). This r value, too, reflects a large effect size.

Table 4. ANOVA results for the frequency of passives in pre-intervention vs. post-intervention papers

Source	*DF*	Sums of Squares	Mean Square	*F* Value	*p*	R squared
Model	1	6500.1	6500.1	80.5.89	< .0001	0.29
Error	196	15819.9	80.7			
Corrected total	197	22320.0				

In sum, then, the analyses were consistent with the hypothesis that, after explicit instruction, students' use of passives decreases in frequency while also increasing in effectiveness, and the overall effectiveness of papers also increases. The effect sizes were surprisingly large, especially given the range of tasks and differences in the materials' implementation.

The differences in the post-intervention student papers were often easy to see, with more sentences like the effective practitioner examples in section 3. Most notable was a higher frequency of active voice with grammatical subjects (usually group names) that showed who was responsible for actions and judgments, for example:

> The City of Benton has asked ABC Engineering [the students' design team] to investigate alternatives for....
> The team performed a simulation using PTV Vissim....
> Our group performed a site visit on Jan. 19, 2016 at 10:00 at the project site located at....

In post-intervention papers there were no passives that made sentences nonsensical (as in example 4 in Table 2). At the same time, there was no evidence of the overuse of active voice; most sentences had relatively short, known information subjects whether they used active or passive. In other words, students appeared to be exercising judgment about easy-to-read sentences, not just trying to use active voice.

Some comments in post-intervention interviews suggest it is the case that students are learning to analyze language, not just apply rules. One student from a course that used the passive unit and other language units in the project commented in an interview:

> We really dissected like language and writing and sentences and stuff like that. Now when I want to write, I can use those bits of information about language as tools to make my writing more effective and have the effect on the reader how I want it to be rather than vague and ambiguous.

Faculty sometimes are concerned that the unit is too analytical for students, who, after all, are studying engineering, not linguistics. Given that engineering tends to attract analytical thinkers, however, it is not surprising that students would appreciate an analytical approach to language and writing, as this student did.

Despite the overall improvement, however, it would be misleading to suggest that all papers improved. The post-intervention papers still exhibited a great deal of variation in their use of

passives. Some papers still appeared to use passives especially to avoid stating students' own role in decisions. In interviews we are currently attempting to learn more about why some students do not change their writing even though the class uses the unit. Some students admit they simply did not do the homework. Another possible reason is that students are getting different feedback from teaching assistants in other courses that did not use the materials. For example, one student described getting feedback that implied a paper needed to consistently use only passives. The student explained, "There were a couple of times where the TAs would say like "You're switching back and forth. You need to stick with this. This is passive...."

5. Conclusion

The results of this study suggest that explicitly teaching the choice between active and passive voice does help civil engineering students use passives more effectively, particularly in ways that experienced engineering practitioners value. The first phase of this project revealed several specific concerns that civil engineering practitioners have when choosing between active and passive voice, concerns that do not affect common school tasks such as laboratory reports. General technical writing courses or English courses cannot be expected to contextualize instruction for civil engineering, but civil engineering faculty themselves can help their students appreciate the importance of grammar decisions in civil engineering practice and give them techniques to apply in their writing.

One implication of this study is that faculty should not issue global rules about using active or passive but instead provide the tools for students to analyze their own writing and be more deliberate about choosing active and passive voice. Using both active and passive voice, even in the same paragraph, can be effective. Students can be taught how to make sure responsibility is not ambiguous and to revise the passive voice when it negatively impacts readability. The application of the new materials shows that we can improve students' writing while teaching them judgment about effectiveness for the context, rather than falling back on absolute rules.

Some faculty themselves may need training in the effective use of passive voice. Journal articles use a higher frequency of passives than workplace documents do, and many faculty have limited experience writing in workplaces where the choice between active and passive voice is more nuanced. The collaboration of faculty with practitioners and applied linguists has been essential in the Civil Engineering Writing Project, and we encourage other faculty to undertake such collaborations. In addition, faculty can use the units of our project to learn about language choices in the context of civil engineering practice. They can also use the units in their own classes; the materials are available to download from the project website (www.cewriting.org).

This study has addressed just a small piece of students' writing needs, and more aspects deserve attention. In addition to other characteristics of writing, other research perspectives are equally important, such as studies of students' developmental processes. Conditions we did not anticipate within the larger project – such as the training of teaching assistants – need attention for improving the outcomes of the project. Nonetheless, the passive voice is a useful case for seeing how teaching grammar judgment improves students' preparation for writing in industry. Employers do not expect new graduates to be fully prepared for writing any more than they expect them to be fully prepared with all technical skills. But just as students' educational

foundation begins to develop their technical judgment, their educational foundation can also begin to develop their writing judgment.

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