A Paramedic Method Drill Master to Improve Student Writing

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Abstract

Engineering instructors have students write reports in order to help learn difficult concepts, data analysis, challenging problem solving, communication skills, and critical thinking. Sadly, many students seem to prefer obfuscating the subject matter and key ideas by using painfully unclear writing. An instructor dismayed by poor prose in submitted assignments has numerous familiar options available. Consider just a few:

1. Ignore the poor writing
2. Mark every error directly
3. Mark every error with a marginal comment
4. Give general feedback about the poor writing over the entire assignment
5. Expect students to rewrite and resubmit work
6. Change careers or retire

Instructors who use one or more of the above techniques in response to their students' work may or may not see their efforts bear fruit, but they do invest time in the process, sometimes quite significant amounts of time. This work questions whether a minor intervention could guide students without adding an excessive burden on the instructor. We describe a tool for students may use to help them identify poor writing symptoms and encourage targeted editing to improve clarity. In practice, it permits students to receive automated feedback prior to first submitting their work, freeing the instructor to focus on more interesting learning.

Richard Lanham's Paramedic Method, described wonderfully in his book, *Revising Prose* (Fifth Edition, Pearson Longman, 2007) inspired the author to steer students toward his excellent advice. However, in the author's hands, the advice too often falls flat. Since devising this Paramedic Method Highlighter tool, the students seem to respond more positively and, sometimes, even edit their work. The webpage, http://tinyurl.com/PM-Macro, contains the free tool, instructions for its use, and video explanations. This work describes the tool, shows how instructors use it in class, gives student feedback, and assesses student work.

Introduction

Educating students "to communicate effectively" has gained sufficient value and prominence in Engineering curricula to deserve its own ABET Program Outcome, Criterion 3(g).[1] This work presents a strategy to introduce students to relevant written communication issues before and during senior design coursework, thereby providing practice and enabling them to achieve such a program outcome more skillfully in senior level coursework. Key practical challenges arise when attempting to add learning content to a one quarter electronics course already bursting at the seams with conceptually challenging learning outcomes:

1. No extra class time exists for additional in-class activities; and
2. Few instructors desire the increased workload associated with reading dozens of additional student essays above normal assignment grading.

To address the in-class time limitation, this work delivers the paramedic method content online. To minimize excess faculty workload, this work presents a tool designed to assist faculty to use

peer review of writing assignments, even in medium to large courses. The Paramedic Method tool finds applications in lecture courses, lab courses, and senior design courses, and the author used the tool while editing this manuscript.

Background Literature

To begin, we must acknowledge a large elephant in the room. Many engineers, including this author, like writing so little that they choose to devote little effort to it.[3] Unfortunately for them and their readers, effective engineering often benefits from effective written communication. Nobelist and Electrical Engineer Jack Kilby emphasizes a connection between writing and circuit design in his Nobel Prize lecture:

> "*T.R Reid has pointed out that building a circuit is like building a sentence.[2] There are certain standard components—nouns, verbs and adjectives in a sentence, and resistors, capacitors, transistors and diodes in a circuit. Each has its own function. By connecting the components in different ways, you can get sentences, or circuits, that perform in different ways.*"[4]

The literature describes numerous ways that writing benefits engineering students and engineers. In a nice section titled "Why Engineers Should Write to Learn: Importance of Writing in an Engineer's Education" Troy et al. cites a dozen sources justifying practical through pedagogic benefits students and engineers gain from writing.[5] Due to links between writing and critical thinking abilities, student learning outcomes, cognitive development, design skills, and engagement improve, when students practice writing.[6-11] Writing may enhance various best practice teaching methods including active learning and problem-based learning (PBL).[12,13] For those not sufficiently swayed by theoretical arguments, practical considerations give students ample reasons to desire to write well:[14]

1. Technical specialists and managers in engineering organizations must write well.
2. Senior engineers have to interact with other professionals such as lawyers and planners who write well.
3. When editing and revision time decreases, an organization's costs decrease.
4. Communications have legal standing when disputes arise.
5. A good writer can receive better grades while a student and impress supervisors to award faster promotions when employed.
6. Professional salaries demand writing at a professional standard.
7. Improvement in writing skill indicates a positive attitude towards continuous learning throughout one's life.

Such reasoning explains why writing may grow more important as an engineer's career progresses.[15]

The literature offers evidence to support some instructor's claims that student writing often leaves room for improvement. Focusing on mechanics and logical flow reveals a list of common errors:[16]

1. Paragraphs do not have any topic sentences, do not flow logically from one paragraph to the next in each section, and last too long to read and comprehend.
2. Sentences state independent facts but do not flow logically from one sentence to the next within a paragraph and do not come across as professional communication.

3. In-text citations and list of references use inconsistent styles, and often lack key bibliographic information.
4. Information taken from other sources lack proper paraphrasing or citations.
5. Literature reviews just summarize rather than synthesize past literature to indicate gaps in the reviewed topic or the need for a proposed engineering idea, design or technique.
6. Students' papers and reports contain many common grammatical errors.
7. The papers and reports have inconsistent formats.

The literature also contains much pedagogical advice about how to encourage even reluctant engineering students to improve their writing.[3,17,18] So much advice exists that it easily feels overwhelming. A google search for "writing drills" yields over 16 million results. The following non-exhaustive list indicates a few ways authors aim to build higher level writing skills:
1. Faculty must do more than embed writing assignments into their classes.[19]
2. The writing assignment must offer students time to receive feedback, reflect on their learning, and revise their drafts. [19,20]
3. Writing requires an interactive, coaching pedagogy—like that advanced by How People Learn techniques.[19]
4. Scaffold complex writing tasks over simple mechanics to promote improvement.[16]
5. Use detailed rubrics so feedback can translate more readily into improved results.[20]
6. Computer assisted instruction (CAI) to teach English composition gained increased attention in the early 1980s as personal computers became available.[21]
7. Improve information quality via literature reviews.[22]
8. Use genre based instruction and rhetorical analysis to familiarize students with engineering discourse techniques.[23,24]

For the author, who tried to respond dutifully to feedback from high school and college instructors, writing always seemed an ominous chore. An abundance of writing handbooks and style manuals did little more than offer grammar and formatting advice. Higher level advice often failed to speak to someone with a technical and algorithmic mindset. What remained after painful writing sessions, even into graduate school, often sounded far too boring, confusing, and lifeless.

An epiphany arrived in the middle of a teaching workshop taught by Deborah Wilhelm designed to help instructors teach writing in generally every discipline [WINGED].[30] The workshop's teaching tips and grammar reviews certainly helped. The workshop's high point arrived in the form of editing advice by Richard Lanham called the Paramedic Method.[25] His short recipe offers clear instructions how to repair dull or broken sentences using the steps shown in Figure 1. For the author, this procedure simplifies the writing process significantly. Instead of letting unsuspecting writers wade in a quagmire of shadowy verbiage surrounded by mysterious advice, the Paramedic Method lifeline tugs writers toward clear trails leading to cleaner language. It seemed that equipping students with such a tool would certainly help them fix their lab reports and papers in no time. After enthusiastically presenting the Paramedic Method to several classes, the modest improvements observed forced the author to rethink this approach.

1. "Circle the prepositions.
2. Circle the "is" forms.
3. Find the *action*.
4. Put this action in a simple (not compound) active verb.
5. Start fast—no slow windups.
6. Read the passage aloud with emphasis and feeling.
7. Write out each sentence on a blank screen or sheet of paper and mark off its basic rhythmic units with a "/."
8. Mark off sentence length with a "/." "

Figure 1. Richard Lanham's Paramedic Method.[25] This work emphasizes the beginning steps boxed in blue.

Applying the Paramedic Method Macro as a Writing Drill

Before explaining what this work does, consider some context, which should also read as an emphatic disclaimer. This strategy does not claim to address or solve all, or even most, student writing problems. It does offer a technique students may use to improve writing clarity. Consider analogies from learning other skills.[9] When seeking to improve their piano playing, pianists practice scales and arpeggios. When seeking to improve their swimming abilities, swimmers drill laps arms only or legs only. When seeking to improve their soccer skills, players run laps, without the ball. Similarly, when seeking to improve their writing, students may also employ drills.

This work devises a convenient drill for students to use as they practice Richard Lanham's Paramedic Method.[25] As an equally emphatic disclaimer, although the tool helps students reduce how many "to be" verbs and prepositions their writing employs, the author does not advocate always eliminating "to be" verbs or prepositions. Nor does the author intend to displace other writing instruction. Rather, the tool can assist students by augmenting other instruction, writing strategies, and drills. Plus, better writing manuals exist now than did during the author's student days. For example, the sophisticated and useful web-based Dozuki/iFixit handbook with its clear and concise messages fosters clear and concise communication.[27]

Figure 1 shows the beginnings of Richard Lanham's Paramedic Method boxed in blue.[25] This work helps students perform steps 1 – 5. To the beginning steps, Lanham adds steps 6 – 8, which this work does not consider. This work does not consider step 6, because students who wish to use it can use their own voice (or a document reader). Nor does this work consider steps 7 and 8, because those currently sit outside the author's comfort zone.

The Paramedic Method advises concise writing by avoiding excessive preposition strings and weak verbs. In its simplest form, the Paramedic Method coaches writers to circle prepositions and "is" forms, editing sentences with too many circles. In teaching Lanham's technique to Engineering students over the past decade, the author had some success helping students avoid

"to be" verbs and less success containing preposition epidemics. While having students employ the Paramedic Method Macro, this trend continues, so the present teaching works to reduce "to be" verbs. Again for emphasis, the drill to reduce "to be" verbs does not represent an end goal, but rather a means to encourage students to write more effectively, by writing active sentences, using descriptive verbs, and conveying their thoughts unambiguously. The "to be" verbs often flag symptoms of poor writing.

Over the past decade, asking students to employ the paramedic method after a brief introduction in class and via a web page produced sporadic results. Some students responded and many didn't, even when offered extra credit for clearer writing. A few years ago, I wondered if a computer program might offer some assistance, so I wrote a Microsoft Word macro to highlight "to be" verbs, prepositions, and expletives.[26] Highlighting the weak verbs in yellow, prepositions in green, and expletives in red produces vivid visual feedback, where colorful sentences and paragraphs demand editing attention. Table I lists the verbs, prepositions, and expletives treated by the macro. The macro creates a new document version containing the highlights and appends a summary report into the document. While the verbs and preposition columns require no further elaboration, the expletive selection does. Lanham's method advises in step 5 to avoid slow starts. The expletive column in Table I includes phrases within the realm of "slow starts." It also includes other ones that convey no useful meaning. Usually, deleting such phrases improves a sentence, so the macro highlights expletives in red and strikes them out. Instructors may wish to edit the expletive list when they use the macro, if they have other pet peeves to share with students.

After writing the macro, the author discovered another piece of software titled Master Edit designed to help improve writing. The software cost about $30 but does not appear online any more. A nice Master Edit YouTube video remains. It explains the Paramedic Method and shows how to use their software to apply the Paramedic Method.[28]

Table I – Words and Phrases Highlighted by the Paramedic Method Macro

To Be Verbs	*Prepositions*	*Expletives*
is, are, were, was, will, be, been, being, shall, am, isn't, aren't, won't, wasn't, weren't	at, in, on, to, of, for, as, with, by, from, into, onto, than, that, under, over, toward, towards, until, up, upon, within, without	it is observed that, it was observed that, I think that, we think that, I believe that, we believe that, respectively, based off

The author has students run the Paramedic Method Macro in lecture courses, lab courses, and project courses. For all but final reports submitted to more official destinations, students turn in the highlighted version created by the macro. For most assignments, the rubric includes required points for turning in the highlighted document containing the macro's summary report. Students earn bonus points for reducing the yellow highlights either to zero, in some cases, or to fewer than two per page in others. As reflected in the survey results below, some students respond favorably to this gamification.

To make it easier for students to use the Paramedic Method Macro, the author posted a webpage explaining how to install the macro into Microsoft Word and run it.[26] The webpage also links to

a YouTube video explaining the Paramedic Method.[29] Table II copied from the webpage gives four example sentences before and after editing designed to reduce the number of colorful highlights. The "Before" examples in Table II come almost verbatim from writing submitted by students. Applying the Paramedic Method usually results in fewer words, and Lanham defines a "Lard Factor" to measure the improvement:[25]

$$\text{Lard Factor} = \frac{(Word\ count\ before\ editing) - (Word\ count\ after\ editing)}{(Word\ count\ before\ editing)} \qquad (1)$$

Table II reports "Lard Factor" improvements in column 3. The edited "After" examples in Table II convey more information and more clearly than their colorful counterparts but use 30% to 50% fewer words. The next section explores how students respond to using the Paramedic Method Macro.

Table II – Paramedic Method Editing Examples[26]

Before	After	Lard Factor
The sensor is attached to a branch, producing data, which can be viewed later in an Excel sheet.	The sensor samples branch temperature, producing data for an Excel worksheet.	39%
The system is an electrically powered mode of transportation and is controlled with a handheld remote control.	The electrically powered transportation system responds to a handheld remote control.	35%
By the end of the project, a new system is expected to be fully functional and ready to operate. In the end, the excellent design is meant to give people a great new way to pursue happiness.	On project completion, the fully functional new system gives people a great new way to pursue happiness.	54%
In Figure 3, it is observed that the lower data are located in the high frequency range of the spectrum.	Figure 3 shows at least 6 dB lower gain at frequencies above 10 MHz.	30%

Student Attitude Survey

This work includes a survey to gauge how students feel about using the Paramedic Method Macro as a writing drill. Students completing a Senior Project Preparation course during Fall 2014 responded after the course ended to the questions listed in Table III. We used the campus Moodle course management system to administer the survey anonymously online only to students registered for the course. 12 out of 26 students responded voluntarily to the survey. The Likert scale survey questions (1-5) each received 12 responses, and the short answer questions (6-8) received 6-7 responses each.

Table III – Survey questions, results, and representative student comments.

Multiple Choice Questions:	(1) % Strongly Disagree	(2) % Disagree	(3) % Neither Agree nor Disagree	(4) % Agree	(5) % Strongly Agree	Average	Std. Dev.	% Agree or Strongly Agree	% Disagree or Strongly Disagree
1 Using the Paramedic Method MS Word Macro this quarter helped me improve writing quality in my EE 460 Project Plan Report.	0.0	0.0	16.7	58.3	25.0	4.1	0.6	83.3	0.0
2 Using the Paramedic Method MS Word Macro helped me identify unclear or awkward writing.	0.0	41.7	0.0	25.0	33.3	3.5	1.3	58.3	41.7
3 The Paramedic Method Macro + Video webpage helped explain the Paramedic Method to me.	0.0	0.0	8.3	33.3	58.3	4.5	0.6	91.7	0.0
4 The Paramedic Method Macro + Video webpage helped me install and run the Paramedic Method MS Word Macro.	0.0	0.0	16.7	41.7	41.7	4.3	0.7	83.3	0.0
5 EE 460 should use the Paramedic Method MS Word Macro next quarter.	0.0	0.0	16.7	50.0	33.3	4.2	0.7	83.3	0.0

Short answer questions:

6 In what ways did the Paramedic Method MS Word Macro provide a valuable educational experience for you?
"It made me consider stronger verbs, but actually the best part about it is it made me reread a lot of my report more carefully than I probably would've if I was just proofreading for grammar errors. It made it somewhat of a competition, to see how highlights I could remove. I will probably use this macro for other writing assignments in the future." *"It made me notice how much I actually use the passive voice."* *"It taught me how to more effectivily use verbs to liven up and clarify my writing, and remove huge chunks of meaningless words."*[sic] *"The Macro helped me to achieve a better understanding of how to write a more technical document and how to cut out unwanted or awkward words."* *"It gave a good visual to my writing habits."*

7 What changes could improve the value of the Paramedic Method MS Word Macro?
"Making it run faster." *"It would be drastically more effective if you spent a 1 hour class period discussing how to approach fixing the highlighted errors."* *"The Macro identifies a lot but it does nothing to help students understand why it's highlighting what it's highlighting and what the best methods to correcting the poor writing is."*[sic] *"It does not identify all passive voice! For example, the following words contain "to be" verbs but are missed: Contractions: I've, I'll, I'm, We'll, We've ect... Other forms of "to be", or other throwaway verbs such as: "get/got", "did/does", "can/could""*[sic]
"I think that a few examples of a poorly written sentence right next to the same sentence, but reworded to fit the Macro style wold have been nice to see right at the beginning. I know this is something we should have done in tech writing but a refresher always helps. Additionally, I think that technical document writing tends to be less fun than normal writing, so any added support would likely hep the morale of the class when it comes to writing in that style."[sic] *"Overall the macro was very cumbersome for me to run on my computer."*

8 If desired, please provide any other comments.
"The hardest thing is actually fixing the problems. I don't know if my English background is just bad, but some sentences were just hard to change to active voice. I now write much clearer even outside of this class and even use these method to clean up email copy for my club. I noticed that the lyrics I listen to seldom use "to be" verbs, so this may even make me a better songwriter!" *"It would be useful to have an equivalent macro for Google Docs so that we could write our reports using Google Drive."*

Survey results appear in Table III. More than 80% of the respondents agree or strongly agree the macro helped them improve writing quality (question 1) and the course should use the macro next quarter (question 5). More than 80% of the responses find the online support webpages and videos helpful (agree or strongly agree with questions 3 and 4). One opinion question elicited ambivalence. With an average response closest to the neutral category (3.5), the average respondents neither agree nor disagree that using the Macro helped them identify unclear or awkward writing (question 2). Direct measures reported below concur with these survey responses.

The typical comments included in Table III reflect how some students confuse the presence of "to be" verbs with the passive voice. As implemented currently, the Paramedic Method Macro probably reinforces the confusion and requires additional instructor intervention to help students make the distinction. In addition to those included in Table III, all responses to the short answer questions appear online.[31] The short answer responses have become more positive since past surveys. Possible explanations include improvements to the macro and improvements to the online support. The most recent macro revision intended to address frustration students express at how long the macro requires to run on a reasonable size MS Word document, 10-30 seconds per page, depending on document complexity and computer speed. The most recent macro version includes a Graphical User Interface, which displays the macro's progress while it scans the document. The online support improvements to the webpage include links to multiple video explanations of the paramedic method, videos by the author describing how to install and run the Paramedic Method Macro, and example sentences before and after editing for improvement.[26]

Results of Direct Measures

This section describes an attempt to quantify the Macro's impact on student writing. The writing samples come from the same Senior Project Preparation course for Electrical Engineering Majors mentioned above with the survey results.[32] During the quarter-long course, students develop a project plan for their Senior Project. The students compose the project plan section by section using weekly assignments, revising the sections as they compose subsequent sections.[33] A complete project plan (V1) comes due during week 8, and a revised final project plan (V2) comes due during final exam week 11. The analysis compares the Macro's report results for the V1 and V2 project plans.

Lanham's "Lard Factor" would offer one measure of the intervention's effectiveness. However, for this assignment, many of the version 1 reports require additional narrative to fulfill the assignment criteria, so the "Lard Factor" would not only measure writing quality. The presence of "to be" verbs offers one way to measure whether using the Paramedic Method Macro improves student writing between project plan versions 1 and 2. Figure 4 plots the version 2 project plan "to be" verb content for each report as a function of the initial version 1 "to be" verb content. Figure 4 shows the "to be" verb count as a fraction of the total word count. A handful of papers contain more than 2% "to be" verbs. Most papers contain fewer. The average "to be" verb fraction decreases from 1.2% in the version 1 project plans to 0.84% in the version 2 project plans, a decrease of 30% (P-value = 0.050). The average preposition fraction increases from 10.7% in the version 1 project plans to 11.2% in the version 2 project plans, an increase of 5.2% (P-value = 0.009). Version 1 project plans varied in length from 2,670 to 9,967 words, with an

average of 4624 words. Version 2 project plans varied in length from 3,012 to 10,345 words, with an average of 5409 words. The average word count increases by 17% (P-value = 0.000).
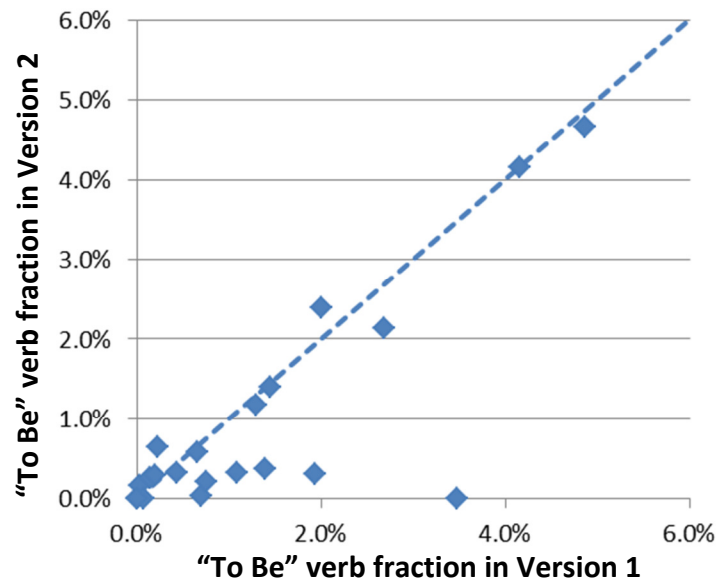

Figure 4. Paramedic method macro "to be" verb fractions in revised reports compared to earlier reports. The dashed line indicates the one-to-one ratio.

The decrease in "to be" verb fractions suggests that the Paramedic Method Macro drill convinces some students to pay attention to their verb choices. 14 of the 22 papers (64%) represented in Figure 4 show a reduction in "to be" verb fractions. A majority of the version 2 reports also read more clearly than the version 1 reports, suggesting the writing improves in the process.

As a calibration to gauge what the percentages mean, consider running the Paramedic Method Macro on the present document minus figures, tables, and the bibliography. The "to be" fraction equals 0.63% and the preposition fraction equals 10.6%. All the "to be," "is," and "are" uses in the narrative come from quoted ones necessary when referring to key elements of this paper's subject or from the Kilby quotation. The current version has 3313 words not including figures, tables, and the bibliography. Earlier drafts have "to be" fractions ranging from 0.00% to 1.30% and preposition fractions ranging from 10.2% to 11.0% on word counts ranging between 1607 and 4297 words. For other calibrations, the reader may run the macro on their own documents.[26]

Conclusion

This work presents a technique designed to help students improve their writing clarity. Indirectly, it could also benefit students' critical thinking skills.[5] Although some students may initially resist such feedback, Lanham's Paramedic Method provides helpful tips for students to improve their writing with minimal time investment.[25] Indirect and direct assessment results show favorable student responses and improved writing, when students use the Paramedic Method Macro. Making the tool available online enables easy dissemination to students or instructors who wish to use it.

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