Bloch School Teaching Mentor Lunch Talk 29 January 2016, UMKC

Incorporating Writing in Quantitative Courses

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Talk web page: http://d.web.umkc.edu/delawarer/BlochTalk2016.htm

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Outline

- UWRB and the RooWriter – Brief remarks; invitation to contribute to website
- Sources in Mathematics and Assignment Ideas
- Benefits of teaching writing
- Other Quantitative Sources

My favorite writing reference and resource:

Student Writing in the Quantitative Disciplines, A Guide for College Faculty,

by Patrick Bahls, 2012, paperback, about $38 new on Amazon

UWRB (University Writing and Reading Board) web site: http://www.umkc.edu/uwrb/

How I use RooWriter Reports at the start of my Math 464 WI History of Mathematics course

Just before the class begins I run a **RooWriter Detailed Instructor Report** on the class, and send an email to my students to run a copy of their **RooWriter Student Report**. On the first day of class, I plan short meetings (15-20 min.) with all my students within the next few days if possible. My WI class enrollment is usually 12-15 so this is manageable. I ask them to bring a hardcopy of their **RooWriter Student Report** to the meeting. I do not ask them to bring copies of their essay, though this too is available to them through the RooWriter site.

In advance of those student meetings I review the data from the **RooWriter Detailed Instructor Report**. This data allows me to get a sense of the writing skills of the class as a whole (at least in the narrow sense of a RooWriter essay 750-1,500 words long), and individually for each student. For the class, if I detect general weaknesses I can pull out an assignment to address some of those. For individual students, we can discuss writing weaknesses and set goals.

Short Writing Assignment Ideas in Mathematics

From me:

- Examine and explain the reasoning behind wrong answers or wrong arguments.
- Identities in algebra or elsewhere should be read and understood in both directions. Discuss the meaning in each direction.
- Explain what a general statement purports to say. For example, Let *a* be a real number. Then the expression $\left(\frac{1}{3}\right)a < a$ seems to say that "one-third of a number is always less than that number." Is this true? If not, why not? What would make it true? This forces a discussion of definitions, domains for symbols, and so on.
- Every algebraic derivation can be interpreted as a sequence of equivalent sentences, with a clear operation occurring between each one, transforming the former into the latter. Explain these carefully. Give the narrative (the story) behind the derivation.
- Re-write mathematical statements from the textbook into clear if-then statements. Tease out all assumptions, especially unstated ones.
- Keep a running journal-type entry of all the twists and turns you take in solving a problem, including your dead ends and mistakes.
- Write a short essay on a mathematical definition.
- Explain the various and different (!) uses of the word "cancel".
- When asked to state the quadratic formula, many students answer $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$. Is this correct? Defend your answer.

From MIT:

- Require that at least one question on each problem set be typed up and written in the style of an expository paper (rather than the usually terse and sometimes scattered style of a homework solution).
- Assign short exposition tasks such as summarizing the proof of a theorem done in class or filling in the gaps in an explanation given briefly in class.
- Have students revise part of a concise textbook
- Before an exam, have students formulate and submit to you a list of 2+ questions they have about the material. Students have a hard time formulating precise questions, yet this is an important communication and learning skill. Some students may feel they understand the course material, so permit questions that go beyond the scope of the course.

Selections from Writing References

More short writing assignments and comments

From: Writing in the Teaching and learning of mathematics, by John Meier and Thomas Rishel, MAA Notes 48, 1998

pp. 9-10:

"Your best friend from high school is also taking linear algebra. Because her professor has gotten behind on the assignment sheet, her class isn't going to start this topic until next week. Write your friend a one-page letter explaining what you think is the most important fact or facts about eigenvalues and eigenvectors. Include at least one good example so that your friend will understand your point. Be careful not to use terminology your friend hasn't learned."

"…having students write post-exam letters to their instructor outlining how they prepared for the exam, what their reaction is to their performance, and how they plan to prepare for the next exam."

"When asked to square a binomial, many students answer that $(x + 5)^2 = x^2 + 25$. Is this correct? Defend your answer."

From: Using Writing to Teach Mathematics, Ed. By Andrew Sterrett, MAA Notes 16, 1990

pp. 50-54: **"You can and you should get your students to write in sentences"** by Melvin Hendriksen

"Any work you submit for evaluation calls for an explanation of what you have done with the aid of complete, grammatically correct English sentences. (Symbols abbreviate English words or phrase and may be used as parts of sentences.) I will read exactly what you have written, and will make no attempt to deduce what you 'really' mean or to supply missing steps or logical connectives. Any symbols you introduce that are not standard must also be explained or quantified. Make sure, also, that you supply an explicit answer to each problem you claim to solve. In particular, I do not separate form from content. If I can't understand some part of your work, I will not struggle to read it, and your grade will suffer accordingly; even if you got the 'right' answer. Your explanations need not be lengthy to be clear."

Nice idea: Write a dialogue or scenario to clarify ideas and settle confusions.

Why writing matters for student learning

From: Student Writing in the Quantitative Disciplines, A Guide for College Faculty, by Patrick Bahls, 2012

pp. 13-14:

"Writing in the disciplines does more than help students feel like members of a specific learning community; it helps them become members of that community. Meanwhile writing-to-learn gives students new tools to tinker with as they prod and probe the ideas put before them."

"…nothing is more fulfilling than comparing the writing students do at the end of a term with the writing they did at the terms' beginning; sometimes the progress students make in discovering, analyzing, and expressing their ideas through writing is nothing short of amazing."

From: Using Writing to Teach Mathematics, Ed. By Andrew Sterrett, MAA Notes 16, 1990

pp. 63-72: **"Using expressive writing to support mathematics instruction: Benefits for the student, teacher, and classroom"**, by Barbara J. Rose

Student-Reported Benefits: Writing…

- Promoted understanding
- Facilitated reasoning and problem solving
- Was integrative
- Was a revealer of understanding
- Was a way to reinforce learning
- Promoted concentration
- Helped retention
- Served as a study tool
- Was a "place to do it."
- Stimulated the posing of questions
- As an icon (used the written record as a reference, to reflect, as a record of past performance)
- Improved writing skills
- Promoted independent learning
- Had "transfer" benefits
- Benefits student personally

From: Writing in the Teaching and learning of mathematics, by John Meier and Thomas Rishel, MAA Notes 48, 1998

pp. 86-87:

"First: there is a real difference between having been taught something and internalizing that same thing…

Second: Reflection is essential to the learning process….

Third: Prewriting, which can include discussion, note-taking, in-class exercises, "just thinking," is an important prologue to "real writing and thinking," and certainly to real mastery of a topic.

Fourth: All mathematicians, even great ones, have phases where they just "don't get it," and these phases are important to the learning process. We must respect the confusion our students have about these matters which may have become trivial to us; and we must find ways to bring these matters to the fore.

And finally: Mathematics is no different from the rest of experience; it is a topic which we store in our heads as a narrative – a story about what we know, what we don't know, and what we wish to know. It's a story we must share with other people to see if we've got it right, to fill in the gaps, to make it grow. We must encourage our students, and ourselves, to share this narrative that we each have constructed and will construct."
