Teach explicit skills with feedback

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I write having just come back from the gym: my biceps are tired from hammer curls, my lats from pull downs, my hamstrings from Smith machine lunges. In building strong bodies we *know* to exercise individual muscles. Sound programs of weight training build broad strength that then power us to play sport and live life. Why then do so many of us fail our students by simplistic 'teaching' of writing skills?

We mathematicians frequently pretend to 'teach' writing by the simple expedient of requiring an essay or two from the students. Such an essay may occur in a project course or a professional issues course. Yet requiring such an essay is not teaching; at best it evaluates the student's current writing skill, but often the marks for the writing are small, and the criteria vague. As John Hattie [1] reminds us, learning requires teachers to set appropriate and specific goals, and to give lots of feedback. In analogy with building strong bodies, I argue we need to improve our students mathematical writing with specific writing exercises and feedback focussed to build specific skills.

To further the analogy with body building, once a range of mathematical writing skills are built, we then ask the students to demonstrate these skills in a grand finale of an essay and/or report. Only then will we close the gap between our students' writing and employers' expectations.

> ... a significant gap exists between how ... students perceive and engage in academic writing and how they are expected to communicate, in oral and written modes, in professional situations and contexts.
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> ... their skills set fails to meet many employers' expectations.
> Susan Thomas, 'Words are failing our graduates', *The Australian*, 14 July 2004

Teach for learning

Writing skills can be so complex we need to keep what we teach simple. After all, we need not aim to develop subtle nuances in writing such as rhyme and rhythm. Instead, surely it is enough to aim for simple, direct and open scientific writing. But nonetheless we want writing that interests the reader, holds their attention, and communicates ideas. Almost all students will improve their writing enormously with a range of simple writing tips.

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This series, *The Style Files*, recommends important writing tips: prefer active writing to passive; clarify this; inform with titles and abstracts; avoid false conditionals; favour the present tense; omit redundancy; write what you mean; use informative synonyms; appearance affects communication; and write to read breadth first. In addition, there are rules of grammar and punctuation to learn when writing with mathematics. All these tips can be learnt with accessible, short examples similar to those presented in this series. Journal and proceedings abstracts then provide a rich source of material for consequent summative assessment.

Also consider psychology. We all find it hard to dissect and critique our own writing. Surely then students need to learn and practice critical writing skills on other people's writing, on writing they do not 'own' and so are psychologically freer. My students happily critique the abstracts I give them from the CTAC and EMAC proceedings. After learning skills in the writing of others, students appear more able to evaluate and improve their own writing.

> Students have plenty of teaching on technical material. They need a break on something that connects them with what they will do when we let them out. James Franklin, Gazette, 2005 [2]

Strategy

As Leigh Wood comments in last year's *Gazette* [3], we can teach such professional skills in either a stand-alone course, or as modules in others courses. I favour the latter to ensure most students meet the challenge of writing with mathematics as a professional. The brain learns quicker than the body builds muscle, but time and repetition are necessary to build strength in both body and brain for later life.

References

[1] Hattie, J. (1999). Influences on student learning. Technical report, University of Auckland. http://www.education.auckland.ac.nz/uoa/education/staff/j.hattie/papers/influences.cfm (accessed 24 June 2008).

[2] Franklin, J. (2005). A 'Professional Issues and Ethics in Mathematics' course. *Gaz. Aust. Math. Soc.* **32,** 98–100. http://www.austms.org.au/Publ/Gazette/2005/May05/franklin.pdf (accessed 24 June 2008).

[3] Wood, L. (2007). Classroom Notes: The transition to professional work. *Gaz. Aust. Math. Soc.* **34,** 246–252. http://www.austms.org.au/Publ/Gazette/2007/Nov07/ClassroomNotes.pdf (accessed 24 June 2008).

Tony Roberts is the world leader in using and further developing a branch of modern dynamical systems theory, in conjunction with new computer algebra algorithms, to derive mathematical models of complex systems. After a couple of decades of writing poorly, both Higham's sensible book on writing and Roberts' role as electronic editor for the Australian Mathematical Society impelled him to not only incorporate writing skills into both undergraduate and postgraduate programs, but to encourage colleagues to use simple rules to improve their own writing.