Telling the Truth

I believe there is wide agreement over the following statement: *The fundamental problem with today's college students is that most arrive thinking that college is a simple continuation of high school.* I have been recommending that the difference between high school and college be explained systematically during Freshman Orientation. Further, *there must be a separate orientation for mathematics and the sciences.* It is beneficial to join up with the sciences, but it is important to avoid diluting the message with generalities that must cover the other disciplines as well. A successful presentation must achieve the difficult balance between directness about the change of terrain and reassurance that the students can succeed if they really try.

In 2001 I did my first joint presentation with professors of engineering and physics. It was so well received that we were urged to do it again in 2002. The blurb in the Orientation Week program was: *The biggest difference between high school and college will lie in your math and science courses. Find out what and why, and how the student can adapt and succeed.* The outline of my part is given with the expectation that it is suitable for "peer institutions" and that an adjusted version could be used for science-oriented students at the premier public institution(s) of most states.

I began with a statement from our *Freshman Academic Handbook*: *The key differences between learning at Hopkins and your high school are: 1) learning does not take place primarily in the classroom; and 2) you, and not your professor, are responsible for what you learn.* Referring to #1, I asked, "Where *does* the learning take place?" Answers like "the library," "your room" were offered. Given that, #2 becomes largely obvious; in the past this point was difficult to get across, for freshmen see it as a threat, so alien to their experience. A solid foundation was thereby laid for the rest of the program:

1. *New level of responsibility.* Though guided by your instructors and advisors, *you* are responsible from now on for your own education.

2. *New peer group.* Most of you are no longer well above the majority of your classmates, but in a new environment with people much like yourself. Virtually all of you have the capability to do well (A or B) in your math classes, but talent alone cannot produce success. (Statistics on grade distributions in freshman courses were provided.) The students getting D or F (10+%) were barred from taking the next course. These are the ones who badly fell behind in their coursework, overestimated their effort, or insisted on high-schoolish modes of learning. (It is rarely the fault of the instructor, whatever students say.)

3. *New level of learning.* In *any* subject, the goal in college is to learn *flexibly* so that you can judge what applies in new situations and carry it out. The subject where this is furthest from high school experience is mathematics. Thus, *most students face a new challenge in their math courses.* Flexible learning is especially important, because many other departments require math courses and want their majors to be ready to *use* the material. For that, *the student must start to think conceptually.*

4. *New roles of the instructor and student.* The instructor's is *to guide the students' learning.* It is not to cover the material, for that is the textbook's job. It is not to teach everything to the student: *teaching in college becomes a cooperative effort shared by the instructor and the student.* There is a corresponding change in what is expected from the student. In a typical high school the attentive student is able to pass with modest exertion. In college the vast majority of students can learn well with *reasonable* exertion: two hours per week outside of class for each hour in class is not an unreasonable effort. That includes reading the textbook for both concept and (additional) examples. The course will then be moving a lot faster than in high school, with far less repetition. The exams will cover several weeks of material, even the whole semester on the final. The student should view the learning of math as accumulating a body of knowledge, not just learning isolated facts and problem types.

I will never forget what one student at Rutgers wrote about me in a course survey in the 1970s: *He's an all right teacher, but you have to read the book too in order to understand the material.* "But," eh? One of the most important things an instructor can do for the students is to insist they learn mathematics in part from written sources, so they can get beyond the surface. Most students are excused from that in high school. I have heard too many of our students say that someone gave a good calculus course when—perhaps I should say *because*—they were able to manage easily without reading the textbook, even when important material was cut from the syllabus.

Now, go back to those two fundamental statements from the *Academic Handbook* and ask yourself to what extent you and your colleagues act on them. I know there is pressure to back off from those principles. It is common to give in, to go with the flow. Students become perceived as consumers of our services. But they are also our output, subject to quality control. Wouldn't it be better to preserve the integrity of our colleges? After all, the education of the next generation is at stake.

—Steven Zucker
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See `http://www.math.jhu.edu/~sz`
for address and "orientation material"

Letter to the Editor

Mathematical Word Processing

W. Brian Arthur, a colleague of Donald Knuth at Stanford, has studied dynamical systems of the self-reinforcing or autocatalytic type. These have a multiplicity of possible emergent structures. The initial state, possibly affected by early random events, pushes the dynamics into "selecting" a structure that the system eventually "locks into". Instances abound of this nonoptimal, premature phenomenon capturing industrial and commercial processes to the detriment of both superior processes and users.

The history of TeX-LaTeX2e described in the December 2002 issue by Michael Downes constitutes still another instance. Downes lists six particular reasons for writing material for the AMS in LaTeX, beginning with (1) the inherent logical structure (read software programming); (2) as a source for HTML and PDF, even though these stand independent in their own right with readily available software that is compatible with Microsoft Word, for instance; (3) well established and stable (but compare his section on the history and his closing "Beware of Obsolete Documentation!"); (5) "…a way that seems well suited to mathematical material" (in the view of a programmer); and (6) "easy to feed directly into the AMS production system." Aye, there's the rub! The AMS has been captured by this ponderous, unintuitive, error-ridden software, and we are all hostage to the obsolescence.

Freely writing mathematics has been replaced by programming in a ponderous system of macros. Downes counts this as a virtue: "a non-WYSIWYG approach helps sensitize authors to the kind of discrimination between visual appearances and essential information that they need to make if they do not want what they write to be inadvertently encumbered by limitations of the medium (or software, or printer, or type of computer monitor) in which it is originally produced." Is "essential information" on mathematics to be judged by software programmers? Are we at the mercy of this obsessive bureaucracy? Is it better to "make it as easy as possible for other programs to print or preview DVI files on an arbitrary printing device or computer screen" than to make writing mathematics as easy as possible for human AMS members? Microsoft Word is certainly a program present on more computers worldwide than any version of TeX-LaTeX. From this author's standpoint, its editor capabilities, when supplemented by MathType (advertised on the inside back cover of the December 2002 issue), are certainly more user-friendly. It is WYSIWYG without any ponderous macros that become obsolete from one edition to the next. It has served me as well as any version of TeX, even in mappings between chain complexes and other diagrammatic structures, except of course in submissions to the AMS.

Downes reviews the sorry history in "Some Historical Notes about TeX". Though released to "people in the wild outside Stanford" (what arrogance!) in 1978, Knuth and others, increasingly dissatisfied, were still putting TeX and its variants through ever more changes, in particular the TeX macro language, through 1978, 1980, 1982, 1983, 1990, culminating in the "final" version of TeX indexed by some finite part of the irrational number pi. May we thus expect an infinite number of patchwork changes extending out to eternity? Downes states that after Knuth's death the version number will change from an approximation to pi itself. Perhaps it would be better to bury TeX with its illustrious inventor and have the AMS go to something closer to a typical user-friendly word processor that still does the job. See the content of Downes' closing statement, "Beware of Obsolete Documentation!". He further warns that this is "only one instance of a more general pitfall that LaTeX users should be careful to watch out for." And the final paragraph of this section directly contradicts Downes's point 4 on page 1384, that the format is "readily exchangeable with colleagues."

I realize full well that with this letter I am "plowing the sea", but things could be better.

—William C. Hoffman
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The *Notices* invites readers to submit letters and opinion pieces on topics related to mathematics. Electronic submissions are preferred (`notices-letters@ams.org`; see the masthead for postal mail addresses. Opinion pieces are usually one printed page in length (about 800 words). Letters are normally less than one page long, and shorter letters are preferred.