Commentary

In My Opinion

Imminent Danger—From a Distance

In *Gulliver's Travels*, Jonathan Swift describes a society in which students learn mathematics by swallowing pieces of paper on which theorems have been transcribed. Recently, California students have learned mathematics by studying Mathland, which has no textbooks, but uses "manipulatives". Soon thousands of university students will learn mathematics either by interacting with a computer or over the Internet via a process called "distance-learning".

These phenomena share one or more of the following three features:

(i) They eschew the method of placing students in a classroom—in a controlled environment—under the supervision of a trained professional or *teacher*.

(ii) They reject the notion that students should learn from a curriculum or a *text* that has been written by *practicing faculty scholars*.

(iii) They value form over substance.

Those promoting distance-learning—i.e., students learning over the Internet without direct, synchronous interaction with a human instructor—want to substitute the act of "logging on" for the productive interaction of first-class minds that takes place in the classroom. Those promoting computer learning want to do much the same. When I think about undergraduate education and when I question one of these methodologies, I am questioning both.

Not to demonize Mathland, but it shares an alarming feature with many other modern educational products: it has no author. It is written by the *publisher's paid staff*. Likewise, the distance-learning companies are *not* hawking a curriculum created by you and me. They are packaging and selling materials that were created by their staff or that were hired out as piecework and later made into "learning materials" by staff.

Years ago we deviated from the true path with graphing calculators, which we neither designed nor consciously chose for our classrooms. They were foisted upon us by the manufacturers. *We conveniently rationalized the educational value of calculators after the fact.* Now, with distance- and computer-learning we have the opportunity to repeat the error on a much larger scale.

At a recent trade show in Atlanta, a major software vendor pledged his company to take over the teaching of lower-division college mathematics in America, because his company's software can do a better job of it than university faculty.

All these observations describe a dangerous trend. In every instance, the proper role of the trained mathematics instructor/scholar is being usurped by a machine or by a device or by the paid staff of a retailer.

Learning from software has merits: (i) a course is self-paced, (ii) there are no "missed classes", (iii) the student can "try things". But the give-and-take of human interaction is central to the learning process; that dynamic is lost when a Pentium chip does the teaching.

Among other qualities, a good teacher

- shows the students how to read the subject matter;
- sets a pace for the students and evaluates their progress;
- adjusts the material to the audience;
- uses voice, style, personality, and knowledge to communicate;
- instills a love for learning;
- helps students to become engaged in the learning process;
- teaches students to reason and to think critically;
- sets a standard for what it means to be educated.

Can a machine perform any of these activities?

Proponents claim that distance- and computer-learning products lower attrition rates and raise scores. The important question is whether students are internalizing and retaining the material. Are they mastering the mathematical method? Can they think critically? Are they attracted to mathematical science? For the distance- and computer-educated, we do not know.

Provosts and deans have dollar signs in their eyes. They envision teaching more students with fewer faculty. But true education is never efficient. Often it is two steps forward and one step back, and it does not come cheap. As Harvard president Derek Bok said, "If you think education is expensive, try ignorance."

Traditional education may not be linear and bullet-like, but it enables students to master the ideas and to retain them for future use. Computer- and distance-learning are slick and quick and high-tech, but their efficacy is unestablished. We should be hesitant to undermine or discard the traditional methods, which have had—and continue to have—considerable success. The vast majority of today's college faculty, for example, were educated with traditional methods. If such caution is not taken, then we are in danger of sacrificing the finest education system in the world on the altar of expediency, austerity, and bottom-line statistics.

If your university is investing in distance- or computer-learning, then apprise yourself of the attendant changes and of how they will affect the quality of learning. Mathematics courses should be designed, taught, and controlled by those who are best qualified—that is, by the mathematics faculty. What is at stake is the education of the next generation of mathematical scientists.

—Steven G. Krantz
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