Keeping Engineering and Science Students on Course

James J. Robinson

INTRODUCTION

In the October 1990 issue of JOM, I wrote an editorial asking readers to comment on the doomsaying observations found in the article "Shortage of Scientists Approaches a Crisis as More Students Drop Out of the Field" (The Wall Street Journal, September 17, 1990, page B1). Using statistics provided by the National Science Foundation, the author of the article, Dana Milbank, pointed out that "some 42% of [students] who enter college professing interest in science or engineering careers drop out of the sciences after [their] freshman year, and another 23% defect before graduation." Those are frightful figures.

Hypotheses explaining this degenerative situation are reported to range from too many students who (through an eroded attention span or inferior secondary school preparation) cannot keep pace with college-level work, to a glut of drab or incomprehensible teachers with alienating presentation skills. Let us not forget, of course, the role of an antiquated educational system that is designed to vex and filter all but the most intelligent and motivated students. Also mentioned was a feeling that grade curving arbitrarily dictates that only a certain number of students can get good grades and that some, according to normal distribution, must receive poor ones. Finally, there is the competition represented by "easy," but lucrative majors such as business.

The Milbank list of reasons for the problem seems endless. For us, the question must be: Are all or only some of the reasons valid? Further, what can and should we do about it?

To begin the gradual process of gathering evidence toward an answer, the October editorial encouraged JOM's readers to offer their insights on the dropout problem by providing their personal perspectives on the problem and offering their ideas on possible solutions through letters to the editor. As is found on the following pages, we have received a variety of opinions in these letters. The views expressed are thoughtful, solution-oriented, occasionally argumentative and, in general, strongly felt.

Part II of this month's coverage of the retention issue is an article by Donald H. Thomas and Alan Lawley of Drexel University, which describes that institution's experimental I+ project (an "Enhanced Educational Experience in Engineering"), a retention-improving program that has just won the Award for Educational Innovation from the Accreditation Board for Engineering and Technology. Although the program has been in effect for less than two years, Drexel has experienced a dramatic improvement in the retention and academic performance of engineering students.

Before we offer a deeper review of that program, however, let us examine the opinions of JOM's readers.

LETTERS TO THE EDITOR

Dear Mr. Robinson:

I enjoyed your editorial about the dropout rate for engineers and scientists in college. I recently finished my master's in materials science at Rensselaer Polytechnic Institute. While that does not make me an expert on the dropout rate, I certainly have my opinions.

First, I disagree with three conclusions stated by The Wall Street Journal. Science is not the only subject that has a grading curve or boring teachers. As for the "weeding out" theory, I have never seen competent students leave because of some kind of persecution; besides, Japan and almost all European countries have some form of selection.

To my eyes, there are two main reasons for the dropout rate: It is easy to quit when it comes to science, and the students feel tricked when they start to study the sciences in college.

First, the "easy to quit" theory. I cannot count the times that I've heard parents say "Young Billy is having trouble in second grade math, but I always hated math too." Radio disk jockeys, television broadcasters, Aunt Millie... it seems that everyone who quit when they came to math and science can't wait to tell others, especially kids, about their failure.

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failure in this area. It is the most socially acceptable area of schooling in which to be a complete failure. I remember telling others about my choice to study physics. The reply was always, "Boy, that's tough; I never could do that." It turns out that as these people get older, many realize that they are more intelligent than the engineers or scientists they know; but by then, the damage is done.

The second theory is the "I was tricked" approach. The state of all science education in this country is terrible, and to lay it all on the high school teachers is unfair. The elementary school years are generally wasted when it comes to science education. All can remember from those years are some vague geology lessons and simple discussions of ideas like temperature. In no way did those years prepare me for high school physics, let alone the challenges of college. The fact is most students have virtually no background in science by the time they are 16, and then they are supposed to swallow it all at once. In the book Surely You're Joking, Mr. Feynman, Feynman talks about reviewing science books for the state of California (I think), and he describes his horror at what the publishers thought was science. This brand of science is much simpler than the real thing, and young kids will panic when they find out what is expected of them. Other examples of the simpler description of science can be found in The New York Times' science section on Tuesdays. It's almost all medicine, archaeology, personal computers or space, with the occasional freak article about cold fusion or computing pto 10^200 places. It is nice, but if that is what you expect freshman chemistry to be like, you are in for a big surprise.

I want to thank you for the opportunity to spout off on this subject. As you may have guessed, most people I know aren't too interested in the place of science in the world today.

Matt Bulger
Middleville, New York
Dear Mr. Robinson:

Initially didn't respond to your appeal in October since I felt that, as a retired engineer, my comments would be out of date and that, having gone to "street-car tech," they might not be relevant to current conditions in engineering schools.

It is my opinion that engineering schools are not user friendly and that there is a pervasive atmosphere of sink or swim. Going away to school is stressful enough without the added burden of rigorous scholastic discipline that almost amounts to a kind of hazing.

Of course, I understand that standards must be kept high. But it would seem that once admitted, every effort should be made to retain those who were motivated enough to get themselves admitted and not wash them out.

Many ambitious students are weak in mathematics, are slow readers or are abysmal writers; some schools have remedial or catch-up courses. But I feel that more good, average, motivated students could be retained while being helped over these obstacles. After all, the large majority of scientists and engineers are going to end up as "average" performers, doing mundane jobs at ordinary enterprises. Perhaps if schools were to recognize this and not expect every student to be an Oppenheimer, Bohr, Urey or Szilard, they might do a better job of retaining their students.

Elwood Meschter, P.E.
Clarendon Hills, Illinois

Dear Editor:

In response to your query as to why the high dropout exists, I would suggest that abysmal teaching of calculus classes turns away many students. Mathematics is the language of science and engineering, and the students who cannot understand math cannot progress in the engineering curriculum. I speak from experience both as a student—who almost dropped out completely from science (I stopped and obtained a B.A. in the classics and then returned to materials science and engineering after three years)—due to the atrocious mathematics professors I had—and as a professor, who has heard many students today complaining about the quality of teaching in their mathematics courses.

A secondary cause may be the rigid curriculum, which is almost impossible to complete in four years and which offers almost no flexibility for breadth in non-engineering/non-science areas.

Martha Mecartney
Associate Professor, Materials Division
Department of Mechanical and Aerospace Engineering
University of California-Irvine

Dear Mr. Robinson:

I must agree with The Wall Street Journal's article as to why so many students are opting for business school over science and engineering curricula. Having taken three graduate-level business courses, I can tell you first-hand that it requires far less work to pass with an acceptable grade than any science course I have ever taken. When you consider the financial rewards of a science degree versus a business degree, it's easy to understand the mass exodus from science. In addition, in terms of maximum career potential, business majors have an advantage over science majors, with some selected exceptions.

I can offer one obvious solution to the perceived problem. In step with the current laissez-faire attitude among the policymakers, I recommend allowing the marketplace to "correct" the approaching "shortage" of scientists and engineers. If, in fact, a shortage in the supply of scientific labor is realized, a natural demand is created. This demand results in increasing salaries, which effectively makes careers in science and engineering more attractive to both high school and college students.

John G. Cowie, Ph.D.
Sr. Research Scientist
Olin Corporation

P.S. The above comments are my own and are not those of the Olin Corporation.

Dear Mr. Robinson:

I'm following up on your invitation for suggestions on how to: (1) induce more students to get into science and engineering careers and (2) reduce the dropout rate for students enrolled in science and engineering courses.

I believe that we can make additional efforts in several areas that will increase the students' interest and career choices in science and engineering. These efforts include:

- Show relevance of the subject matter in courses to things the students experience in everyday life.
- Show real examples of theory at work, using field trips or movie and television presentations in class. Lecture demonstrations have a valid place in class if chosen carefully, done well and not over-used.
- Seek new faculty members from those who have had some indus-