Reflections on Math Education


When I was a child, science fiction books provided me with hundreds of hours of entertainment and mind-expanding ideas. When I became a teacher, I often drew on these ideas. A good idea is a good idea, whether it comes from science fiction or a more scholarly source.

Isaac Asimov has always been one of my favorite authors, and the *Foundation* trilogy made a lasting impression on me when I was a child. In these books Asimov chronicles more than a thousand years of human history, at a time more than 30,000 years in the future. In recent years Asimov has added three more books to the trilogy, one preceding the original trilogy and two following it.

Recently I have been rereading the six-volume *Foundation Saga*. It is fun to see how Asimov blended the old with the new. It was interesting to see how he coped with his own increased knowledge of science and computer technology. I was particularly impressed by a scene in the fifth book where a space pilot named Trevize is learning to use a new, top-secret spaceship. Trevize had learned a little about using a ship's computer system and piloting a ship when he was in the space navy a dozen years earlier. He remembered it as being a task he felt he would never be able to master because he lacked the appropriate native talents.

As Trevize enters the control room, he quickly notices a "round circle of light, with neat lettering that read: COMPUTER INSTRUCTIONS." Trevize touches the circle, and it expands into an outline of two hands. He places his hands on the outline, and he is in direct mental contact with the ship's computer! After a few minutes of experimentation, Trevize realizes that he is in full control of the computer and the ship.

*He found—as he cast the net of his Computer- enhanced consciousness outward—that he could sense the condition of the upper atmosphere; that he could see the weather patterns; that he could detect the other ships that were swarming upward and the others that were settling downward. All of this had to be taken into account and the computer was taking it into account. If the computer had not been doing so, Trevize realized, he need only desire the computer to do so—and it would be done.*

—*Foundation’s Edge* (1984)

Trevize then reflects briefly on how little time it has taken him to learn to use the system. "So much for the volumes of programming; there were none."

What, you may ask, does this Asimov story have to do with mathematics education? In my mind, quite a bit. My doctorate is in mathematics, and math is still near and dear to my heart. Thus, I enjoy the opportunity to attend and participate in an occasional math conference.

This past fall I attended the 28th Northwest Mathematics Conference in Seattle. It was a rather large conference with well over 2,000 in attendance. I toured the exhibits, handed out ISTE literature, gave three presentations, and talked to a large number of people.

Mathematics education is struggling with the information age. The National Council of Teachers of Mathematics has developed a set of standards to help guide mathematics educators.
A number of the conference presentations were designed to help acquaint teachers with these standards.

There were a number of other areas that received substantial attention in the conference program. Hand-held calculators, including the more expensive calculators that can draw a graph, were featured in many presentations. There were a number of talks on such topics as computers, cooperative learning, critical thinking, and problem solving. And, of course, there was the usual potpourri of talks on a huge variety of other math topics.

In retrospect, I found three things about this conference to be particularly interesting.

1. I toured the vendor area and visited each of the 38 displays. I carefully looked for materials for the Computers in Math Education course that I was scheduled to teach the next term. I didn't find anything new, nor did I find anything particularly useful. It was a disappointment. It suggests to me that vendors are taking a rather conservative approach to the field of computers in mathematics education.

2. Not a single one of the approximately 300 sessions appeared to focus on Mathematica, the powerful and relatively new piece of software that stands as a major interface between computer hardware and the field of mathematics. Mathematica can do high precision arithmetic, solve a huge range of equations, do a wide range of mathematical symbol manipulation tasks, differentiate, and integrate. It has a number of the characteristics of the human-computer interface that Trevize found on the new spaceship. With just a modest amount of training, a person can carry out tasks that previously may have taken hundreds or thousands of hours of training and experience. Mathematica and its future successors have the potential to revolutionize mathematics education. (Please note how this relates to the Asimov story!)

3. I did three presentations and my wife, Sharon Yoder, did two presentations. In these presentations we tended to focus on the idea that mathematics education needs to change quite drastically. We suggested that much of what is currently being taught is inappropriate for students who will live in a society where powerful computers are readily available. We have an Industrial Age mathematics education system and it does not work well in preparing students for life in an Information Age.

But neither Sharon's nor my presentations were well received! Perhaps this is not surprising. After all, who likes to be told that quite a bit of what they are doing in their teaching is a waste of time and effort? This pinpoints a major problem in our educational system. Like any "system," our educational system attempts to maintain the status quo and to preserve itself. One of my students hit the nail on the head when he recently observed that much of the pressure for educational reform is coming from outside the educational system. A great many people within the system have a combination of "blinders" and vested interests. They are so wrapped up in the day-to-day operations of the current system that they cannot even imagine some of the changes that could lead to significant improvement.

We are beginning to see major signs of educational change being legislated from outside the system—often by people who have relatively little knowledge of the intricacies of education.
These pressures for educational change will surely grow, unless educators themselves take a much more proactive stance.