Hand-Held Storage Devices


A few weeks ago I was talking to a friend who is an undergraduate majoring in electronic engineering. He showed me his latest "toy," a $50 hand-held BASIC computer which is also a calculator. It makes a nice addition to his collection, which includes several different types of $20-$25 scientific calculators, a $200 symbol manipulation and equation solving calculator, an ancient computer (about five years old) and a more modern computer (one megabyte of RAM, bit-mapped graphics, plus a hard disk).

The BASIC calculator/computer allows one to store up to 10 short BASIC programs in memory. All of the students in the engineering program have calculators of some sort, so it is standard to allow use of calculators on tests. My friend noted that for a recent test he had studied quite diligently and had memorized all of the formulas that the course had covered so far in the term, but he had also keyed all of these formulas into the calculator/computer. There are quite a few new formulas introduced in each course, and some professors actually expect that their students will remember formulas from courses taken in previous years, even though the formulas are quite infrequently used.

It seemed clear that my friend was a little defensive about admitting to his behavior of storing the formulas, so I raised the issue of what the teacher and the other students thought about this idea. It turns out (as one would expect) that the professor is quite aware of the capabilities of the calculator/computer devices to store information such as formulas and text. Indeed, the professor had discussed the issue with a class last year, suggesting that it was not appropriate to type the entire text into a machine that was being used during tests. He indicated that he could ban use of calculators on tests if students were disturbed by some gaining an unfair advantage through the particular calculator/computer device they could afford to own. The professor gave students the chance to come in individually, to avoid peer pressure, to talk about this.

No student came in, so the professor made a decision to ignore the issue, at least for that class. But more recently the professor has raised the issue again. It is evident to the professor that some students have an advantage over others because they have better electronic storage devices. Note that these need not be calculator/computer-like devices; one can purchase for under $50 a wrist watch that comes with 2K bytes of memory, an RS232 port, and a cable for downloading files from a computer. In his recent conversation with the class the professor indicated that he didn't want students storing formulas and other information in their calculator/computer devices for use during tests.

I suspect the professor realizes that he is fighting a losing battle. He could, of course, design every test question so that a calculator/computer was of no help. Or he could include on the test sheet copies of all formulas that might be relevant. Some professors do such things.

But, key to this editorial, the issue of what to memorize and what to store in one's calculator/computer is not an explicit part of the professor's courses. In essence, the professor has given tacit approval for all students to bring crib sheets to tests (calculator/computers with widely varying capability), but he has not given explicit approval to make use of the full range of capabilities of such devices. The professor has no easy way to check whether students are
misusing the calculator/computer. And he has not adequately addressed the issue of varying capabilities of machines. For example, if Brand X has a particular formula built in, is it all right to key that formula into Brand Y and carry it to the test?

The basic issue is what one should memorize and what one should learn to retrieve from a calculator/computer, book, or other information storage device. In an engineering type of class, especially one focusing on applications rather than on theory and proofs, most formulas are used for computation. The actual computations are done using a machine. Thus, if one is making use of a memorized formula, then one has to key it into the machine. Why not just have it in the machine to begin with?

I feel that the example of my friend and his professor is representative of a major problem our educational system should openly address. The problem far predates calculator/computers and other electronic aids to information retrieval. Books and paper have been with us for a long time. Some teachers give open book exams. Others give open notes exams or allow their students to bring perhaps one page or one note card to the test. Others explicitly prohibit students' making use of such aids to information retrieval. In such cases the student who is good at memorizing formulas has a distinct advantage.

The problem is of increasing importance because electronic aids to information storage and retrieval are much more powerful than paper. The calculator/computer can not only store formulas, it can carry out the computations specified by the formulas. A computerized database can not only store information, it can rearrange the information to make it much easier to answer various questions. And the issue will continue to grow as storage capacities of hand-held devices continue to grow.

We already have hand-held devices that play compact laser audio discs. A modest modification of such a device would make it into an information retrieval system. If a person can carry around a typical college textbook, a person might just as well carry such an information retrieval system. But then a single disk stores the equivalent of several hundred books. A computer can search an entire disk of books for a specified combination of key words about as fast as a person can look in a printed index for a single key word. People with access to such equipment would certainly have a distinct advantage in many areas of problem solving over people who lack such access.

We can expect that individual students and their teachers will continue to face such issues on an individual basis. But I believe this represents intellectual dishonesty and a lack of leadership in our educational system. Educational leaders should address the issue openly, come up with their best answer and recommendations at this time, and work toward implementation of their ideas. They should periodically review their recommendations, taking into consideration effects of the implementation as well as changes in technology.

Students should not be made to feel guilty for making appropriate use of modern technology. Rather, educators should be made to feel guilty for their failure to openly address such use of technology.

**Retrospective Comment 8/26/08**

Looking back, I am impressed by my 20 years old insights into a problem that is of growing concern in our educational system. I am somewhat amused by my statement about 2K bytes of storage in a handheld device. If I were writing the editorial now, I would need to take into
consideration 8 or 16-gigabyte thumb drives (flash drives). And, of course, wireless connectivity is now commonplace.

Our educational system talks a lot about authentic assessment that is appropriately aligned with content and instruction. However, it has not yet figured out ways that it considers acceptable to allow full use of Information and Communication Technology during tests. This is interesting, since such full use is now expected in writing papers and doing other homework. Moreover, that is how one works on the job.