Confessions of a Modern Luddite: A Critique of Computer-Based Instruction

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The Luddite Legacy

Mention of the shire of Nottingham usually evokes the image of Robin Hood. But Nottingham also produced, in 1811, another mythical figure, Ned Ludd. Although the existence of "King Ludd" is questionable, the agrarian revolt associated with those who claimed to be his followers was real and the "Luddite" movement spread rapidly through northern England. By 1813, the Ludds represented a serious enough threat to justify a series of trials in Yorkshire that resulted in hangings and transportations. The Luddite movement resurfaced in 1816, during the depression that followed the Napoleonic Wars, but a combination of vigorous repression and economic recovery led to its demise in 1817.

In 1830, "The Society for the Diffusion of Useful Knowledge" felt compelled to publish an eight-page pamphlet entitled "An Address to the Labourers, on the Subject of Destroying Machinery", which reflected conventional wisdom among proponents of the industrial revolution at the time. After surreptitious replacement of a few words here and there, it also reflects conventional wisdom among proponents of the information highway that is supposed to transform society at the turn of the 21st century.

"The word Machine seems to convey to your minds, some contrivance necessarily attended with mischief to the Poor; whereas in truth, the word Machine means the same as Tool or Instrument ... Man ... as soon as he feels ... the necessity of finding food ... first invents the most simple tools; the hoe, the spade, the rake, the axe, the flail. As men ... extend their knowledge further, they contrive other machines, ... the wheel, the cart, the plough all of which are intended and used to ease his toil and abridge his labour. ... In following the course you are now pursuing, you are driving men back to their savage state, when they lived upon acorns and roots, and had no machines nor tools at all, a great demand for labour, and very little to eat."

In these more enlightened times, we no longer hang opponents of technical revolutions or even transport them to foreign lands because all we have to do is whisper the accusation: Luddite! Thus branded, these individuals automatically become ignorant, naive, backward, destructive people, who are opposed to "progress". However the insight provided by historians who have studied this movement shows that it was not the new technology to which the Luddites objected, but the societal changes that were being imposed on them from above by proponents of this technology. It was not the threat to full employment that concerned them, but the threat to the traditional wages a labourer could earn. They did not ask for a return to old fashioned work, but to "full fashioned work at the old fashion'd price."

Luddite in the Age of Computers

It would be a mistake to conclude from either the title or contents of this article that the author is opposed to computers. The first thing he does when he walks into his office, after turning on the lights, is to turn on a computer. It would also be a mistake to presume that, by labelling himself a modern Luddite, the author wishes to destroy the computers in our schools and universities, or even remove them from the classroom. There is abundant evidence that computers can play a role in teaching and learning.

Instead, like his predecessors, this Luddite would like to concentrate on carefully selected targets, to remind the reader that any critical analysis of computer-based instruction would conclude that its use does not necessarily improve the teaching/learning environment.

Should Instructional Equipment Carry a Warning Label?

Firstly, a cautionary tale. A year-long course in organic chemistry was presented in computer-projected format with many graphics and simulations, particularly of molecular structure[1]. Printouts of the screens were distributed as notes and computer materials were made available for individual study. Students took very few notes, but class participation (questions, comments, discussion) was unusually high, better than the lecturer had experienced in thirty years of teaching. Students liked the course and believed that they understood the subject well.

A control class was taught by classic techniques. Both lecturers shared similar teaching philosophy and standards. The same textbook was used in both sections, pacing was similar, and the final exam was the same.

In the final exam given at the end of the first quarter, the average score for the 30 students in the control group was 125 out of 200, whereas for the 29 students in the experimental group it was only 88 out of 200. When the test questions were sorted into categories, the experimental class was found to have done worse on all categories, even those topics that were visually intensive and potentially better understood with computer presentation.

The instructor concluded that the "electronic blackboard" allowed for the presentation of substantially more information in the time, but students had trouble absorbing the added information. They had to invest more time in the course, and the professor took three to four times the normal time to prepare each lesson. He concluded: "... introduction [of the electronic blackboard] into the lecture has more profound consequences than would first appear, and a warning label should limit its use to those tasks it does best".

Questions for the Implementation of CBI

There are many such cases on record, but, because few people want to be associated with stories of failure, the author will transform case histories of "less than successful use" of computers into a series of questions that both authors of CBI programs and potential users of these programs might consider.

Does the program teach skills that you value?

In every field of science one can find examples of beautiful programs on which students could spend hours developing skills that earn them less than 1% of the marks for the course. If they do this they will have less time to develop other skills, which might be more likely to earn them marks. When choosing (or designing) software it is useful to remember that it carries a hidden message to students, who believe that we wouldn't have spent all this money unless the content of the programs we assigned was important.

Does the program teach skills with which your students have difficulty?

It is common to come across experiments done to evaluate CBI programs in which only modest changes in student performance were observed because the students did reasonably well on the test questions even before they used the program.

Do we need a computer to deliver instruction?

The computer has revolutionized the development of instructional materials, but that doesn't mean the computer also has to be used to deliver this instruction. For the instructor, funds spent on purchasing computers to deliver instruction aren't available for upgrading laboratory equipment. For students, a computer-generated handout can be studied whenever and wherever they choose; it doesn't require a special trip to the computer lab.

Are the computers being used to do something that requires a computer?

The cost of computers can be justified when they are used to do something that can best be done with a computer, such as collecting realtime data, doing extensive calculations, manipulating massive data bases, storing and retrieving information, and so on. All too often, however, computers are being used to deliver instruction that could be presented almost as well with a two- or three-page handout at a cost about five orders of magnitude smaller.

Are the computers being used to do things you would use a computer to do?

There are 50 faculty and more than 300 graduate students in the Department of Chemistry at Purdue. Virtually all use computers - to collect, store, or manipulate data, for molecular modelling or other calculations, for e-mail and Web access, for word processing, and even for playing games. None of them use the computer the way CBI programs ask students to use the computer to learn conceptually difficult material. Perhaps the optimum way of using computers with students is to use them as productivity tools, the way we use them.

Do the students have difficulty navigating through a CBI program?

Studies of student use of CBI programs suggest that students often get lost, or disoriented, while navigating their way through the program. Navigation problems are often the result of programs that try to do too much. Because they can link many topics, developers of software programs often believe that they should link these topics.

Is the program a first draft or a finished product?

Because of the time and effort that goes into writing a CBI program, they often have a stronger resemblance to the first draft of a textbook being considered for publication than they do to the third or fourth edition of a popular text.

Does the program feature things that can be done or things that should be done?

Consider two software packages. One randomly selects an organic compound from examples stored in its memory, displays the structure, asks for the correct IUPAC name, and then tells the students whether they were right or wrong. The other allows the student to enter virtually any compound they could imagine, asks them to propose its name, analyses the structure to determine the IUPAC-approved name, and then analyses the student's answer to determine what errors have been made. The second would be the program that does what should be done, not merely what can be done, and it is one that this author would gladly purchase.

Are the students using computers because they want to, or because they have to?

The author is familiar with a variety of programs that represent excellent course supplements. Some are particularly useful for weak students, struggling with the course. Others provide a challenge to strong students, who might otherwise be bored. But these programs aren't equally successful when they are required of all students in the course.

Does the program increase the students' understanding of course content or their familiarity with computers?

Several years ago, we used a popular spreadsheet program to create a series of templates that guided students through the calculations associated with four general chemistry laboratory experiments. Although the student response to these spreadsheets was favourable, they had no effect on the students' performance on exams related to the laboratory or on students' retention of information. The most significant effect was on the students' ability to use a spreadsheet program, which wasn't one of the goals of the course.

Conclusion

Hippocrates (460377 B.C.) is the source of the Physician's Oath, which includes the notion that "I will use treatment to help the sick ... but never with a view to injury and wrong doing. ... to help the sick, and ... abstain from all intentional wrongdoing and harm."

When implementing computer-based instruction, we should strive, above all else, to ensure that we don't interfere with the students' progress through our course. This can only be achieved by recognizing that any change in an instructional environment will have both positive and negative effects. By reflecting on what happens when we make changes in our course, we should be able to find ways to maximize the positive effects and minimize the negative effects of these changes.

Reference

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