Effective Practices (Part 4): Problem Solving


Q. I am planning to make a presentation to our school board. What are some really good arguments that computers make a difference in education?

I am currently involved in a research project designed to investigate this issue and provide some answers to this frequently asked question. This column is the fourth in a five-part series of columns summarizing some of what my research group is finding as well as explaining my own current thinking on this question.

Key Ideas in Problem Solving

Here are two of the most important ideas in problem solving:

1. Build on your own previous work and on the work of others. (Don't reinvent the wheel.)

2. Represent the problem-solving work you do in a way that makes it easy for you and others to build on it.

Any tool you use represents some stored work and knowledge of its inventors and developers. Thus, whether you are using a hammer to drive a nail or a computer to do word processing, you are using the previous work of others.

Some of the previous work of people can be stored in written form. Words and pictures can describe a hammer and how to make a hammer, even down to the level of smelting the metal ores for the hammer head. However, it is evident that most people find it more convenient to directly access a hammer when they need one rather than access a description of how to make a hammer.

Computer and Information Science

In a great many instances, computerized equipment can both store the information about how to solve a particular kind of problem and can actually do the work to solve the problem. You can think of this as a major step forward in the automation of building on the previous work of others. In some sense, it is like storing the description of a hammer in a form so that the computer can build a hammer and then use it to solve a "hammering" problem.

Computer scientists have coined the term effective procedure to represent a detailed, step-by-step set of instructions that can be mechanically interpreted and carried out by a computer. Procedures and procedural thinking are two of the most important ideas that have come out of the field of computer and information science. These ideas are fundamental to developing computer systems that can help people solve problems.

Templates and Artificially Intelligent Agents

Computer scientists are continuing to make significant progress in developing aids to problem solving. Thus, there is a steady flow of increasingly powerful computer tools. Two ideas
are particularly important in this regard: (a) templates and (b) artificially intelligent agents and expert systems.

A template can be thought of as sample design for a particular type of document or procedure. For example, suppose you want to develop a slide show using desktop presentation software. The software will likely contain a number of different templates, each adhering to good design principles. One design might be best for a formal report to a school board while a different design may be best for a humorous after-dinner presentation. The built-in templates store the knowledge and experience of experts in the design of slides.

It is now common for major pieces of application software to include a number of built-in templates that often contain detailed instructions on how to use the templates and how to modify them to better fit the user's specific needs. And, of course, the computer system makes it easy to create your own templates for your own use and for use by others. For example, in a word processor you can save a document as Stationery and then use the styles and parameters of that document again and again on future files.

Steady progress is also being made in the field of artificial intelligence. A wide range of intelligent agents have been developed. They can do such things as screen incoming telephone calls or search a variety of information sources for specific types of information. Expert systems have been designed to solve or help solve a wide range of problems that humans find intellectually challenging. Thus, expert systems exist to help make decisions about such things as loan applications, medical diagnoses, and car repair procedures.

Applications in Education

One goal many schools have is for all of their students to become computer literate. Computer literacy has many components, including learning to use a wide range of generic computer tools (word processors, spreadsheets, databases, and others) and learning to use a computer effectively as an aid to problem solving.

It is relatively easy to learn the mechanics of using a generic computer tool at a rudimentary level. It is much more difficult to learn to think, represent problems, and solve problems in the environment of a computer tool. The difficulty is magnified when the problem requires simultaneous use of several tools. Learning to deal with procedures and procedural thinking in problem solving does not come easily.

Various software developers have packaged a number of the generic computer tools into integrated packages. An integrated package may contain a half-dozen generic tools, all designed for simultaneous work on a single problem. For example, two widely used integrated packages are ClarisWorks and Microsoft Works. Any integrated package can be used to help students learn the two key ideas about problem solving discussed at the beginning of this article. An integrated package can also be used as a computer environment to learn about procedures and procedural thinking. Many schools are now using integrated packages throughout their curricula. This is a worthy and achievable goal for all schools.

[Send your questions/or this column to Learning and Leading With Technology, International Society for Technology in Education, 1787 Agate Street, Eugene, OR 97403-1923; fax 541/346-5890; iste@oregon.uoregon.edu. You can e-mail Dr. Moursund directly at moursund@oregon.uoregon.edu.]
Note: The National Foundation for the Improvement of Education (NFIE) has received funding from Microsoft founder and CEO William Gates III to carry out a project titled “The Road Ahead.” NFIE is a non-profit educational foundation created by the National Educational Association in 1969. NFIE has subcontracted with the International Society for Technology in Education (ISTE) to do research and evaluation on this project. Some of the ideas in this series of columns on computers and effective practices are based on this research.