Q. It seems like every time I talk to you, you have come up with some new far out idea. What's your latest?

Recently I read the book *Outsmarting IQ: The Emerging Science of Learnable Intelligence*, by David Perkins (New York: The Free Press, 1995). This book discusses a number of different definitions of intelligence. It examines these definitions in terms of whether various types of intelligence can be increased by things such as drug avoidance, proper nutrition, exposure to a rich intellectual environment, appropriate schooling, and so on. As might be expected from the title of the book, the author believes intelligence can be increased. His specific approach is closely related to the idea of high-road transfer, a theory of transfer of learning that he helped develop nearly a decade ago.

The last part of Perkins' book is futuristic. He speculates about the inadequacies of individual human intelligence to effectively deal with many of the complex problems faced by the societies of our world. This speculation serves as an introduction to discussing distributed intelligence.

Distributed intelligence is defined as a combination of people and computers networked together and supported by software designed to help the overall system carry out activities that require intelligence. The individual computers as well as the networking system include artificial intelligence software and groupware—software specifically designed to enhance collaborative work by the people on the network. The system may include access to massive databases and to huge amounts of computing power.

Two things strike me as particularly important about distributed intelligence

1. Research conducted using a variety of different approaches supports the need for and value of distributed intelligence systems.

2. The various components of the system can all become more "intelligent."

There has been quite a bit of research on problem solving done by collaborative groups versus individuals. The research supports the value of collaborative groups in a wide range of different problem-solving situations. Access to information and access to computer tools to help process the information are important aids to problem solving. Perhaps most important, however, is that many of the problems that people want to solve and tasks that people want to accomplish are too large to be carried out by a single person. Collaborative efforts are necessary.

Consider the following points about how each of the individual components of a distributed system can grow in the contributions it makes to the overall intelligence of the system.

1. Research by Perkins and many others assures us that we can significantly increase the "effective" intelligence of a person functioning in rather general problem-solving environments, such as in a distributed intelligence system. If you have worked with cooperative learning groups in your own teaching, you
know that students can learn to be more effective in such groups. And, of course, it is obvious that training and experience in problem solving making use of a distributed intelligence system will help a participant to get better at such an activity.

2. The hardware components of computer networks are getting better. Eventually it will be common to use networks that allow high-definition, two-way interactive audio and video.

3. Significant progress is continuing in the development of groupware.

4. The field of artificial intelligence continues to make progress, and it is producing useful problem-solving aids, such as expert systems and agents.

5. More and more of the collected knowledge of the human race is being digitized and stored in computer databases. The capabilities of the hardware and software needed to store, retrieve, and make effective use of this information is increasing at a rapid pace.

It is clear to me that distributed intelligence systems are a wave of the future whose time is rapidly approaching in the area of education. Of course, this presents educators and our educational system with still another challenge. Our educational system does not have in place the full-blown distributed intelligence systems that are just now coming into use in many businesses.

However, there are many different things that schools can do now to help their students become better prepared to function well in distributed intelligence systems. Examples include:

- An increased emphasis on cooperative learning and cooperative problem solving.
- Use of e-mail and other forms of communication systems as an aid to collaborative activities. A project carried out by students located in two different classrooms in a school or in two different school buildings in a city can be a useful learning experience.
- Increased emphasis on learning to represent, communicate about, and solve complex problems in all disciplines.
- Increased emphasis on learning to use the power of computer tools such as databases, spreadsheets, graphics, and word processing to represent and solve problems.
- Increased emphasis on powerful aids to problem solving, such as those found in computer-assisted design and mathematics packages.

The work of Perkins and other cognitive scientists suggests ways that we can help individual people become more "intelligent." The potential gains are real, but modest in size. They pale to insignificance when compared to the potentials of distributed intelligence.