



IT as Language and Content

Powerful Ideas Shaping Our Educational System

By David Moursund

In my September 1999 editorial, I listed 10 powerful ideas of information technology (IT) in education. (Read them online at www.iste.org/L&L.) Each of these powerful ideas cuts across many disciplines, makes effective use of IT, and has enduring value. Powerful Idea 5 is addressed here.

Logan (1995) argues that IT is a language—the fifth in the series that begins with natural language, reading/writing, mathematics, and formal science. What is particularly interesting about the third and fourth languages—mathematics and formal science—is that each is both a “language” and a content area. For example, the language and tools of mathematics are inextricably intertwined with its content.

IT as language and the discipline of computer and information science are, of course, inextricably intertwined. But, IT has emerged as an aid to representing and solving problems in academic areas outside computer science. Thus, we have an entirely new phenomenon.

IT is becoming an integral component of both the language and the content of every academic discipline. This is gradually changing what it means to know and work in the various academic disciplines.

Some Examples

The spreadsheet was originally developed for use in business, and it certainly has changed the content of business courses. However, the spreadsheet is useful in representing and helping solve problems in a wide variety of disciplines. For example, a spreadsheet can be used to represent population data, do computations on the data, and draw graphs using the results of the computations. Because of its capability, the spreadsheet has affected the content of math, science, social science, and other subjects.

Geographic information systems (GIS) are a powerful aid to problem solving in geography, cartography, environmental engineering, and related

**10 Powerful Ideas
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fields. (GIS are spreadsheet-like, specifically designed for creating graphical representations of data stored on or with maps.) GIS contribute to major changes in the ways of representing and solving a wide variety of social science, science, engineering, and environmental problems.

In math, we have long had powerful math problem-solving and manipulation systems such as Mathematica and Maple. Many secondary school mathematics courses now make routine use of handheld calculators that can automatically graph functions or solve equations. These and similar powerful tools are now routine parts of the ways of understanding and using math throughout all areas of science and engineering.

Graphic design software has completely changed mechanical drawing and graphic artist coursework. Musical Instrument Digital Interface (MIDI) software and related hardware have changed the music industry. Desktop publishing software has changed the publishing industry. Computer-based animation and computer-based editing have strongly affected the movie industry. In each of these examples, the content of the discipline and how one solves problems in the discipline are becoming inextricably intertwined with IT.

Some Implementation Ideas

These teaching ideas focus on IT as interdisciplinary language and content.

1. Each academic discipline is characterized by the types of problems it addresses, its accumulated body of knowledge, its specialized vocabulary and methodology, its ways of knowing and doing, its history, and so on. Divide your class into teams. Each team is to select a different discipline and develop a presentation that clearly defines the discipline and illustrates how the content of the discipline is being affected by IT. Some variations:

- A. Students can be assigned to teams on the basis of courses that they are taking from other faculty. Thus, for example, the First-Year Algebra Team would explore how IT is integrated into the content of algebra and specifically how it is affecting the content of the course they are taking.
 - B. Broaden the scope of disciplines or areas that students can select. Examples of areas that might be studied include sports, collecting (e.g., coins, stamps, trading cards), games, travel, and retail selling.
2. Many disciplines make use of special symbols or notation in their writing. For example, music uses musical notation, math uses a wide range of special math symbols, and foreign languages use diacritical marks and a variety of symbols not in the English alphabet. Divide your class into teams. Each team is to select a discipline and explore the symbols and notations that are common to the discipline but are not routinely used in other disciplines. Then, the team is to find and learn to use desktop publishing software that includes the symbol set. They are to explore how this software has changed publishing within the discipline. *Hint:* Many word processors (such as Microsoft Word) contain very extensive symbol sets.
 3. IT helps nonspecialists in a particular field solve some of the complex problems of their field. For example, a spreadsheet contains a variety of graphing routines, statistical routines, and computational formulas. Students can use these routines without having the knowledge and skills of how to carry them out by hand. A computer system can accept music as input and produce musical notation as its output. The Global Positioning System (GPS) can pinpoint one's location on earth. There are a huge and growing number of

artificially intelligent expert systems that have come into routine use. Working individually or in teams, develop a bulletin board display and/or whole class presentation of such examples. Quite likely, you will want to use scanned images and those downloaded from the Web. This project might extend throughout a semester or year.

4. Working in teams or as a whole class, develop a generic list of modes of communication that cut across all disciplines and that are facilitated by IT. E-mail, desktop publishing, desktop presentation, and interactive hypermedia are examples. Also, make a list of the general areas of study provided in your school.
 - A. Rank each course area taught in the school on the basis of the relative value of each of these modes of communication for understanding and working in the discipline.
 - B. Then, working in teams, explore the nature and extent to which each general area or department in the school facilitates, encourages, allows, discourages, or does not allow students in their classes to make use of these aids to communication.
 - C. We are familiar with writing across the curriculum. Have your class select an IT-based communication mode, such as hypermedia. The class then works on a whole-school project (for example, hypermedia across the curriculum), encouraging and facilitating all teachers in the school to help their students gain increased fluency in this mode of communication.

Final Remarks

IT is of growing importance within the content of each academic discipline. Therefore, each teacher needs to help

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his or her students learn how IT is affecting the disciplines he or she teaches. Schoolwide and districtwide planning and coordination are needed in this endeavor, with a special emphasis on articulation across different courses and grade levels.

Resources

Maple is available from Waterloo Maple, Inc. Find out more by visiting www.waterloomaple.com or calling 800.267.6583 or 519.747.2373.

Find out more about Mathematica by calling 800.441.MATH or 217.398.5151 or by visiting Wolfram Research's Web site at www.wolfram.com.

Word is available as a stand-alone product or as part of Microsoft's Office suite from your local software reseller or at www.microsoft.com.

For more on geographic information systems, visit www.geoinfosystems.com, and for more on the Global Positioning System, visit www.gpsworld.com.

Reference

Logan, R. K. (1995). *The fifth language: Learning a living in the computer age*. Toronto, ON: Stoddart Publishing Company.

Dr. David Moursund (dmoursund@iste.org) has been teaching and writing about information technology in education since 1963. In 1979, he founded the International Council for Computers in Education (ICCE). In 1989, ICCE merged with the International Association for Computing in Education to form ISTE. He currently serves as executive officer for research, development, and evaluation.

Letters



Dear Editors:

Your October feature really hit home with me (*L&L*, vol. 27 no. 2, "Why Gen www.Y?" pp. 7–9). Five years ago, I received my master's degree in math and computer science education. I envisioned moving into a teaching position where I could integrate technology into lessons in existing curriculum areas, rather than instruct what I felt were useful, yet isolated lessons about how to use computers and software.

My team members and I wrote lessons, activities, and units into which we integrated technology for our middle schoolers. We included best practices across disciplines, where all team members were occasionally "the expert." I gained confidence and experience through my district-level committee memberships, which were definitely collaborative. We wrote and analyzed learning objectives, outcomes, and authentic assessments to align with state goals! Because of all of the collaboration (and success) I was a part of, I had grown tremendously and wanted to share my experience with others.

I recently accepted my current position of Educational Technology Specialist, where one of my responsibilities is to help teachers in Grades K–8 integrate technology across the curriculum in Glencoe (Illinois) School District 35.

I have been fortunate to work with teachers across the district who exemplify student-teacher collaboration. At Glencoe's Central School for fifth through eighth graders, Mrs. Nancy Riddle's "Tech Corp" students collaborate with teachers to design Web pages. They also assist at staff and community classes during and after school hours.

Having worked with these students as the instructor, I have found them to be patient, knowledgeable, and creative with their teachers. The role reversal is a wonderful experience for all of the learners involved! I believe that when students become teachers, even briefly, they build self-esteem. The opportunity is real and valuable, the responses haven't been manufactured, and the students own the memory of their contributions to others' learning. The creative problem solving that occurs is a powerful example of celebrating differences in ideas and personality.

The collaboration of teachers (teaching experience) and students (technological experience) provides both groups with an opportunity to interact at a level where mutual respect and metacognition occur simultaneously!

Thank you for this great feature article!

Sincerely,

Jean Uselman (uselmanj@nttc.org)

Educational Technology Specialist, Glencoe (Illinois) School District #35
(by e-mail)

Dear Editor:

I would like to compliment ISTE for devoting a whole issue of *L&L* to the theme of professional development (vol. 27 no. 3). School districts need to get teachers through the hardware/software classes into those that help them integrate technology into their own curriculum, as well as include the "hot" issues of testing, standards, and assessment.

Thank you!

Mary Kreul (mkreul@execpc.com)

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L&L welcomes your feedback. Send letters to Kate Conley, editor, kconley@iste.org.

Online Supplement

Ten Powerful Ideas Shaping the Present and Future of IT in Education

By David Moursund

In the September 1999 issue of L&L, I listed 10 powerful ideas that are helping shape the present and future of information technology (IT) in education. Each of these powerful ideas cuts across many disciplines, makes effective use of IT, and has enduring value.

1. **Connectivity.** IT has facilitated the development of a Global Digital Library as well as other huge databases that are in routine use, and IT aids in communication among people. The world is being changed by communication systems that cut across national boundaries. Mobile computing is making access possible anywhere, anytime to information and to people. This supports increased educational emphasis on understanding and on library research skills, as compared to rote memory.
2. **Information appliances** (Norman, 1998). We are still in the early stages of a megatrend toward computers becoming invisible—much in the same way that electric motors are built into all kinds of appliances and are no longer emphasized. When a technology reaches the appliance stage, the focus switches from learning the technology to learning to solve problems and accomplish tasks using the appliance.
3. **Effective procedure.** An effective procedure is a detailed step-by-step set of instructions that can be mechanically interpreted and carried out by a specified agent, such as a computer or automated equipment. Procedural thinking includes developing, representing, testing, and debugging procedures.
4. **User interface.** We all understand the significance of the development of the graphical user interface that includes the mouse. We are just at the beginnings of routine use of voice and virtual reality as part of the human/machine interface.
5. **IT as integral part of the content of non-IT disciplines.** Logan (1995) points out that IT is a language that cuts across all disciplines and is increasingly part of the content of various disciplines. Examples include spreadsheets, geographic information systems, computer-aided design, and mathematics systems such as Mathematica and Maple. This trend means that each discipline-oriented teacher needs to have an increasing amount of knowledge of roles of IT in knowing and doing the discipline.
6. **IT-assisted problem solving.** One of the most useful strategies in problem solving is breaking big problems into smaller, more manageable subproblems. Increasingly, IT is a tool that can solve these subproblems—thus, greatly increasing the problem-solving capabilities of computer users.
7. **Modeling and simulation.** The 1998 Nobel Prize in chemistry was awarded to two computational chemists. Computer-based modeling and simulation are now powerful aids to knowing and doing all of the sciences as well as many other disciplines such as economics and business. For example, a spreadsheet is now a

routine aid to developing business models.

8. ***Communication in Cyberspace.*** This includes desktop publishing, desktop presentation, e-mail, videoconferencing, and interactive hypermedia. IT has opened up entirely new ways to communicate in both synchronous and asynchronous modes that include text, graphics, sound, color, and video.
9. ***Empowering students through project-based learning (PBL).*** IT is a powerful aid to doing the work on a project and to representing the results of this work. PBL is an excellent vehicle for implementing constructivism, cooperative learning, and collaborative problem solving (Papert, 1980; Moursund, 1999).
10. ***Lifelong learning—anywhere, anytime.*** IT has added new dimensions to learning, such as distance learning, computer-assisted learning, intelligent computer-assisted instruction, and learner-centered software. Progress in learning theory, brain theory, and artificial intelligence is being incorporated in software that is designed to help people learn—often in a “just-in-time” environment.

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