



Powerful Lesson Plans

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.

Lesson plans can be designed to help students simultaneously learn powerful ideas in IT and in other fields. I call these interdisciplinary IT (IIT) lesson plans. This month's editorial discusses desirable features of IIT lesson plans.

The Principle of "And"

A good lesson plan has multiple, mutually supportive goals, all targeted toward supporting student learning. A good IIT-oriented teacher might make the following type of statement about a lesson plan she or he is developing: "In this constructivist-based lesson I will help students learn one of the really important ideas in math *and* learn one of the really important ideas in IT *and* practice cooperative learning *and* work on their higher-order problem-solving skills *and* reinforce their basic skills."

Note the *ands* in this sentence. As a teacher gains knowledge, skills, and experience, the teacher's lessons tend to include more and more *ands*.

Features of a Powerful IIT Lesson Plan

This section lists and briefly discusses six features of a powerful IIT lesson plan. This list may help you as you develop powerful lesson plans for your own use and to share with others.

1. A powerful IIT lesson plan is practitioner oriented. It can be adopted and adapted by teachers with significantly different backgrounds, knowledge, and skills. It will work with a wide range of students in widely varying learning and teaching environments. It is respectful of the amount of time a teacher has to prepare lessons.
2. A powerful IIT lesson plan is rooted in the best practices from practitioners and researchers. The teaching and learning strategies are research based. Often such a lesson openly engages both the teacher and the student as action researchers, exploring the theory and practice of teaching and learning. Students learn about learning theory, brain theory, themselves as learners, and learning to learn.
3. A powerful IIT lesson has multiple content goals, including:
 - A. a focus on one or more powerful ideas in disciplines outside of IT.

10 Powerful Ideas
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These powerful ideas are rooted in and supportive of national, state, and regional standards in the disciplines.

- B. a focus on one or more powerful ideas in IT. These powerful IT ideas are rooted in and supportive of national, state, and regional IT standards, such as the National Educational Technology Standards (NETS) that ISTE has developed.
 - C. a focus on how the combination of 3A and 3B empowers students to solve problems and accomplish tasks that cannot readily be accomplished without the combined knowledge and skills from the non-IT and IT fields.
4. A powerful IIT lesson has an explicit focus on higher-order thinking and problem-solving skills and on transfer of learning. Thus, each of the powerful ideas is named and explicitly explored. Students are facilitated in exploring uses of these powerful ideas in different areas—and especially, uses that they have made in the past and that they may want to make in areas of particular interest to the students. (This general approach to transfer of learning is sometimes called High Road Transfer.)
 5. A powerful IIT lesson has clearly defined assessment that is communicated to students. The lesson provides ample opportunity for students to self-assess and to take responsibility for their own learning. It is designed to help students grow as independent, self-sufficient, lifetime learners. The assessment supports student growth in higher-order

thinking and problem-solving skills and in transfer of learning.

6. A powerful IIT lesson plan is designed to facilitate and encourage the principle of “and.” It can be incrementally improved over time, based on input from practitioners, researchers, and students. The lesson incorporates all or most of the five ideas listed above.

An Illustration

This section illustrates some of the thinking that might underlie the development of a powerful IIT lesson.

Graphing is a powerful idea from mathematics. Students learn to graph functions, relations, and all kinds of data. Such visual representations are useful for a wide range of problems and are fundamental to knowing and doing mathematics.

IT brings us computer graphics—the ability to use a computer to graph functions, relations, and all kinds of data. The use of computer-based graphing brings new power to people working to solve math problems. Even such a modest tool as a graphing calculator is having a significant effect on the math curriculum.

Next, think about transfer of learning. Developing and using visual models is a powerful idea in many disciplines besides mathematics. For example, architects and engineers develop visual models of the structures they are designing. With the aid of computer graphics, they can allow such models to be viewed from different directions (including from the inside) and under different weather and lighting conditions.

Visual models are a key component of virtual realities. Virtual realities are a type of simulation, and computer

simulation is a powerful idea from IT. With the aid of powerful computers, virtual realities (more generally, computer simulations) can be constructed that aid learning and problem solving in any discipline.

Notice how the discussion has moved from the relatively concrete (graphing in math, use of computers to do math graphing), to visual representations as an aid to representing and solving problems in many disciplines, to use of computer graphics in virtual realities. Virtual realities are an overarching IIT idea that will eventually have a profound effect on teaching, learning, and problem solving.

Moreover, virtual realities are a topic that many students find inherently interesting. Many of the computer games that girls and boys enjoy playing make extensive use of graphics to depict simulated worlds. These simulation games can be thought of as examples of virtual realities.

Final Remarks

It is not easy to develop a powerful IIT lesson plan. It can be very helpful to have input from practitioners, discipline-oriented specialists, IT specialists, and educational researchers. That is the approach that ISTE has been using in the second phase of its NETS project. In this phase, sample IIT lesson plans have been developed. These lesson plans are available online at <http://cnets.iste.org>. ■

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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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