

What is Effective Integration of Technology, and Does it Make a Difference?

Debra Rein
Apple Computer, Inc.
Cupertino, CA, USA

Effective technology integration can make a difference in student learning in significant ways. In particular, the Apple Classrooms of Tomorrow (ACOT) research project, conducted from 1985 to 1995, looked at the impact of technology on teaching and learning, and found that effective technology integration facilitated student improvement in a variety of skills identified as essential to prepare today's students for tomorrow's world. The *SCANS Report*, published in 1991 by the U.S. Department of Labor, identified, in addition to traditional basic skills, the following vital skills for tomorrow's workforce: Thinking Skills—the ability to learn, reason, think creatively, make decisions, and solve problems; Personal Qualities— individual responsibility, self-esteem and self-management, sociability, and integrity.¹ The ACOT studies found that technology, when used appropriately, can facilitate an increase in collaboration, dynamic exploration of information, problem solving and experimentation, social awareness, independence, and positive orientation toward the future.²

However, technology doesn't make a difference, unless it is well used. ACOT researchers found that teachers progress through a series of developmental stages in their ability to effectively think about and use technology for teaching and learning.³ A teacher's progress along the continuum, called the Evolution of Thought and Practice, has a very significant impact on how the

technology is used, and thus on what kind of a difference it makes.

The Evolution of Thought and Practice

Stage 1: Entry

Teachers at the Entry level are not comfortable using technology. They avoid using it themselves and they are fearful that if they or their students use the computers, something that they don't understand, or cannot manage, will happen. They rely on someone else in the school to install software on their classroom computers for students to use independently, and don't make explicit connections between computer work and the rest of the curriculum.

A typical entry-level teacher uses direct instruction and whole class activities to deliver content and skills to their students. They are teaching in a traditional fashion, and don't see how the computers fit, both in terms of how they are useful, and also how they can possibly make time to use them.

If they have classroom computer(s), they are usually pushed "out of the way", against a back or side wall, and are used in incidental ways not connected to core curriculum or process. If the class has computer lab time, the entry-level teacher typically uses this as a planning period.

Stage 2: Adoption

Teachers at the Adoption stage typically use one or two software applications that they find useful for themselves. Popular choices include software that allows them to create banners for their classrooms, or word processing programs to write letters home to

¹ SCANS 2000.

² Apple Computer, 1995.

³ Sandholtz, 1997, p. 37.

parents, or create a class newsletter. You won't see much student computer use in their classrooms. Students may use a word processor to create the final draft of their writing for publication, but not until they have an approved final draft. If the Internet is used, it's used by the teacher, to prepare lessons, etc. You will typically see the classroom computer set up in a place convenient to the teacher, with a printer nearby.

Stage 3: Adaptation

Adaptation is the stage where teachers begin to make the transition to using technology with their students in the context of the curriculum. Often, one of the first tentative steps is assigning students to write documents with the word processor, and then to engage in peer editing. The nature of the task initially isn't any different than it might have been prior to using technology, but they now use the technology to support the process in some way. Student computer assignments tend to be uniform for the entire class, and very clearly delineated. Direct instruction is still the primary mode, with little opportunity for students to construct their own knowledge. In part as a result of adding technology into the mix without making other fundamental changes in practice or structure, teachers at adaptation are often concerned with classroom management, assessment, time, and the impact on student learning when they "add in" using technology.

Stage 4: Appropriation

The Appropriation stage is when teachers begin to leverage technology for things that it can do best and uniquely makes possible. Teachers at Appropriation consider their teaching objectives, the best way to approach those objectives, and the best tools. This is when technology opens possibilities for higher order thinking, collaboration and cooperation, enhanced comprehension, problem solving, etc. They are beginning to loosen up the classroom management

structure, and instead of a structured computer schedule, it is more seamlessly integrated into the day. Student tasks are more rigorous, open-ended and multidisciplinary.

Stage 5: Innovation

Innovation (or Invention) is when the teacher begins to break the education mold. In a classroom of a teacher at Innovation, students are engaged in learning activities in ways which may not resemble conventional teaching and learning, in much the same way that a modern operating theater bears little resemblance to how medicine was traditionally practiced 50 or so years ago. At this stage, the teacher has made the transition to making the technology be an ever-present transparent part of the curriculum. The classroom environment typically is one where students are given opportunities to construct their own knowledge in a meaningful context. Learning is student-directed, and objectives and standards are addressed through student projects, rather than projects supplementing more traditional ways of addressing standards. Students are given many options as they approach a learning unit, and they are encouraged to go beyond the teacher's understanding of the topic and the uses of technology. Students feel free to share what they know with each other and with the teacher.

Thus, in considering whether technology is making a positive impact on education, it is essential to consider how it is being used, and how to both discern and create environments where it is being used at the Appropriation or Innovation level. Unfortunately, most educators are not equipped to either recognize or create such environments, and much professional development is required if this is to change.

Some of the key distinguishing factors of classrooms of teachers at the Appropriation or Innovation stage include:

- students working at different tasks

- students taking on a variety of roles, including acting as experts after investigating a particular topic
- students collaborating, applying themselves to different aspects of a project, and then bringing their collective accomplishments and knowledge together to produce a new result or understanding
- constructivist teaching methods being applied
- technology being used to do things that could not have been done without it, such as contacting distant experts or collaborating with another class and sharing data over the Internet
- teachers employing a variety of assessment methods, including performance assessments, peer-review, self-assessment, tests and quizzes.

Each technological tool has its own unique contribution. For example, mobile computers allow you to take the processing power with you wherever you go. Taking a mobile computer on a field trip allows students to do more than just collect data. If they are only collecting data, perhaps a pencil and paper will suffice. But with the computer along, students can analyze the data on the spot, create hypotheses or strategies based on that analysis, and take different actions because of it. This allows for a more robust learning experience, engaging many higher order skills. It also more closely resembles the ways in which professionals leverage technology to great benefit in the scientific and business communities.

Leveraging the power of technology requires that teachers approach teaching and learning in fundamentally different ways. If you start with a fixed set of information to be learned, and define tasks narrowly, then technology becomes a problematic add-on, just one more thing to squeeze into an already crowded daily schedule. An example of this is the struggle of teachers whose preferred methodology is whole class instruction, with

access to only a handful of computers, not one for every student. However, if the teacher views their task as supporting students to construct relevant knowledge, to learn how to learn, and how to cooperate and collaborate, then technology has clear and fundamental value as a tool for achieving these objectives. For example, in a learning environment designed around exploring a topic or question using a variety of resources and media, working in groups, analyzing and synthesizing the information gathered with the support of the technological tools available, and creating a means of sharing their final understandings and conclusions with others.

Another element of the ACOT research with relevance to this topic is a model for developing and discussing curriculum, for which the ACOT researchers coined the term, "Unit of Practice." The Unit of Practice (UOP) model promotes reflecting on learning environments through seven primary filters.

The Unit of Practice

- The **Invitation** is an essential question that frames the unit and presents the fundamental learning the unit is intended to address. Ideally, it represents a broad concept or theme.
- The **Situation** refers to the duration and location of the activities that comprise the unit. Students may do part of the unit in the classroom, part on field trips or visits on the Internet, or part in the community. This section of the UOP helps teachers think outside the classroom box and address classroom management issues.
- The **Interactions** describe how the students and teacher work together. It includes grouping strategies as well as student and teacher roles. How do students collaborate? Are they expected to acquire and share expertise with

classmates? This is also the section that addresses other people contributing to the unit and their role. These might include guest speakers, the library-media specialist, and others.

- The **Tasks** describe what the students actually do.
- The **Standards** refer to the National, State or District curriculum and technology standards addressed by the unit.
- The **Assessment** includes all of the ways in which the teacher knows whether the students have met the standards and accomplished the objectives set forth in the various tasks.
- The **Tools** include all of the tools and materials needed to accomplish the unit, both high tech tools, and more traditional tools, such as paper, pencils, and art supplies.

In particular, several of the UOP elements can be used to reflect on the question of exemplary integration of technology, and help point to opportunities for technology to make a fundamental difference in learning.

For example, in designing the situations for a unit, a teacher at Appropriation or Innovation may think about what situations are possible or perhaps necessary because of the technologies she and her class have available to them. Virtual field trips might be one of the new possibilities, while flexible scheduling to take advantage of flex times in the school computer lab, or creative, collaborative scheduling with colleagues to create the opportunity to “borrow” computers located in their classrooms, might become necessities.

In exploring the appropriate interactions, a teacher designing a unit to be relevant and meaningful for the students can consider

engaging students in addressing problems that are relevant to an audience outside of the classroom, and then involving people from outside the school with the project. The Internet is an example of a technology that makes entirely new and rich interactions available to students. They can collaborate with peers and experts at a distance who are working on the same issue and they can share their findings with people who have a reason to be interested. With Internet access, students have an opportunity to become an expert within their class on almost any topic, researching and becoming even more knowledgeable about it than their teacher, and then sharing that knowledge for the benefit of the class.

A well-designed unit would have the students achieving objectives associated with appropriate standards, and would assess this as a natural part of the activities in which the students are engaged. That is, do the work products they are producing reflect an understanding of the topic? Have they selected relevant information to portray to the audience for the product? Have they analyzed or synthesized information to reach new understandings and conclusions, both for themselves and for their audience? In the answers to these questions lies the true power of technology for teaching and learning – the power to engage students of all ages in relevant and meaningful work, while teaching them both essential subject matter and essential skills for future success.

For teachers to become skillful at creating these kinds of advanced technology integrated learning environments takes time, professional development, and support. Over the years we have learned a great deal about what it takes to get teachers to this point in their own development, both through the ACOT research and through experience working in professional development with thousands of teachers in hundreds of schools across the nation and around the world.

The ACOT research pointed out the value of changing the fundamental approach to teaching, to incorporate more genuine inquiry, problem-solving, and other kinds of authentic learning tasks. The challenge identified by the ACOT research is to strengthen the educational community's understanding and recognition of advanced technology integration, as it is reflected in the teacher's approach to both teaching and to technology. When school districts change their objectives for technology integration from getting technology used, to having technology effectively leveraged, and begin to target the kinds of tasks and outcomes addressed above, then the true potential of effective technology integration will finally be unleashed.

References

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