A Range of Use: Technology in Learning
Current Research Affirms the Benefits of Student Technology Use

By Cheryl Lemke

Given the realities of globalization, knowledge work, and accelerating societal change, it's obvious that what students learn—as well as how and when they learn—is changing.

Over the last decade, there were tremendous advances in the science of learning, made possible by the convergence of research in the cognitive sciences, neuroscience, human development, and technology. As a result, we know a great deal more today about how people think and learn (Bransford, Brown & Cocking, 2000).

For starters, studies show a clear correlation between student learning and engagement in meaningful, relevant, and intellectually stimulating work (Newmann, Bryk & Nagaoka, 2001). While all learning is deeply personal, the frequency and relevance of learning increases when technology enables us to tap outside experts, visualize and analyze data, link to real-world contexts, and take advantage of opportunities for feedback, reflection, and analysis (Bransford, Brown & Cocking, 2000).

Technology influences learning in three significant ways. A synthesis of recent research and national skill sets shows that it is a driver of change, a bridge to academic excellence, and a platform for informed decision-making and accountability:

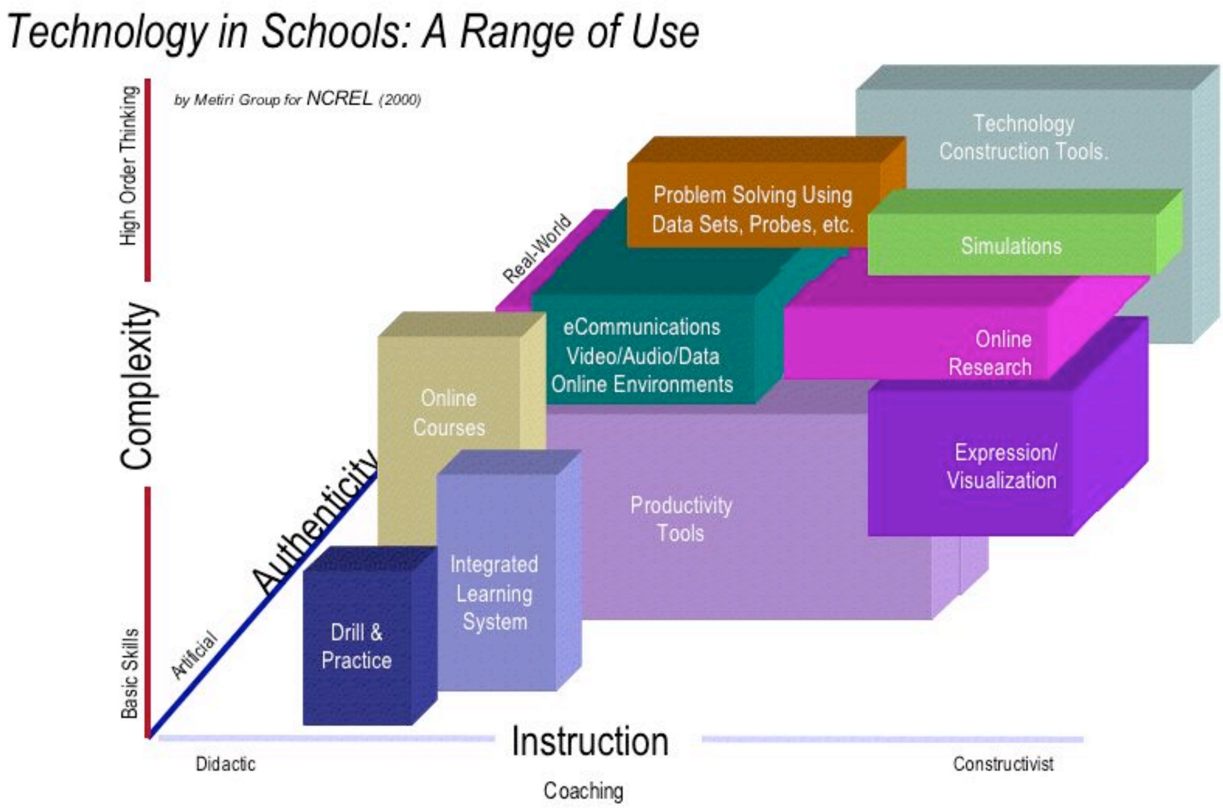
1. **A Driver for Change: The 21st Century Skills**
   Technology has catapulted us into a knowledge-based, global society. It is clear that success in this society will require significantly different skills than in the past. However, policymakers and educators have not yet clearly defined what it means to be "educated" in a Digital Age. The irony of a call for twenty-first century skills in this era of high stakes testing based on conventional metrics is not lost on teachers. To fully realize the educational opportunities twenty-first century skills can bring to students, education leaders must formally incorporate them into the mainstream of school curriculum, instruction, and assessment.

2. **A Bridge to High Academic Achievement**
   Technology serves as a bridge to more engaged, relevant, meaningful, and personalized learning—all of which lead to higher academic achievement. Research shows that when technology is used appropriately, children learn more, even as measured by conventional tests (Newmann, Bryk & Nagaoka, 2001; Weglinsky, 1998). It is important to demonstrate this research link to teachers, thereby encouraging them to incorporate technology into the mainstream of student learning.

3. **A Platform for Informed Decision-Making and Accountability**

> Technology provides a platform for more informed decision-making using timely, meaningful data to shape learning opportunities. This translates into more personalized learning based on continuous feedback available to students, teachers, and parents. The challenge lies in building such accountability systems on the foundation of the right indicators—indicators that lead to high academic standards <u>and</u> twenty-first century skills. Only this will enable true digital-age readiness.

While there is no 'right' way to focus on technology use in schools, some 'rules of thumb' are emerging that clearly define a *range of use* every school should consider—from productivity tools to digital imagery. This range is broad, and the possibilities for application within a school day are broader yet!



A Taxonomy of Technology Uses

In his groundbreaking book, <u>How People Learn</u>, John Bransford and colleagues contend that, "Computer-based technologies can be powerful pedagogical tools—not just rich resources of information, but also extensions of human capabilities and contexts for social interactions supporting learning."

The question before teachers is, "Which technologies, under what circumstances, are apt to extend which aspects of learning?" The range of use is designed to consider three important aspects of technology use:

- The **Instruction**, which determines learner engagement
- The **Complexity of the Learning** (i.e., basic through higher order)
- The **Level of Authenticity** of the experience

The Y-axis: Complexity in Learning
What learning are we trying to extend?

Technology use ranges across levels of complexity of learning. At the basic levels, technology can help to develop automaticity, whereas at higher levels technology can augment problem solving, sound reasoning, and critical thinking. This axis aligns to Bloom's Taxonomy, a classification of levels of intellectual behavior important in learning, including three overlapping domains: the cognitive, psychomotor, and affective. Bloom's taxonomy is noted for its timelessness and universality—and it's familiar to most educators. It ranges from basic skills to higher order thinking as follows:

- Evaluation
- Analysis
- Synthesis
- Application
- Comprehension
- Knowledge

Educators should integrate technology uses that correspond to all levels of cognition.

The X-axis: Engagement in Learning
What instructional approaches work most effectively with which applications of technology—and to what effect?

With data emerging that students, especially in secondary schools, are increasingly disenfranchised with schooling, the consideration of engagement in learning is especially critical. Wiggins and McTighe's Taxonomy of Teaching describes a continuum of teaching styles and student learning modalities. Their three general classifications are:

1. Didactic/Direct Instruction. (Students receive, take in and respond)
2. Coaching (Students refine skills, deepen understanding)
3. Facilitative/Constructivist/Reflective (Students construct, examine, extend meaning)

In describing the added value that technology brings to teaching, many researchers (see Bransford et al.; Shank; Means and Becker) report on the benefits of "learning by doing" instructional approaches (what Wiggins and McTighe classify as constructivist). In terms of technology, these take advantage of applications such as simulations, visualization tools, and the use of real data sets in problem solving.

At the other end of the scale are software programs that employ didactic instructional approaches. Despite the negative reviews that drill and practice programs have received (Wenglinsky, 1998), there are situations where such didactic instruction by computers has been shown to result in positive gains (see Hasselbring; Mann and Shankshaft) when used in appropriate circumstances, especially in developing fluency with basic literacy skills.

Margaret Riel, et al., in a study of over 4,000 U.S. K-12 teachers, found a strong correlation between the designation of a teacher as constructivist and that teacher's frequent use of "tool" technologies like multimedia, the Internet, email, and presentation software. The authors noted that such software is used "primarily to communicate with other people and to produce products for an audience—activities closely associated with constructivist pedagogy."

According to Riel et al., "The most talented Teacher Leaders with a strong constructivist orientation could not possibly ignore one of the most powerful tools for constructivist learning, and so they would naturally invest their time and energy in learning how to use them…Teacher Leaders who become involved in using computers become more constructivist as a result of seeing what their students are able to accomplish through computer mediated learning." This supports the Range of Use grid's correlation between the types of technology uses and instructional approaches.

The Z-Axis: Authenticity
What applications of technology can serve as a springboard to a real-world context for student learning?

Roger Shank suggests that children's natural learning mechanisms, "experimentation and reflection," can be engaged through the "right computer systems." He suggests that through such systems "we can show students the implications of their individual decisions,"—allowing them to learn by doing. Furthermore, Bransford et al. suggest that the transfer from school to everyday environments is the ultimate purpose of school-based learning.

Fred Newmann et al. have established three criteria for authentic teaching, learning and assessment. While these three do not form a continuum, their combination determines the degree of authenticity.

- Value Beyond School
- Disciplined Inquiry
- Construction of Knowledge

This emphasis informs the third axis of the Range of Use diagram, which ranges from the contrived or artificial to the real-world context of genuinely authentic learning. At the latter end, students use processes of inquiry to solve real problems and create knowledge that is valued by persons or communities outside the school environment.

School Uses of the Range of Use

As educators look across a student's career, they should be able to trace the student's experience in using each of the types of uses in this Range of Use taxonomy. Many schools use this Range of Use taxonomy by conducting "walk-throughs" of schools to document the range of use available to students. Others use the taxonomy in professional development sessions to expand teachers' views of how technology should be used in learning. The research shows that all children, regardless of age, gender, socioeconomic, or academic status need a balance between structured learning for automaticity and the opportunity to excel when immersed in relevant, meaningful, higher order, authentic work (see Newmann, Bryk & Nagaoka, 2001).

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