Technology Integration in the Classroom

Is There Only One Way to Make It Effective?

Soledad MacKinnon
Inter-American Development Bank

Technology Integration for What?

*Technology can and does help students develop all kinds of skills-- from the basic to the higher-order critical thinking ones. However, for technology to be successful, teachers need to make informed choices relating to pedagogical approach, students' needs, and learning objectives. Just as important as **what** technology is used, is **how** learning can be enhanced through technology (Strommen and Lincoln, 1992, p. 473). Moreover, a teacher's philosophy of education and pedagogical praxis must play a vital role in forming one's theoretical framework for technology integration.*

> "Teachers are being asked to learn new methods of teaching, while at the same time they are facing even greater challenges of rapidly increasing technological changes and greater diversity in the classroom…but relatively few teachers (20%) report feeling well prepared to integrate educational technology into classroom instruction." *U.S. Department of Education, 1999.*

Technology integration means a lot of things to different people. When teachers are asked if and how they integrate technology into their curricula, many answers appear. For example:

- "I use the computer in my class as a reinforcement of topics we have covered."
- "Students use the Internet to find information for their reports."
- "My students must turn in their homework in word-processed form."
- "I use PowerPoint to make all presentations to my class."

Are these examples of technology integration? One might reasonably argue that each of these examples integrates technology. But the real issue is not if technology is used in the classroom, it is whether or not technology is enhancing the learning process.

Technologies do not guarantee effective learning. Yet inappropriate uses of technology can make learning more difficult. This is the case, for example, when students spend most of their time selecting fonts and colors for reports instead of planning, writing, and revising their ideas. Although technology integration is talked about a lot in education, very few educators have a clear vision or philosophy of what technology integration is all about. Moreover, if you ask educators how to integrate technology into the curriculum, very few will know how to go about doing it in a meaningful and purposeful way.

Pedagogical Approaches for Technology Integration

Most of the recent studies and recommendations put emphasis on only one approach: constructivism. In this sense, there is an ideological fervor that borders on evangelism, practically rejecting all other perspectives as heresy (Perkins, 1991). It is as if the constructivist approach were the only way to resolve educational problems. What is the place and role of other more direct approaches to teaching and learning? This article seeks to revisit the literature about different approaches towards integrating technology in today's classrooms.

Educational goals change according to new social needs, and so do strategies for integrating technology into teaching and learning. Lately, there have been disagreements among learning theorists about which strategies will prove most effective in achieving today's educational goals. This dispute has served as a catalyst for two very different models of teaching and learning: **directed instruction** and **constructivism** (Roblyer et al., 1997). Directed instruction is grounded primarily in behaviorist learning theory and the information-processing branch of the cognitive learning theories. The constructivist view, on the other hand, evolved from other aspects of the cognitive learning theory. A few technology applications (e.g., drill and practice, tutorials) are associated only with directed instruction; most others (e.g., problem solving, multimedia applications, and telecommunications) can enhance either directed instruction or constructivist environments, depending on how teachers integrate them into classroom instruction.

Directed Instruction

The earliest uses of computers to aid instruction based their instructional models on the work of behaviorists such as B.F. Skinner, whose followers considered that computers were able to provide drill and practice on previously learned skills. The stimulus-response interaction between student and technology was the dominant paradigm. Skinner and other behaviorists viewed the teacher's job as modifying the behavior of students through positive reinforcement. These behavioral principles underlay the following two well-known trends in education:

- behavior modification techniques in classroom management, and
- programmed instruction.

Although current use of programmed instruction itself is limited, its principles form much of the basis of effective drill and practice and tutorial software.

Information-processing theories emerged from a branch of cognitive psychology that focused on the memory and storage processes that enable learning. A theorist in this area explored how a person receives information and stores it in memory, the structure of memory that allows the learning of something new to relate to and build on something learned previously, and how a learner retrieves information from short-term and long-term memory and applies it to new situations. One well-known information-processing theorist was David Ausubel, who proposed that the way a learner receives and stores information affects the usefulness of the information, for example, by transferring current learning to learning other skills.

Roblyer et al., 1997 identified four major needs addressed by computerized directed instruction. They are

- individual pacing and remediation, especially when teacher time is limited;
- making learning paths more efficient, especially for instruction in skills that are prerequisite to higher-level skills;
- performing time-consuming and labor-intensive task, freeing teaching time for other, more complex student needs; and
- supplying self-instructional sequences, especially when human teachers are not available, teacher time for structured review is limited, and/or students are already highly motivated to learn skills.

The behaviorist and information-processing theories have not only helped establish key concepts such as types of learning and instructional conditions required to bring about each type; they also laid the groundwork for more efficient methods of creating directed instruction. The directed method approaches, however, have faced some problems. For example, students cannot do problem solving and they find directed instruction activities unmotivating and irrelevant.

Constructivist Instruction

Constructivism is a theory of learning that describes how our minds create knowledge or how a student's knowledge structures and "…deeper conceptual understanding" come about (Fosnot, 1996, p.30). A constructivist perspective views learners as actively engaged in making meaning, and teaching with that approach looks for what students can analyze, investigate, collaborate, share, build and generate based on what they already know, rather than what facts, skills, and processes they can parrot. To do this effectively, teachers need to be learners and researchers, to strive for greater awareness of the environments and the participants in a given teaching situation in order to continually adjust their actions to engage students in learning, using constructivism as a referent. Constructivist activities ask students to intentionally bring forth their own relevant mental models and attempt to integrate external information within these personal frameworks (Glynn & Duit, 1995; Novak, 1995). To help the learner integrate new ideas with his or her own familiar model, constructivists recommend grounding activities in everyday contexts such as realistic cases, expressing topics to be learned. Piaget, Papert, and Vygotsky are representatives of different types of constructivism.

Cognitive Constructivism is based on the work of Jean Piaget. Piaget's theory has two major parts: one component that predicts what children can and cannot understand at different ages, and a theory of development that describes how children develop cognitive abilities. There are two key Piagetian implications for teaching and learning. First, learning is an active process where direct experience, making errors, and looking for solutions is vital for the assimilation and accommodation of information. How information is presented is important. When information is introduced as an aid to problem solving, it functions as a tool rather than an isolated arbitrary fact. Second, learning should be whole, authentic, and "real." In a Piagetian classroom there is less emphasis on directly teaching specific skills and more emphasis on learning in a meaningful context. Technology, particularly multimedia, offers a vast array of such opportunities (Chen, 2000). With technology support such as videodisks and CD-ROMs, teachers can provide a learning environment that helps expand the conceptual and experiential background of the reader. Although much of the educational software created in the 1970s and 1980s was based on behavioral principles, much of the new multimedia educational software is based on constructivist theories.

Within the field of educational computing, the best-known cognitive constructivist theoretician is Papert (Chen, 2000). Unlike Piaget, Papert (1993) uses the term "*contructionism*" to brand his favored approach to learning. "*Constructionism* is built on the assumption that children will do best by finding ("fishing") for themselves the specific knowledge they need. Organized or informal education can help most by making sure they are supported morally, psychologically, materially, and intellectually in their efforts" (Papert, p.139). As such, "the goal is to teach in such a way as to produce the most learning for the least teaching."

As examples of constructionist learning activities, Papert refers, amongst others, to measuring quantities while making a cake, building with Lego or working with the computer programming language *LOGO* developed specifically by Papert and colleagues for educational use. Papert's philosophy of learning and his constructionist approach rely on the computer for realization. He postulates that the computer, and particularly, its future development, will change children's relationship with knowledge, producing a revolution comparable to that of the advent of printing and writing. He imagines a machine he refers to as "The Knowledge Machine," which would allow children a rich exploration of the world. While the computer offers "new opportunities to craft alternatives, moving from the present epistemology and approach in schools will, in Papert's view, require "mega-change." Little schools, involvement of community, encouragement of educational diversity, decentralization, fostering of personal teaching styles, and the involvement of parents, teachers and students: these are to be the prime ingredients of change to embark on the revolution necessary to move into "the age of learning".

Vygotsky's constructivist theory, which is often called *social constructivism*, has much more room for an active, involved teacher than cognitive constructivism. The central point of our psychology, Vygotsky claimed, is mediation. Through mediation - both material and semiotic - human cognition engages in relationships with the material and social environment that are fundamentally different from non-mediated relationships. In Vygotsky's view, the use of technology to connect rather than separate students from one another would be appropriate. Teachers, thus, can facilitate cognitive growth and learning as can peers and other members of the child's community.

At present, interest in constructivist methods is on the rise. Robin and Harris (1998) found that technology-using teacher educators are generally learner-centered in their teaching styles, have higher levels of formal schooling, are more often female than male, and prefer to learn by concrete experience. Most frequently, proponents of information technologies in education speak of assisting student-centered learning through technology's ability to access, store, manipulate and analyze information, thereby enabling learners to spend less time gathering information and more time reflecting on its meaning (Robin & Harris, 1998).

Roblyer et al. (1997) identified four major instructional needs met by the constructivist model. They are

- making skills more relevant to students' backgrounds and experiences by anchoring learning tasks in meaningful, authentic, highly visual situations;
- addressing motivation problems through interactive activities in which students must play active rather than passive roles;
- teaching students how to work together to solve problems through group-based, cooperative learning activities; and
- emphasizing engaging, motivational activities that require higher-level skills and prerequisite lower-lever skills at the same time.

Despite the current popularity of constructivism, its principles and practices have also stimulated a variety of criticisms. For example, under the constructivist approach, it is difficult to certify skill learning and to determine the amount of prior knowledge needed. Additionally, there has been little evidence that indicates that problem-solving skills taught in authentic situations in school will transfer more easily to problems that students must solve in real life (Roblyer, et al., 1997).

Which Approach is Best Suited for Technology Integration?

There is no right or wrong answer, yet there is one more question to bear in mind: Who is going to decide this? The software package producer, the computer, or the educator?

First of all, believing that acquiring the hardware and the software packages will resolve the problem is denying the importance of the human mind and capacity to choose. Second, the computer can be used as a tool to facilitate teaching and learning. However, the machine cannot make the choice of pedagogical approach. Whether to use one approach or the other is up to the teacher, who knows the lesson objectives, the expected results, and the students. Both approaches presented above, the *directed instruction* and *constructivism* could be used alternatively as long as educators have in mind why they chose them.

Three questions[1] could help educators determine technology's worthiness in a given lesson or situation. These questions are:

1. Is the lesson content worthwhile? (Are there clear objectives, connected to standards or significant questions, etc?)
2. Do the lesson activities engage students?

3. How does technology enhance the lesson in ways that would not be possible without it?

Educational practitioners, who are looking for the best means to facilitate a diversity of learning styles, can't afford the luxury of being so ideological, dogmatic, and exclusionary in their view of education. Educational technologists need to be more pragmatic and eclectic, drawing from diverse theoretical perspectives as each proves useful in facilitating different kinds of learning. Educators need to be competent observers of the social milieu in which learners interact as well as knowledgeable about the content to which they wish to expose learners.

Practical, Ready To Use Ideas For Technology Use in the Classroom

Cted.org
http://www.cted.org/
Internet content connected to CT curriculum frameworks (MarcoPolo)

Directed Teaching with Technology
http://edtechinct.org/integrate/directed.asp
A quick look at using a computer as a tool for teaching.

Ideas for integrating the **Connecticut PK-12 Student Technology Competencies** into your lessons
http://www.state.ct.us/sde/dtl/curriculum/index.htm

Technology Leadership Institute
http://www.ncrel.org/sdrs/
Pathways is a comprehensive resource for educators engaged in school improvement. Pathways provides research, policy, and classroom practice together in a user-friendly Critical Issue format written for teachers, administrators, and other practitioners.

Etips.info
http://www.etips.info/About/about.html
Educational Technology Integration and Implementation Principles provide the foundation for eTip Cases, online, multimedia technology integration decision-making scenarios that give pre-service teachers an opportunity to practice thoughtful instructional decision-making about technology integration.

WebQuests Professor Bernie Dodge (http://edweb.sdsu.edu/webquest/) of San Diego State University maintains a website that contains some examples of engaged learning activities.

References

Chen, Irene (2000).Technology and learning environment: an electronic textbook. Retrieved in December, 2000. [On line] http://www.coe.uh.edu/~ichen/ebook/ET-IT/cover.htm

Fosnot, C. T. (1996). Constructivism: Theory, perspectives, and practice. New York: Teachers College Press.

Glynn, S., & Duit, R. (1995). Learning science meaningfully: Constructing conceptual models. In S.M. Glynn & R. Duit (Eds.), Learning science in the schools (pp. 3-34). Mahwah, NJ: Lawrence Erlbaum Associates.

Novak, J.D. (1995). Concept mapping: A strategy for organizing knowledge. In S. M. Glynn & R. Duit (Eds.), Learning science in the schools (pp. 229-245). Mahwah, NJ: Lawrence Erlbaum Associates.

Papert, S. (1993). The children's machine: Rethinking the school in the age of computers. Basic Books: New York.

Perkins, D. N. (1991). Technology meets constructivism: do they make a marriage? Educational Technology, May 1991.

Robin, B., & Harris, J. (1998). Correlates among computer-using teacher educator's beliefs, teaching and learning preferences, and demographics. Journal of Educational Computing Research, 18 (1), 15-35.

Roblyer, M., Edwards, J., & Havriluk, M.A. (1997). Integrating educational technology into teaching. Prentice Hall: Columbus, Ohio.

Strommen, Erik F. & Lincoln, Bruce. (1992, August). Constructivism, technology, and the future of classroom learning. Education and Urban Society, 24, 466-476.

U.S. Department of Education (1999). Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers. National Center for Education Statistics January 1999.

Vygotsky, L. S. (1930/1985). La méthode instrumentale en psychologie. In B. Schneuwly & J. P. Bronckart (Eds.), Vygotsky aujourd'hui Neufchâtel: Delachaux et Niestlé, pp. 39-47.

---

[1] Source: Technology & Learning Center @aces http://edtechinct.org/integrate/index.asp