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Group 1

New capabilities and organization in schools

The widespread application of technology to promote engaged learning will yield several exciting changes in the ways schools organize curricula, define teacher and student roles, and structure themselves. These changes, in turn, will significantly effect student achievement.

- Greatly expanded information exchange capabilities. New technologies and tools such as World Wide Web, e-mail, distribution lists, and group mail reflectors will give schools greater access to text, audio, and video, as well as to search tools and bulletin boards for exchanging local and global resources.
- Curriculum organized as projects involving sustained and complex co-investigations. Students will participate in projects without regard to geographic and political boundaries, and interact with practicing scientists and other professionals. Such projects offer students the opportunity to make real contributions to science, literature, and other areas within local and global communities.
- Changes in student and teacher roles. Teachers and students will increasingly become contributors to knowledge, able to take charge not only of learning but also of creating and directing learning opportunities, and as co-investigators and citizens of the global learning community. Teachers and librarians will become resource managers or brokers.
- Accelerated curriculum and school restructuring to promote learning. Many schools are implementing interdisciplinary curricula and themes that revolve around the use of technologies — especially those involved in accessing the Internet. The primary source of this energy is the extraordinary motivation that many users derive from working on authentic tasks and collaborating with others in a learning community. Projects that ask students to perform challenging and authentic tasks align curriculum, instruction, and assessment into one seamless experience.
- Changes in student achievement. Several technology-enhanced curricula show that they can improve student achievement on standardized measures. Pogrow's HOTS Program (Higher Order Thinking Skills) and the Jasper Woodbury Series, developed by the Cognition and Technology Group, for example, are perhaps the most well-documented; both are effective with students at risk. Numerous other programs appear promising based on data, documentation, surveys, and classroom observations. These studies show that students improved their understanding of concepts, engaged in more active learning, preferred more difficult questions and challenging tasks, demonstrated more student leadership, and engaged in more authentic tasks that produced real products or services for real audiences.

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Group 2

7. **Teacher Role Indicators.** In classrooms where students engage in learning, teachers are more than information givers. Teachers are *facilitators*, guides, and co-learners. As facilitators, teachers provide rich learning environments, experiences, and activities; create opportunities for students to work collaboratively, to solve problems, do authentic tasks, and share knowledge and responsibility.

Teachers play complex and varied roles as guides. They mediate, model, and coach. When mediating student learning, teachers must constantly adjust the level of information and support according to students' needs and help them link new information to prior knowledge, refine their problem-solving strategies, and learn how to learn. Teacher modeling involves thinking aloud and demonstrating, when needed. Coaching involves giving hints or cues, providing feedback, refocusing student efforts, assisting students in the use of a strategy, and providing procedural and factual knowledge when needed. As guides, teachers rely heavily on active listening skills and Socratic questioning techniques.

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Group 3

Distributed systems typically feature tools that make it possible for users to take part in collaborative projects and co-investigations. On-line conferences and bulletin boards, access to remote files and joint products, and the capability to communicate in real time with other users accessing the same data all promote collaboration. Users can access programs to work in groups, build consensus, brainstorm, outline, develop plans, schedule meetings, monitor programs on group objectives, and develop joint products. All these capabilities help develop knowledge-building communities.

4. **Engagability Indicators.** This indicator refers to features in a technology's design that promote engaged learning. One such design feature is the technology's capability (e.g., software) to *provide challenging tasks, opportunities, and experiences*. For example, the technology could provide:

- complex problems and cases; links to challenging curricula and unique resource repositories from museums and libraries; opportunities to examine contrasting events or data sets;
- access to experts, peers, community members, and/or other learners who can guide, mentor, tutor, mediate, broker, share, inform, and involve users in learning in productive and meaningful ways;
- access to rich media resources — three-dimensional images, audio, video, virtual reality — for data manipulation and for presentations; and/or
- tools for interactive browsing, searching, and authoring.

A second design feature that enhances engaged learning allows students to learn by doing. Tools such as scenarios and simulations provide opportunities to develop expertise using real-world problems and resources. These tools let the user plan, reflect, make decisions, experience the consequences of actions, change direction, and examine alternative solutions and assumptions.