Strengthening Collaborative Work

Go beyond the obvious with tools for technology-enhanced collaboration.

By Diane McGrath

Subject: Coooperative learning

Audience: Teachers, teacher educators

Grade Level: K–12 (Ages 5–18)

Technology: Probes, digital cameras, digital microscopes, handhelds, digital voice recorders, concept and causal mapping software

Standards: *NETS•S* 4–6; *NETS•T* II (http://www.iste.org/standards/)

Collaborative work is the cornerstone of project-based learning, central to inquiry, research, organization, time and task management, design, reflection, feedback and revision, and public presentation. Some collaborations take place within a single classroom, some across classrooms in a district, some across the country or the globe. Within a project, collaborations occur between and among students, between teachers and students, and between experts and students.

Learning has come to be recognized as fundamentally a social process, and modern views of how to design a learning environment lean heavily on the notion of collaboration with a community of learners. The focus of collaborative work in this view is the improvement of learning and understanding *for the community* of learners, not simply for the individual. In other words, we *all* want to understand better when we are done with our project.

In the online article *What Is the Collaborative Classroom?,* M. B. Tinzmann and colleagues describe one of the chief characteristics of collaboration in a school setting as *shared knowledge* among teachers and students. Though this idea may sound like what we have always done, the focus here is on two-way sharing, not on one-way telling. Students have greater engagement in learning when their participation, their knowledge, and their work are valued as central to the group's process. Tinzmann et al. also discuss a second characteristic of collaborative classrooms: *shared authority.* Once the teacher has designed the framework for collaboration, students are encouraged to provide their ideas about goals, tasks, norms of behavior and of evidence, strategies, and assessment of their learning outcomes. (***Editor's note:*** Find the URL for this article and

other Web sites mentioned in this article under Resources on p. 33.)

In their article in *Cognition and Instruction,* Randi A. Engle and Faith R. Conant tell of elementary school children sustaining research and debate on the question of whether orcas are whales or dolphins—over a period of eight weeks, and with a good deal of student-initiated research. Collaboration of this sort doesn't just happen—or at least it doesn't always happen. Brigid Barron carried out an excellent research project to look at what happens in groups that succeed in their collaboration and what happens in groups that fail. She presents the results of her project in the *Journal of the Learning Sciences.* In particular, she focused on groups that had an opportunity to succeed at a complex mathematical problem (from the Jasper series), because at least one member of the group suggested a correct solution, but then that solution was not taken up or was even actively rejected. Among other things, she found that when a student proposed a correct solution, the group was likely to succeed if at least one of the other two members took up the suggestion for discussion, but not if neither of the other members paid attention to the suggestion.

This kind of finding lets us know that we are far from having all the answers to how to successfully run a collaborative classroom. But it seems likely that at the very least these two suggestions could help us get better at collaboration:

1. The teacher needs to engage the learners in setting up and adhering to good norms (for argument, evidence, respect and attention paid to others' opinions and arguments).
2. It will be important to have good tools to help learners track what they are doing, communicate about it, reflect on their ideas and understanding, and design projects that make understanding visible so that others may give good feedback.

Technology offers a lot of good tools for collaborative projects. As I began to make a list of all the tasks in PBL that might be assisted by new (and old) technologies, that list got very long. I decided I'd better be a lumper rather than a splitter if I planned on completing this article before I retire. So I begin by describing the obvious uses for technology in PBL.

The Usual Suspects

Designing. For designing a project, students will need high-level graphic design tools, and perhaps, depending on the project, computer programming tools. If students are designing across a distance, they will need to be able to see each other's design proposals, so digital pictures and e-mail would be very helpful.

Communication Within and Between Groups. Whether your students are working within a single classroom or across the Internet, it would be useful to keep track of what each student or group has completed and what they are currently working on through the use of technological means that can be accessed by all participants both at home and at school. Communicating by e-mail is one possibility; writing to a file that can be downloaded to a handheld device is another.

Publication. To publish your artifact or information about your artifact, Web design tools will be important. If, however, the project is local, perhaps a PowerPoint presentation or even a videotape would be enough. If you want to be on the cutting edge, make a DVD.

The More Unusual Tools

I grouped the remaining tools into five categories of PBL work:

- research
- organization of ideas
- visualization
- management
- reflection tools

In each, I describe free and/or readily available tools that you might want to consider. Each category represents an area that students have particular difficulty with, and the tools should be quite helpful. This is just a sample of possible tools for possible projects. I'm sure many of you will be able to tell me about other useful tools.

Research. First, students may need to measure scientific data. Probes are wonderful tools for measuring all types of things. Then students can download data from scientific probes to their computer or handheld. Students can also use their Palm handhelds with free CCProbe software from the Concord Consortium as a data-gathering tool.

Students may also need to capture their research for use later. A digital microscope camera is one tool for this task, enabling students to take pictures of microscopic organisms and the elements of visible items that the naked eye can't see. A digital camera can help students record people and events around them.

Your students may need to take notes in the field or during an interview. They can use digital voice recorders with speech recognition to record their ideas or interviews and later download their words to a word processor on their computer. Students can also use handhelds to write their interview questions out ahead of time as a prompt when they get into the field to do an interview or collect data and to take notes about the interview

or experiment while they are in the field. It would also be useful to have a portable keyboard along on the field trip/interview.

Finally, technology allows students to have remote access to professional tools or resources that are not affordable for schools. Bugscope, hosted by the University of Illinois at Urbana-Champaign, allows students to control an electron microscope at a distance to view their own bug samples. And, students can visit virtual museums to gather data, as for example, the Doing History Virtual Tours Web site, with its tour of Colorado Indians.

Organization of Observations and Ideas. Concept mapping software, such as Inspiration for desktop computers and PicoMap for Palm handhelds, enables students to indicate their ideas about relationships between and among events while in the field. Causal mapping software, such as Seeing Reason, allows students to show the causal relationships among ideas and concepts.

Visual organizers that allow text and images are a good tool for seeing, reflecting on, and modifying students' ideas and concepts and the connections among them. StorySpace is a hypermedia writing tool with several views. Inspiration also helps students visualize relationships among ideas and convert those visual outlines to textual outlines.

Visualization of Difficult Processes. Software tools for visualization and analysis can help you scaffold learning during student projects. WorldWatcher allows students to display maps showing geographic data with latitude and longitude as well as optional continent outlines. My World is a professional-level geographic information system (GIS) designed specifically for middle school classrooms. Both tools are developed by Northwestern University.

Management of Project, Tasks, and People. In PBL, many authors often work on the same document. The Mac software program SubEthaEdit allows students to work on the same document at the same time, even remotely. SubEthaEdit won Apple's 2003 Best Mac OS Student Product award.

Another important component of PBL is keeping track of the project's progress. The Mac-only Progress Portfolio (another product developed by researchers at Northwestern) allows students to track the steps of their project and reflect on their learning throughout the project.

Reflection. Many of the same tools used for organizing may also be used for individual and group reflection on the design and eventual product of a project. It will be important at this stage to make things accessible to others to see and comment on besides the group that originally worked on it. Consequently, for this purpose, we might consider three examples:

- Handhelds: Students can share files or concept maps using their handhelds. If students have handhelds they can take home, they can reflect on a file overnight or over a weekend before giving feedback to the author.
- Web pages: Web pages allow people in multiple sites to see and comment on the same document to help the authors reflect on how their presentation or artifact comes across to others.
- Chat rooms: Students can link to their concept maps, documents, photographs, or Web pages and have other, more distant viewers contribute feedback in real time.

I am certain you can think of many other technology tools out there that can help you and your students with these cognitively difficult tasks of collaboratively carrying out research projects: organizing, visualizing, managing, and relating one idea to another. Please write and tell us about tools you know about so we can share that information with other teachers who are eager to improve the collaboration aspect of their classroom projects.

Resources

Diane McGrath's PBL Web site (http://coe.ksu.edu/PBL/), will take you directly to the Web resources discussed in this column, as well as resources that have been mentioned in other columns. So check in early, and check in often.

Web Sites

Bugscope: http://bugscope.beckman.uiuc.edu/

CCProbeware from the Concord Consortium: http://www.concord.org

Doing History Virtual Tours: http://hewit.unco.edu/dohist/vftrips/themes.htm

Inspiration: http://www.inspiration.com

NASA Telerobotics Program: http://ranier.hq.nasa.gov/telerobotics_page/realrobots.htm

PicoMap: http://www.freewarepalm.com/educational/picomap.shtml

Progress Portfolio: http://www.progressportfolio.northwestern.edu/general/

Seeing Reason: Mindful Mapping of Cause and Effect: http://www97.intel.com/scripts-seeingreason/

StorySpace: http://www.eastgate.com

SubEthaEdit: http://www.apple.com/downloads/macosx/productivity_tools/subethaedit.html

WorldWatcher and MyWorld: http://www.worldwatcher.northwestern.edu/software.htm

Articles

Barron, B. (2003). Why smart groups fail. *The Journal of the Learning Sciences, 12*(3), 307–359.

Engle, R. A., & Conant, F. R. (2002). Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom. *Cognition and Instruction, 20*(4), 399–483.

Tinzmann, M. B., Jones, B. F., Fennimore, T. F., Bakker, J., Fine, C., & Pierce, J. (1990). *What is the collaborative classroom?* Available: http://www.ncrel.org/sdrs/areas/rpl_esys/collab.htm

Diane McGrath is an associate professor of educational computing, design, and online learning at Kansas State University. She is former editor of the Journal of Computer Science Education *(now published on ISTE's SIGCS Web site as* JCSE Online*) and the* Journal of Research on Computing in Education *(now the* Journal of Research on Technology in Education*), and she has written a number of articles related to technology and higher-order thinking for ISTE periodicals.*

Erratum

In the December/January 2003–04 article "Pump Yourself Up with PBL Learning," we incorrectly listed the name of a Web page. "Project-Based Learning Supported By Multimedia: An Online Course for Educators" is the correct title of http://www.smcoe.k12.ca.us/pblmm/. We are sorry for any inconvenience. The online course was written by Gayle Britt, Michael Simkins, and Linda Ullah. The San Mateo County Office of Education is the copyright owner.