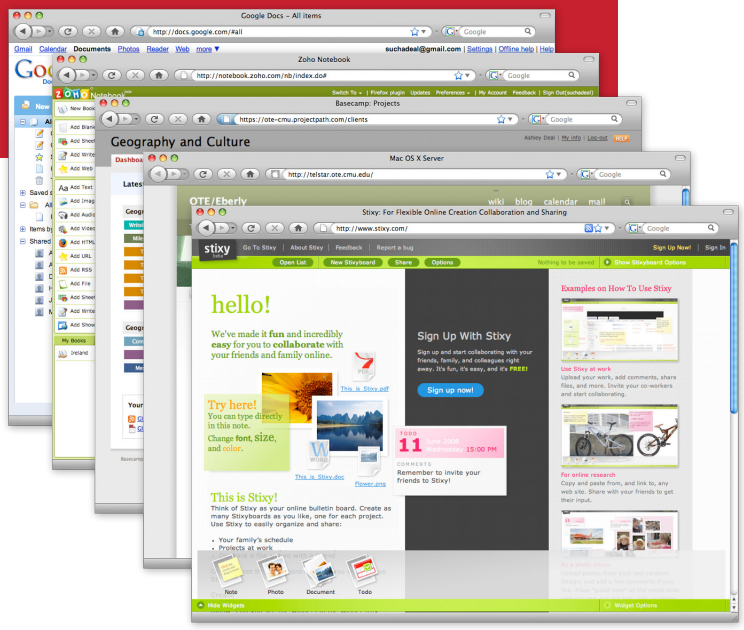
A Teaching with Technology White Paper

Collaboration Tools

Ashley Deal | 1.23.2009



The landscape of technology that can be used to support project-based collaborative learning is vast and varied. Educators can benefit from a more detailed and disaggregated view of what tools are available, and how they can be used most effectively in support of specific teaching and learning goals.

In this paper, we offer a working model of the collaborative process and outline basic approaches to assessing project-based group work. We then discuss potential risks and benefits of taking project-based collaborative learning online, and give an overview of technology tools that can be used to support various activities in project-based collaborative learning.

Office of Technology for Education

Eberly Center for Teaching Excellence

http://www.cmu.edu/teaching

Carnegie Mellon

Working Definition

Project-based collaborative learning broadly consists of the following types of activities:

Communication

Team Definition & Participants

Project Management

Resource Management

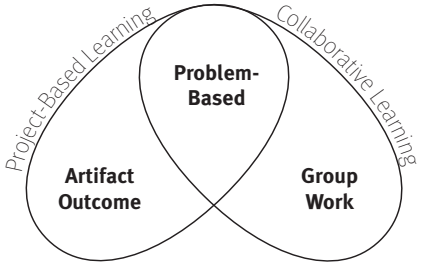
Co-Creation & Ideation

Consensus Building

Presentation & Archiving

Project-based collaborative learning is an active, problem-centered approach to teaching and learning. As the name implies, it is a fusion of two related approaches—project-based learning and collaborative learning—which are often discussed separately in the literature.

Project-based learning requires the student to engage in design, problem-solving, decision-making, and investigative activities, often resulting in an artifact or product ("Project-based learning," 2008). *Collaborative learning* involves joint intellectual effort by groups of students who are mutually searching for meanings, understanding, or solutions (Smith and MacGregor, 1992). Both approaches require a central question or problem that serves to organize and drive activities, and encourage application, analysis, and synthesis of course material.



The fusion of these two approaches can be characterized simply as people working together to create something, and to meet certain learning objectives throughout the process. This context yields an ideal yet complex territory for support with technology tools. Tools are currently available that can:

- facilitate real-time and asynchronous text, voice, and video *communication*;
- assist in basic *project management* activities, like task management, calendaring, workflow planning and routing, and time tracking;
- support *co-creation* by enabling groups to modify output in real-time or asynchronously;
- facilitate *consensus building* through group discussions and polling (see Cavalier, 2008 and 2007);
- simplify and streamline *resource management* in terms of basic file sharing, in addition to more advanced features like search, tagging, version tracking, privilege management, and so on;
- enable local and remote *presentation*, and allow for *archiving* of completed projects.

> This paper presents a working model of the collaborative process, and gives an overview of technology tools that can be used to support project-based collaborative learning.

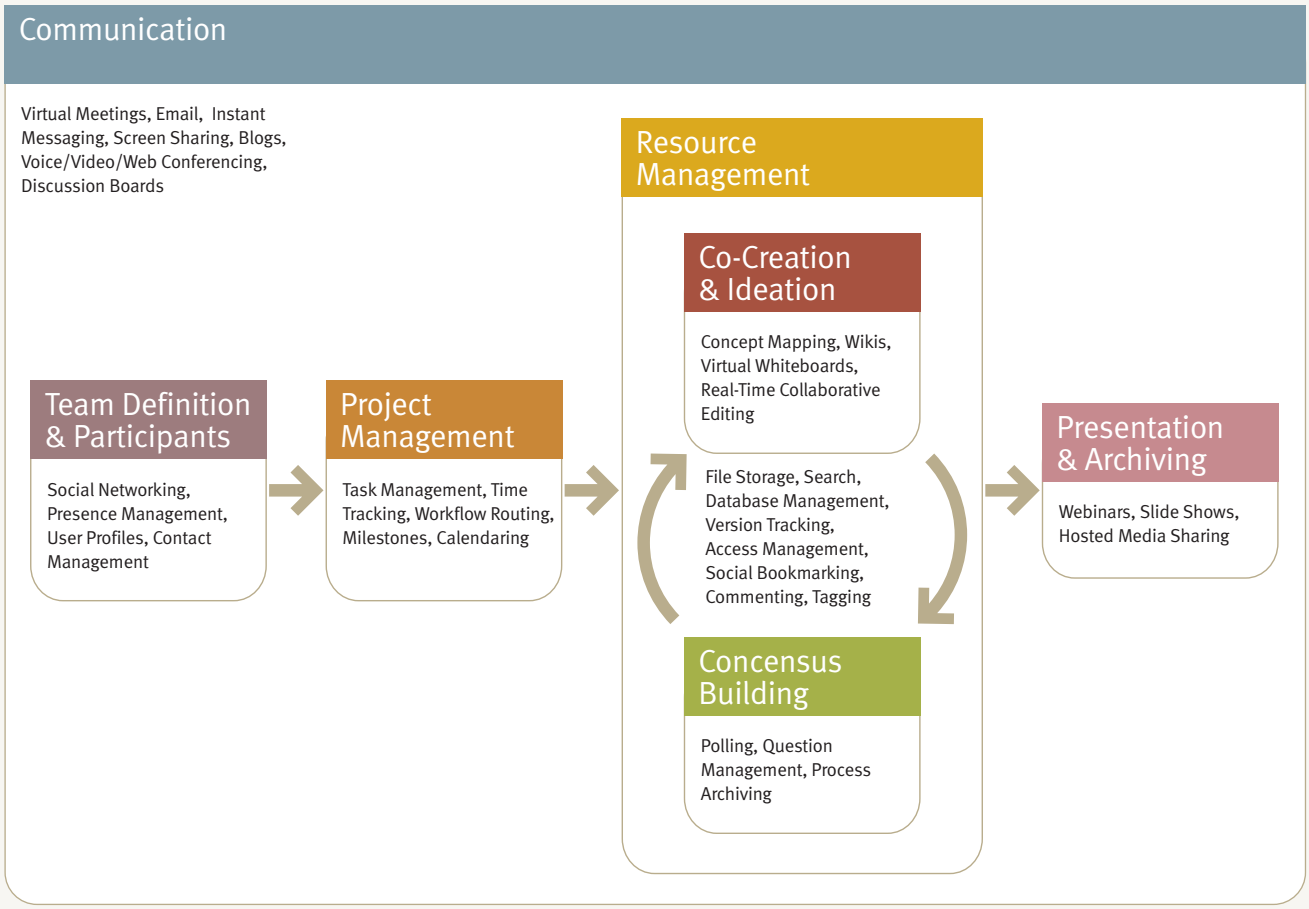
While the landscape of technology that can be used to support central activities of project-based collaborative learning is vast and varied, it is often lumped together under a single label: "collaboration tools." Educators and educational technologists can benefit from a more detailed and disaggregated view of what tools are available, and how different types of tools can be used most effectively in support of specific teaching and learning goals.

To that end, this paper presents a working model of the collaborative learning process, and gives an overview of types of tools that can be used to support project-based collaborative learning. We use a model of the collaborative process to frame the discussion of collaboration tools. It is intended as one possible view of the process and supporting technologies.

For the sake of simplicity, we divide the process into distinct phases, and present a sequence of those phases that we feel clearly summarizes the collaborative process. However, we acknowledge that collaborative work is not typically linear, and the phases are often not distinct.

It is important to note (in this paper, and in the process of implementing technology support for a collaborative learning project) that not every collaborative effort requires every type of tool, and no single system or product encompasses all the features discussed in the following sections. Decisions about which collaboration tools to use should be driven by learning objectives.

Technology Support for Project-Based Collaborative Learning



This model presents a high-level view of the collaboration process, and lists available tools and technology that can support each phase. It is not intended to indicate that the process is strictly linear, nor that every project requires every type of tool. Technology support should be selected based on the requirements of the individual learning activity.

Communication

The entire project-based collaborative effort takes place in the context of communication. Many features of collaborative software are geared toward the facilitation and management of effective communication among team members.

Team Definition & Participants

Tools in this category are designed to help team members identify key players in a project, and draw on the appropriate "people resources" at the appropriate time. They also allow participants to manage their availability for various types of interaction (e.g., text chat or video conferencing).

Project Management

Project management tools are geared toward handling the logistical aspects of planning, scheduling, workflow, and task management.

Resource Management

Some of the main challenges faced in collaboration are the most basic. Resource management tools help address common issues, like having access to a shared storage space for project files, and keeping up with multiple versions of the same document.

Co-Creation & Ideation

Co-creation and ideation tools facilitate the most direct interaction between team members on the goals or desired outcomes of the project. Using these tools, participants can often work in groups directly editing or building the project artifact.

Consensus Building

While co-creation and ideation tools help generate possible alternative solutions to a given problem, consensus-building tools help participants narrow and refine the proposed solutions.

Presentation & Archiving

These tools allow the project team to present outcomes to the instructor, to a project client, or to the general public. Communication tools also factor heavily into this phase of project-based collaborative learning.

Assessments & Examples

To shed light on the use of technology to support project-based collaborative learning, we address the following three topics:

Approaches to assessment in project-based collaborative learning

Potential risks and benefits of **technology-mediated collaboration**

Example tools & technologies for project-based collaborative learning

Project-based collaborative learning is not a new idea; it is firmly grounded in a long-standing body of theory and research into teaching and learning. But the complexity of the topic and the diversity of project-based collaborative learning strategies—not to mention the ever-growing selection of technology tools that can be used to support these strategies—make it difficult to analyze and measure direct effects on student learning.

The body of technology-based collaborative learning research to date is largely descriptive. Educators outline their approach to a specific collaborative learning project (or collaborative learning in general), and offer observations on perceived challenges and successes.

While this type of commentary is useful, these descriptions stop short of the type of comparative analysis we typically present in this White Paper series. As such, it is difficult to make any generalizations from this research about what makes technological supported for collaborative learning successful or unsuccessful.

Project-based collaborative learning is not a new idea; it is firmly grounded in a long-standing body of theory and research into teaching and learning.

Instead of following our usual approach, we will outline three basic approaches to the assessment of project-based learning activities. We focus on assessment because it plays a critical role in how students approach a given project, and is complicated somewhat by factors specific to project-based collaborative learning (i.e., assessing individual versus group work, process versus outcomes). Next, we will present relevant research from the fields of cognitive, social, and organizational psychology to demonstrate the potential risks and benefits of taking project-based collaborative learning online. Finally, we will give an overview of existing technology tools that can be used to support various activities in project-based collaborative learning.

The Eberly Center for Teaching Excellence at Carnegie Mellon offers valuable information about group work as an instructional strategy on their web site at http://www.cmu.edu/teaching/designteach/design/instructionalstrategies. This information does not deal specifically with technology, but offers practical information about why and when to use group work, and how to structure and assess group work for optimal effectiveness.

Approaches to Assessment

There are three areas of project-based collaborative learning activities that can be assessed. Instructors can evaluate the **process** students use in approaching a given problem and finding solutions; they can assess the **final product** or end result of the project; or they can evaluate the individual student's **learning outcomes**.

Often, instructors evaluate group work in just one of the areas above. Using a single approach to assessment can be problematic, however, because the relationship between these elements is unknown. Instructors should keep in mind that a satisfactory final product does not necessarily indicate that students approached the problem according to the preferred process. Similarly, even using the correct process to arrive at a satisfactory final product does not indicate that individual students grasped relevant concepts.

The paper, "Doing with Understanding: Lessons from Research on Problem- and Project-Based Learning" (Barron, Schwartz, Vye, Moore, Petrosino, Zech, and Bransford, 1998) presents a good example of students following the proper process and reaching desired outcomes, while lacking a basic understanding of underlying concepts. The authors describe a model rocket building activity that is intended to familiarize sixth-grade students with the scientific method.

Most students properly constructed and launched the rockets, but were unable to describe the purpose of the project, or what made a given type of rocket better or worse. Many of these students would be given high marks if assessed solely on *process* (how the rocket was built) and *product* (whether the rocket properly launched). In this case, it required a more appropriate framing of the project using a clear driving question, and pre- and post-evaluations to determine individual *learning outcomes* from the project.

Good assessment provides opportunities for students to demonstrate and practice the knowledge and skills articulated in the learning objectives, and for instructors to offer targeted feedback that can guide further learning.

To evaluate learning outcomes in terms of declarative and conceptual knowledge, instructors might use traditional assessment methods, like short answer or essay questions. Declarative knowledge is knowing facts, formulas, and semantic meanings, and conceptual knowledge involves an understanding of more complex relationships, causes, etc.

Evaluating a group's process can help instructors assess procedural and contextual learning. Procedural learning refers to students' understanding of how to execute some task, while contextual learning describes students' ability to discern what contexts require the application of given tools or concepts.

Finally, assessing the product or outcomes from student work can provide an opportunity to gather information about advancements in student's metacognitive learning. For example, instructors can ask for reflection on the overall experience and process when students are presenting the final product. Instructors might learn more about student learning by listening to how the student describes the product or outlines the process than from the quality of the final product itself. (In his course, *Building Virtual Worlds*, Carnegie Mellon Professor Randy Pausch encouraged students to take risk by giving an award to the team that failed most spectacularly in attempting a new and ambitious project.)

Technology-Mediated Collaboration

An often-overlooked body of research on collaboration comes from the field of psychology. Thomas Finholt and Stephanie Teasley summarize much of the relevant work in their paper, "The Need for Psychology Research on Computer-Supported Cooperative Work" (1998).

Finholt and Teasley note that cognitive, social, and organizational psychologists have examined work in groups for more than 20 years, and have been able to identify some of the relative strengths and weaknesses of relying on technology in the context of group collaboration.

For example, psychology research has demonstrated that computer-mediated groups are better at generating a range of ideas, while face-to-face groups perform better at tasks that require problem-solving or reaching consensus on group preferences. Furthermore, participation in computer-mediated groups tends to be more equally distributed, whereas face-to-face groups are more easily dominated by a single or few individuals (Finholt and Teasley, 1998, p. 45).

> Computer-mediated groups are better at generating a range of ideas, and participation tends to be more equally distributed.

In social psychology, a commonly observed phenomenon is "social loafing," or the likelihood that individual people exert less effort to meet a goal when working in a group than they might otherwise exert working toward the same goal on their own. Social loafing is often attributed to the perception that an individual's contributions might not be evaluated. Therefore,

technology that allows an instructor to monitor individual or group performance might help mitigate social loafing. Interestingly, studies have shown that technology allowing performance to be monitored at the group level is better for reducing social loafing when compared to monitoring at the individual level (Finholt and Teasley, 1998, pp. 45–46). Monitoring at the group level also reduces the stress associated with monitoring performance.

Group decision support systems (GDSS) are a relatively heavily investigated category of collaboration technology. They combine "communication, computing, and decision support technologies to facilitate formulation and solution of unstructured problems by a group of people" (Desanctis and Gallupe, 1987). Research has shown that these systems increase the quality of decisions, facilitate more equal participation, and encourage groups to stay focused on tasks. However, groups using GDSS take longer to reach a decision, achieve less overall consensus, and less satisfaction with the decision-making process and outcomes (Finholt and Teasley, 1998, p. 46).

Decisions about which collaboration tools to use (and how) should be shaped by the objectives of the assignment.

Computer mediated groups outperform face-to-face groups in brainstorming tasks (p. 45) due to reduced production blocking (the tendency for one individual to inhibit contributions from other people during a group discussion). Along the same line, physically dispersed participants outperform physically proximate participants when using the same decision support system while brainstorming.

However, computer-mediated groups are less likely to exchange unshared information (information that is not considered "common knowledge") than members of face-to-face groups (p. 46). Furthermore, higher status group members have been shown to dominate in both face-to-face and computer-mediated groups (p. 46).

These lessons and others from the field of psychology demonstrate that instructors should be cautious and thoughtful about how group dynamics can be influenced when work moves to the digital realm.

Example Tools & Technologies

The range of tools available creates many interesting opportunities for collaboration and instruction, but decisions about which tools to use (and how) should be shaped by the objectives of the assignment.

This section of the paper outlines some of the main categories of tools available, and some of the general features that might be useful in the context of project-based collaborative learning. For more information on specific products, please see the Appendix on "Available Products."

Collaboration Suites

Several companies have developed families of applications that meet a range of collaborative needs. These tools might be used individually, but they are often designed to work together or integrate for optimal usefulness.

These systems might include traditional desktop applications for word processing, spreadsheets, communication, or calendaring, but often extend beyond basic functionality by virtue of the ability for these artifacts to be accessed and edited by multiple members. Collaboration suites also might include an additional "aggregator" application that allows pieces from each of the other applications to be pulled together into a common work space.

Course Management Systems

Most course management systems give instructors the ability to make group

work spaces for their students. Tools available in group spaces might include discussion boards or other group communication tools, file sharing, and peer evaluation tools.

While these tools are not ideal for supporting complex collaborative efforts, in many cases these tools are readily available to instructors and can be easily activated. For information about Carnegie Mellon's course management system, please visit http://www.cmu.edu/blackboard.

Project Management Tools

Project management solutions are multifunctional systems that often deal with logistical issues, like scheduling, time tracking, task management, resource allocation, collaborative writing or editing, communication, file sharing, and process documentation.

These tools might be particularly useful for semester-long projects where the instructor hopes to monitor group interactions and evaluate students' work processes and communications.

Wikis

A wiki is a page or collection of web pages that allows anyone with proper privileges to modify, add, or delete content. A wiki also often has the functionality of maintaining a document history, which allows users to track and view changes over time.

Wikis are most effective for collaborative writing or collaborative creation of text-based documents. However, the ability to incorporate other media types (audio, video, images) is often considered useful in encouraging rich communication.

Real-Time Communications

Products in this category include web-based presentation tools, screen sharing applications, web or audio conferencing tools, and VoIP (Voice over Internet Protocol) or internet-based telecommunications.

These tools are especially useful for project teams that are not co-located, or who do a significant portion of their work at a distance. They allow teams to share work in progress, discuss concepts with the help of rich media, and exchange information and ideas in a manner that more closely approximates the face-to-face experience than traditional text-only communications.

Current real-time communication tools allow students to exchange ideas in a manner that more closely approximates the face-to-face experience.

And So On...

Web-based tools are also available to support collaborative concept mapping, collaborative writing, stand-alone list or task management, software development and issue tracking, creative or design collaboration, slide sharing, market research, contact management, and on and on. Many of these products are presented in the Appendix.

Conclusion

Collaboration tools can be very useful in supporting project-based collaborative learning. Projects should be selected carefully based on learning objectives.

This report is intended to give instructors a basic understanding of project-based collaborative learning, and the types of tools that are currently available to support project-based collaborative learning activities. Although "collaboration tools" are typically lumped together as a single category, we believe that a more disaggregated view is useful when considering what types of tools might be most useful given the details of a specific group work assignment.

Support

If you are an instructor at Carnegie Mellon and are interested in discussing the use of collaboration technologies in your class, please contact the:

Office of Technology for Education
ote@andrew.cmu.edu
412-268-5503

Our consultants will be happy to assist you with any phase of planning, designing, implementing, funding, and evaluating the use of technology tools and strategies for teaching.

References

Barron JS, Schwartz DL, Vye NL, Moore A, Petrosino A, Zech L, Bransford JD, & The Cognition and Technology Group at Vanderbilt (1998) "Doing with understanding: Lessons from research on problem- and project-based learning." *Journal of the Learning Sciences*, 7 (3&4), 271-311.

Cavalier R (2008) "Campus conversations: modeling a diverse democracy through deliberative polling." *Diversity and Democracy* 11(1): 16-17.

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Finholt TA, Teasley SD (1998) "Psychology: The Need for Psychology in Research on Computer-Supported Cooperative Work." *Social Science Computer Review,* 16: 40-52.

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About the Series

The purpose of the *Teaching With Technology White Paper* series is to provide Carnegie Mellon faculty and staff access to high-quality, research-based information with regard to a given classroom technology. These papers offer a general overview of the technology topic, summarize findings from available assessments and evaluations, and give direction toward further reading and online resources.

This series does not introduce original research findings from technology assessments or evaluations conducted at the Office of Technology for Education and/or Carnegie Mellon University. The papers serve as literature reviews, intended to provide scholarly integration and synthesis of the most sound and comprehensive studies documented at the time of publication.

Available Products

Appendix One

Collaboration Suites

Google http://www.google.com/intl/en/options/ (under "Communicate, show & share")

Zimbra http://www.zimbra.com/

Zoho http://www.zoho.com/

Course Management Systems

Blackboard http://www.blackboard.com/

Moodle http://moodle.org/

Sakai http://sakaiproject.org/

Project Management Tools

ActiveCollab http://www.activecollab.com/

Basecamp http://www.basecamphq.com/

Copper http://www.copperproject.com/

GoPlan http://goplan.info/

ProjectSpaces http://www.projectspaces.com/

WebEx WebOffice http://www.weboffice.com/

Wrike http://www.wrike.com/

Wikis

OpenTeams http://www.openteams.com/

PBwiki http://pbwiki.com/

Springnote http://www.springnote.com/

Wikispaces http://www.wikispaces.com/

Real-Time Communications

Acrobat Connect http://www.adobe.com/products/acrobatconnect/

Campfire http://www.campfirenow.com/

GoToMeeting http://www.gotomeeting.com

LiveMeeting http://office.microsoft.com/en-us/livemeeting/

Skype http://www.skype.com/

Vyew http://vyew.com/

WebEx http://www.webex.com/

Yugma http://www.yugma.com/

Available Products
Appendix One, continued

Collaborative Concept Mapping

- bubbl.us http://bubbl.us/
- Comapping http://www.comapping.com/
- Gliffy http://www.gliffy.com/
- Mind42 http://www.mind42.com/
- Mindmeister http://www.mindmeister.com/
- Mindomo http://www.mindomo.com/
- Thinkature http://thinkature.com/
- WriteMaps http://writemaps.com/

List/Task Management

- Backpack http://www.backpackit.com/
- Clocking IT http://www.clockingit.com/
- Loose Stitch http://www.loosestitch.com/
- Remember the Milk http://www.rememberthemilk.com/
- Ta-da Lists http://www.tadalist.com/

Software Development & Issue Tracking

- Lighthouse http://lighthouseapp.com/
- Planix http://planixonline.com/
- Unfuddle http://www.unfuddle.com/

Presentation & Slide Sharing

- BubbleShare http://www.bubbleshare.com/
- SlideShare http://www.slideshare.net/

Collaborative Writing

- Writeboard http://www.writeboard.com/
- WriteWith http://www.writewith.com/

Creative/Design Collaboration

- ConceptShare http://www.conceptshare.com/
- Octopz http://www.octopz.com/
- Stixy http://stixy.com/