# Google Apps for Education at CU Boulder

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**Abstract**

After observing four classes that used Google Apps for Education (GAFE) during the spring of 2012, we recommend the University deliver and support GAFE for faculty, students, and staff. GAFE will enhance and extend the collaboration and communication tools available in Desire2Learn, providing features and functions not available to the campus.

**Executive Summary**

After observing the use of Google Apps for Education (GAFE) during the Spring 2012 semester, we recommend the adoption of GAFE on the CU Boulder campus. We observed four courses that pilot tested GAFE: two Engineering courses, one Education course, and one Architecture and Planning course. We gathered data about how GAFE was used through observations, surveys, and semi-structured interviews of students and faculty members.

Our examination found that GAFE could facilitate sharing artifacts among faculty and students, encourage conversations at a distance, and provide tools for course management. Our pilot confirms the need for teaching and learning tools with affordances and functions not available in the current learning management system, Desire2Learn. Instructors and students voiced a desire for tools that encourage participation, sharing, and collaborative knowledge building; and demonstrated a need for online spaces that may engage audiences outside the university and model student participation in authentic online communities. These needs aptly represent components of the 21st century digital literacies needed by today's graduates. This report describes how GAFE meets these requirements and may support both formal and informal learning opportunities for CU students.

The report includes:

- Descriptions of Google Apps for Education and the affordances the offer for teaching and learning.
- Summaries of the courses studied.
- Summaries of issues and barriers encountered during the pilot
- Summaries of themes from the GoingOn (GO) and GAFE studies

**Description of Google Apps for Education** [1]

**Google Apps for Education | Official Website**

Google Apps for Education (GAFE) offers a variety of tools that support collaboration, communication, and productivity. GAFE may be used as a stand-alone system or may be integrated with other campus systems such as learning management systems. Google Apps for Education supports open standards and offers numerous APIs.[2]

A number of higher education institutions have deployed Google Apps for Education: Allegheny, Arizona State University, Brown, Case Western University, Colorado State University, Columbus State, Northeastern University, St. Louis University,Temple, University of Maine System, University of North Carolina at Greensboro, and Wesleyan College among others.[3] In the Denver area, Jefferson County School District has used Google Apps for Education since 2010.[4] The Colorado executive branch has also announced migration to Google Apps for Government.[5]

We recommend the following web-based services for CU adoption of GAFE:

- Gmail: Provides 25 GB email storage, chat, and video conferencing. Compatible with Android, IOS, and Blackberry mobile platforms. There has been strong student support and a campus decision at this university to adopt Gmail.
- Google Sites: Offers easy web site creation (public or private) and management. Google Sites may be used in courses for collaborative site development, course portal and materials management, student portfolio or individual site creation[6], as well as a variety of other educational purposes.
- Google Calendar: Provides scheduling, sharing, and synchronization. Google Calendar supports group project management, events scheduling, and chronological course structures, among several other educational uses.
- Google Drive: Provides simultaneous collaboration in spreadsheets, documents, presentations, drawings, and forms. Many students come from environments that have used Google Drive (previously known as Docs) whether that be a public school, a CU class, or work-related tasks. These tools are designed to facilitate social and collaborative learning and content creation as well as public publishing opportunities.
- Google Groups: Provides mailing lists and web-based discussion groups. Courses may adopt groups to facilitate discussions and conversations beyond the classroom. Google Groups offers

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[1] "Google Apps for Education | Official Website." 2008. 16 May. 2012 <http://www.google.com/apps/edu/>
[2] "Integration & Customization – Google Apps for Education." 2011. 20 Jun. 2012 <http://www.google.com/apps/intl/en/edu/integration.html>
[3] "Success Stories – Google Apps for Education." 2011. 20 Jun. 2012 <http://www.google.com/apps/intl/en/edu/customers.html>
[4] "Two more states open Google Apps for teachers and ... - Google Blog." 2010. 20 Jun. 2012 <http://googleblog.blogspot.com/2010/06/two-more-states-open-google-apps-for.html>
[5] "Official Google Enterprise Blog: Colorado is the newest state to go ..." 2012. 20 Jun. 2012 <http://googleenterprise.blogspot.com/2012/03/colorado-is-newest-state-to-go-google.html>
[6] "Google Apps as an e-portfolio solution at Clemson U. - YouTube." 20 Jun. 2012 <http://www.youtube.com/watch?v=zq9oIbM0_Ew>

customizable subscription settings, tool access permissions, archiving functionality, and file sharing.

We further recommend that CU adopt these Google applications that are not part of the formal GAFE suite. This would include turning on these applications from inside the GAFE environment and allowing members of the University community to seamlessly access them once they are logged into the GAFE environment.

- Blogger: Provides a blogging environment. Includes a WYSIWYG editor with design templates, media embedding, an RSS feed, and statistics. Wake Forest University provides its campus with Blogger and Google Sites as services for personal blogs.
- Google Maps: Provides navigation of global maps information. Courses may use Google Maps to direct a geographically-driven course, provide simulated experience of location-based content, develop collaborative maps for public or private consumption, or contribute to global map projects.
- Google Plus: Provides a social networking environment including virtual meetings (Google Hangouts), screen sharing, and document sharing (Hangouts with Extras). Courses may use Google Plus to foster discussion, share content, and connect with professionals or experts in an online social environment.
- YouTube: Provides a video file hosting and sharing service with unlimited disk space.

**Affordances for Teaching and Learning**

Based on our interviews, surveys, and observations we have identified several types of teaching and learning situations that GAFE would facilitate. EDUmic's eLearning Blog has also identified interesting affordances for teaching and learning that GAFE provides.

*Sharing Artifacts Among Students and Between Students and Teachers*

Google Drive is the primary tool for sharing artifacts with others and it is within the GAFE suite. It was widely used in this pilot, and was received positively. Other Google tools that could be used for sharing artifacts include Plus, YouTube, Picasa, and Blogger.

Google Drive allows users to simultaneously edit content and to chat as they do so. Drive files can be accessed from browsers and apps on most computing devices including laptops, tablets, iPads, and smart telephones. Drive files can be made available to the general public, to those with a URL, or to groups of users. Drive makes it possible for students to collaborate on writing, computational analyses, graphing, presentations, and images. It also makes it possible for instructors to comment on files and give students advice for improving them. Classes that require individual or team papers, calculations, presentations, or images for assignments will likely find Drive to be a useful tool. Classes with writing as a key part of the curriculum will find the drafting and commenting tools to be useful. They may also be able to provide wiki-like functions through the collaboration features of documents.

Drive includes a form editor, which when paired with assessment rubrics could be used by instructors to facilitate feedback. One instructor we observed created a Google form for each assignment. Each form contained fields associated with elements in her assessment rubric. So as she reviewed student work,

she typed comments in each field and then exported the form input into an evaluation document that paired elements of the rubric with her comments.

Several universities including St. John Fisher College and Clemson have used Google Drive with Sites to implement an electronic portfolio system. They store student work in Google Drive and make it available to audiences through Sites. As students graduate, they are able to keep their Drive files or to export them into other usable formats. While the university has a contract with Desire2Learn for an electronic portfolio system, it may be worthwhile to compare and contrast the features and functions of their portfolio and one that could be created in GAFE.

*Engaging in Conversations at a Distance*

Google Apps for Education provides several methods for exchanging messages. In our GAFE pilot, we added Google Plus to the GAFE suite, which includes Google Mail, Google Groups, Google Drive and Google Chat. Normally Plus is not included in GAFE deployments, and a different end-user license agreement covers it. When using Google Plus, though, our instructors and students could sign on with their GAFE credentials and select Plus. While the user experience between GAFE and Plus is fairly seamless, Google's end-user agreement about advertising and protecting data is different for Plus than for the traditional GAFE.

Google Mail

The most common method of asynchronous communication in GAFE is through Google Mail (or Gmail). While Gmail was not turned on for this pilot (because mail was being evaluated by a separate initiative), students and instructors used their own personal Gmail accounts anyway to communicate. Now that the campus direction has been set to provide students with Gmail, and to allow faculty to choose Gmail, we suspect it will be widely used for faculty-to-student and student-to-student communication.

One interesting finding from this study was students in one class occasionally emailed the instructor personally in response to Google Plus posts intended for the whole class to respond to. Perhaps students felt the need to save face and speak only with the instructor, or students may have been suspicions about whether the replies they limited on Google Plus were really limited to the class (as opposed to being publicly available).

Google Plus

Plus provided a familiar social interface for sharing (as opposed to other social Google tools like Groups). Posts on Plus could include embedded video, audio, and images alongside text comments. A +1 button is included for "liking" posts. And posts can be limited to members of a group (called a circle) or shared publicly.

In the pilot, Google Plus seemed to encourage more free-flowing conversations than Google Groups. Plus seemed to be a place where less formal communication happened where faculty and students expected community to form. Students and instructors reported not feeling compelled to respond to every post (as opposed to Google Groups where there was a felt expectation to respond). Most students and faculty members liked the Google Plus format; although a few expressed reservations about the time it took to

get used to it, and about whether they could trust that posts limited to a group were truly limited. One participant commented that in a world where Facebook engenders mistrust about how public posts are, it's hard for them to believe that Google is limiting posts as they say they are. Instructors and students liked the way the Plus interface embedded thumbnails of the media attached to a post. That gave them a gestalt sense of what they would find if they clicked to activate the media. Posts on Plus seemed to be more spontaneous and linked to a flow of posts in a conversation rather than linked to discrete statements broadcast by community members.

Plus includes a videoconferencing feature called Hangouts. Up to ten parties may participate in two-way video conversations. However, the 11th and following parties participate only by viewing the broadcast (similar to webinar situations). Hangouts also allows screen sharing, document sharing, and a shared whiteboard. Hangouts were used in the pilot to bring remote visitors into the classroom. Two students went to a conference and used their Android telephones to initiate a videoconference interview with experts at the conference while the rest of the class participated from CU Boulder. On other occasions, the instructor travelled and was able to teach the class at a distance twice while joining them through Hangouts.

Google Groups

Google Groups is a traditional list server combined with a web-based threaded discussion interface. Subscribers can choose to receive posts in email, through reading the threaded discussion on a web site, or both. It was used in a number of the classes in this pilot. Some participants reported liking the web-based bulletin board view because it allowed them to keep course-related emails out of their inboxes. Others used it as a traditional email list service and managed messages through an email client or web-based email system.

Students and instructors reported perceiving an expectation that everyone in the class was responsible for reading every message sent through Google Groups. In Plus, however, it appears that students and instructors perceived that it was permissible to not read everything. They were able to treat Google Plus posts like a flow of communication that one could view as they had time. Participants using Groups reported feeling guilty about not responding to most posts. Others reported feeling upset that there was unequal participation among the students.

Participants varied in the frequency with which they posted and the length of the posts. A small number of people in each class community contributed the bulk of the messages. Many messages from instructors did not receive follow-up responses. And just as in the Plus setting, some students sent email to the professor privately instead of replying to the Google Group. In larger classes, it was easier for some students to be anonymous and to participate infrequently.

Based on this pilot, we recommend using all the GAFE communication tools: Gmail, Groups, and Chat; as well as Google Plus. Groups are useful for getting a one-to-many announcement message out to students that can be retrieved in their inboxes, such as an announcement about a change in an assignment or a due date. Groups seems to evoke a formal and structured environment where students might be assumed to be watched and graded on their interactions. Plus, on the other hand, seems to be

better for a less-formal, more spontaneous, multi-modal flow type of interaction. Classes that use Plus might use them for unexpected findings on the Internet and creative thoughts that don't require everyone to read and respond.

We anticipate the conversational tools in GAFE and in Plus could be helpful for class discussions, sharing useful web content among students, sending an announcement between class meetings, bringing experts into class sessions, and allowing the professor to teach while on the road, among other collaborative acts.

*Course Management*

Google Sites appears to be a flexible and useful tool for creating an online home for a course. It has the advantage that it can persist beyond the confines of an academic semester, and allow outsiders to view the work done by the class. It can also be a collaborative artifact that is built by students and faculty. Thus Google Sites can fill a "lite" course management niche. Said another way, if an instructor doesn't need all the features and functions of a learning management system, Sites can provide basic and widely used functions of a course management system.

Google Sites can be used to communicate about a course and set the visual tone for the course. This site can persist as long as the creator wants it to. It can also be transferred to the control of another person. It can be collaboratively edited by students. In some ways it can provide a more persistent and robust presence for a course than a learning management system. In our pilot, one course used Sites to allow students to document their service learning project, which provided useful tools for Architects and for parents of children with Autism. That site will likely persist for years and will be enhanced each time the course is taught.

Instructors can post course content through a Google Site gadget that accesses Google Drive files. They can also use gadgets that show content from YouTube, Picasa, Blogger, and other Google media sharing services. In our pilot two of the instructors used gadgets to display YouTube videos and other media content, as well as a Google Calendar. The calendar gadget can be useful for communicating course due dates. The calendar can also be collaboratively edited. So students can add calendar events for upcoming and relevant lectures or campus happenings, for example.

We see an opportunity for Google Sites to be used in many situations where a learning management system is used. because Desire2Learn allows GAFE tools to be accessed through a widget. Users can submit files via Google Drive to the Desire2Learn Dropbox. They also can check Google Calendars and read Gmail. This will allow instructors to take advantage of the "lite" course management tools that GAFE provides while also allowing protected access to sensitive data in a course like grade information. Instructors can bring in content from services like YouTube and Picasa. They also can have a Blog for their students or class through Blogger gadgets.

Two caveats emerged from this study. One student commented that reading long texts online was problematic, so professors may want to consider whether or not to post very long articles through Google Drive that are intended to be read online. Also, both students and professors commented that

they would like to see Google improve the method of sharing which Sites are available for people to access, and what the URL is for those sites.

**Spring 2012 Google Apps for Education Pilot: Use Cases**

The following describes each course environment we observed during the pilot.

**Course One: Education**

**Overview**

The course was a in-person doctoral seminar. Eleven students were enrolled in the course; students were masters or doctoral level.

**Motivation for use**

The teacher's goal was to explore Google Plus as a mechanism for enhancing conversation and collaboration.

**How tool was used**

The teacher and students signed up for Google Plus accounts and created a course circle. The teacher intended to encourage conversation and content sharing between students. Due to account confusion and the availability of other communication tools, students did not actively use Google Plus.

The teacher has used a number of Google applications in courses previously, including: Google docs, Google sites, and Youtube.

**Specific features used**

- Google Plus

**Course Two: Engineering**

**Overview**

There were approximately 24 students who completed the class in-person and 3 students who completed the class through the CAETE program. All students were senior or graduate level.

**Motivation for use**

The teacher's goal was to create a space that enabled easy access to course materials, student feedback and content sharing, as well as assignment descriptions and dropbox features.

**How tool was used**

*Posts and comments:* Students were required to locate information regarding course content, for example: a post about a new discovery, or recent news coverage, or relevant scholarly literature. During the first few weeks of class, the teacher modeled sharing of links, news, articles, or other content using Google Groups. Next, students were required to add several posts as well as to comment on the posts of peers. The teacher was specifically pleased with the quality of information sharing enabled by this assignment.

*Course content sharing:* The teacher used Google Sites as the central course

management tool. The teacher posted the syllabus and schedule of coursework on a Google Site. Additionally, students could extend their learning with access to all lecture powerpoint presentations and supplemental material recommendations.
*Assignment submission:* Teacher and students also used both Google Groups and Google Docs for assignment submission.

**Specific features used**

- Google Sites
- Google Groups
- Google Docs

**Course Three: Environmental Design**

**Overview**

The course is a core component of the undergraduate degree in architecture and planning. Students typically complete the course in their junior year. The course offers opportunities for students to engage with the community through participatory design and mock client services. The class included 11-12 students this semester.

**Motivation for use**

A central outcome of the course was a collaborative web page which shared student projects and work.

**How tool was used**

*Site creation:* Throughout the semester, students worked with community clients on issues of learning space design and design intervention. Students researched scholarly literature on several topics including: autism, cognitive diversity, creativity etc. In collaboration with a partner studio class and community clients, students developed tip sheets about the various topics. The tip sheets and other course work were posted on the course site. Through experiential learning, students ultimately designed an installation for a local school and produced an informational website for the community.

**Specific features used**

- Google Sites
- Google Groups

**Course Four: Education and Engineering**

**Overview**

This course was a graduate seminar composed of 9 enrolled students, community members, past students and three distance experts. The class was an informal and experimental seminar focussed on the application of game mechanisms in education. Students and professor determined flow and progression of the class based on interests and discovery.

**Motivation for use**

The class chose to use Google Apps in order to establish an online space to extend conversation and collaboration. The group shared found and student-generated information sources in a variety of formats including: individual posts, images, videos, and sound files. As a result of the seminar, the group worked collaboratively on a white

paper in Google Docs.

**How tool was used**

- *Site home*: created course site for sharing google group comments, video sharing, image sharing, gaming news, student generated screencasts
- *Formal communication*: used Google Groups for site permissions and course news, schedule, and posts
- *Collaborative content creation*: used Google Docs to begin work on a collaborative white paper
- *Virtual meetings*: used Google Hangout for virtual classes and expert interviews
- *Content sharing and informal communication*: the professor encouraged students to look for 'real world' examples and applications of game theory. Students shared reflections, questions, and content with Google Groups, Google Plus, and Picasa.

**Specific features used**

- Google Groups
- Google Plus
- Google Docs
- Google Sites
- Google Hangout
- Picasa

**Other users**

A number of other courses and campus groups report use of Google Apps but were not part of the official pilot. Other use cases include individual classes using google docs for collaborative peer editing and content creation, student groups use of calendaring for scheduling, professional development groups and clubs using sites, plus, or calendaring, among other undocumented examples.

With university sanctioned agreements, users would have guarantees about how data is owned and handled. Advertisements and other commercial features in Google would be removed.

**Issues and needs expressed**

This portion of the report details issues, barriers or on-going needs reported during the pilot. Some were a direct result of the pilot situation and the lack of centralized support and deployment. The research team lists recommendations for correcting or countering these issues when relevant.

*Timing and training:*

Many of the teacher-participants chose to use Google Apps fairly late in their semester planning. As a result, teachers had minimal time to actively investigate the tools and the capabilities therein. Several participants requested training materials, help documentation, best practice documentation and time to explore the tools more thoroughly. Specifically, one participant noted the need for best practices when selecting a communication tool (Google groups or

Google plus) based on formality or informality of discussion.

*Recommendations:*
We recommend that CU curate materials, made available by the Google community at no cost, in a convenient location for campus faculty. Additionally, we recommend help documentation and templates for popular class use cases such as:

- Collaborative site creation (for public audience)
- Collaborative site creation (for restricted audience)
- Individual student site/ portfolio creation (public or restricted audience)
- Collaborative resource curation and peer commenting (Groups v. Plus comparison)
- Course management and material posting (chronological)
- Course management and material posting (thematic)
- Course content library with copyrighted materials
- Project management

Additional documentation for specific needs should be developed. For example:

- Site discovery solutions
- Homework submission
- D2L grade book linking

*Account creation/ management:*

Several participants found it challenging to manage multiple google accounts: personal gmail (google applications) and CU Pilot account. When working within Google Apps, participants movement between accounts was problematic. Some participants used work-arounds such as multiple browsers or chrome identity functions.

Several courses used google groups to facilitate discussions, which received positive feedback in general. However, some teacher-participants reported difficulty with the initial account creation and the ability to see who had or had not activated the group and account. Since the pilot, the Google Apps for Education administrator has determined an easier and more efficient groups activation process.

Most pilot courses (three of four) created a central course page using Google Sites. Site permissions were managed using the Google Group account which makes permissions setting more involved than it needs to be.

The main Google Apps for Education campus administrator reported significant challenges due to the pilot nature this semester. Account creation and management issues were complicated due to the lack of integration with university systems. Furthermore, provisioning into Google is complicated due to Google's opt-in culture. The inclusion of gmail into the suite of tools would reduce issues significantly, according to the pilot coordinator.

*Recommendation:*

We have identified the need for documentation or training which clarifies the following:

- Best practices: assigning Google Sites permissions for a course
- Best practices: creating and managing Google groups for a course
- Best practices: creating and managing a Google plus circle for a course
- User help: customizing notification settings in Groups or Plus

*Navigation (site discovery):*

Many teacher and student participants expressed frustration with locating course pages built with Google Sites. The links to course pages were not easily discoverable from students' google accounts or another central location; therefore, students were required to bookmark or store the url.

*Recommendation:*

With automatic provisioning to D2L, the central CMS could be used as a portal to a Google site, which would eliminate issues of site discovery. Using D2L, course designers and teachers may set the D2L course home to an external URL, including a Google Sites page.

We recommend documentation or training for:

- Best practices: course site naming and D2L integration

*Identity and privacy:*

Concern of online identity confusion and separation of professional, private, and academic identities. Some participants expressed unease with posting to circles in Google Plus. This indicates a need for more training materials to reduce posting insecurities.

We recommend documentation or training for:

- Google Plus circle management
- Best practises for faculty: online publication and student identity
- Sample syllabi or assignment clause: online publication and student identity
- Privacy statements and ability to customize settings

*Accessibility:*

While accessibility issues were not encountered during the study, the research team consulted with the CU Boulder Disabilities Office for additional assessment. Cath Stager-Kilcommons, CU Boulder Disabilities Office, reported that there are some accessibility issues with GAFE. The Assistive Technologist Higher Education Network released a report on known accessibility issues in February 2012. [7] Both Gmail and Google Calendar present shortcomings for visually impaired users, including limitations for screen reader users:

- the inability to easily navigate messages in a conversation
- the inability to  attach files to an email

[7] "ATHEN Report on the Accessibility of GMail and Google Calendar ..." 2012. 13 Jul. 2012 <http://www.athenpro.org/google-gmail-calendar-accessibility>

- the inability to schedule meeting times between multiple participants
- excessive tabbing or illogical layouts resulting significant user inefficiencies

Stager-Kilcommons reported that work between higher education institutions and Google is currently underway to resolve issues. There are also positive findings for the use of screen magnification software, keyboard-only interactions and some high contrast visual layouts.

*Browser compatibility:*

Some Google Apps Features are more enhanced with the Chrome browser. Beyond this observation, the study did not uncover other browser issues.

*Performance time:*

No issues were reported during the study.

*Interface:*

The Google interface appeared to be easily navigable by participants in the study. No significant issues were reported.

*File sharing:*

Some users expressed frustration with the attachment limits in Google Groups. However, sharing content via Google Drive or Google Sites may eliminate these issues. File sharing in Google Groups is limited to 25 MB, including attachments, which is the normal Gmail limit. [8]

With Google Drive, a file, folder or document may be shared with up to 200 users or made public to an unlimited number of users. Editing accommodates 50 simultaneous users.[9] Drive provides 5 GB for synced and uploaded files. However files converted to Google Docs format do not count against the storage space limit.[10]

**Summary of Research Team Investigations**

In this and our previous study of Goingon, we discovered a campus need for teaching and learning tools in addition to the course management system. Overall, participants value the CMS for course management and teacher to student communications; however, courses and content that emphasize social, collaborative, or problem-based learning often require more flexible tools. Additionally, teachers seeking authentic learning experiences or student exposure to communities of practice value tools that extend beyond the university community. Through both investigations, Goingon and GAFE, we have compiled a list of emergent themes important to faculty and students when using alternative tools.

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[8] "Groups FAQ for administrators - Google Apps Help." 13 Jul. 2012 <http://support.google.com/a/bin/answer.py?hl=en&answer=167085>

[9] "Limits on sharing - Google Drive Help." 13 Jul. 2012 <http://support.google.com/drive/bin/answer.py?hl=en&answer=2494827>

[10] "How Google storage plans work - Google Drive Help." 2012. 13 Jul. 2012 <http://support.google.com/drive/bin/answer.py?hl=en&answer=2375124>

*Digital Literacy:*
While faculty participants often reported digital literacy education as a minor factor for using learning technologies, students listed experience with digital tools as one of the most valued outcomes.

*Extended community engagement:*
Several courses engaged professional communities or content experts in order to enhance student learning. With GAFE, students communicated with experts using Google Hangout, Google Plus, or by adding experts to a course Google Group. In another example, Google Sites facilitated the creation of public content for a client-based service learning course.

- Ability to add members beyond class enrollment and campus community
- Ability for students to publish content open to the public
- Ability for online community to extend beyond the traditional academic calendar
- Ability to introduce students to online communities of practice
- Ability to adjust and change permission settings easily

*Pedagogical Match:*
Instructors and participants often mentioned the need for best practice documentation and assistance for selecting the appropriate tool for their pedagogical purpose. For example, a few participants tried both Google Groups and Google Plus as venues for discussion, with differing degrees of success. A class that was more informal in nature and heavily involved with the expert community had greater success with Google Plus while a more traditional class discussion list was better served by Google Groups. Or, faculty that only require a gradebook and basic course management features would save time using Desire2Learn rather than customizing and experimenting with GAFE. Documentation that matches purpose with suggested tools or case studies of successful use would help faculty successfully apply learning technologies in the classroom, which directly impacts student buy-in.

*Student Attitude and Buy-in:*
Generally, students reported positive attitudes towards classroom technologies. However, it was apparent that student satisfaction increased when the teacher clarified the tools learning purpose and the reason for use. When a tool was seen as a distraction and not explicitly tied to learning, students were less engaged.

Similarly, students valued credit-driven incentives for being an active participant in the online class environment. Many student participants reported that this and active teacher communication equalized concerns about peer participation and increased the sense of a course community.

*Developing community:*
Several questions about class community development arose during both pilot studies. This represents areas for continued research.

- Does class size impact motivation and active participation in online class communities?
- What student characteristics impact motivation and active participation in online class communities?
- What teacher practices impact motivation and active participation in online class communities?
- What course structures or assignments impact motivation and active participation in online class communities?