Collaborative Learning at Low Cost: CoWeb Use in English Composition

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ABSTRACT

CoWeb is a collaborative learning environment used in many classes at Georgia Institute of Technology; it is an extremely simple domain-independent collaboration tool. Our aim is to show that such a simple system can sustain useful peer-to-peer and instructor-to-student interaction that fosters better performance and learning, without incurring a high cost. In this paper, we present evidence of the success of this tool in supporting learning at low cost in one environment—freshman-level English classes.

Keywords

CoWeb, low cost, close reading, English composition, collaborative learning

INTRODUCTION

In 1998, we introduced CoWeb (short for Collaborative Web-site) to Georgia Institute of Technology. Since then, we have been applying this simple collaboration technology to class contexts in different domains: architecture, computer science, mathematics, engineering, and English. Though we have developed a few specialized features, such as an equation editor to simplify sharing of mathematical equations, the CoWeb interface remains largely the same across these different domains.

This study examines the use of CoWeb in freshman-level English classes. In particular, we show both learning and cost effectiveness. By engaging students in collaboration, we can leverage the large numbers in classes to create greater opportunities for discussion, reflection, and (consequently) learning. Because the increased opportunity for learning is coming from the students themselves, the cost for the institution does not need to rise any further than simply providing oversight of the process. Thus, for relatively low costs (cost effectiveness), significant improvement can be made in class performance (learning effectiveness).

So, our use of CoWeb in English composition demonstrates that a simple and flexible collaboration tool can be effective for providing the benefit of collaborative learning while still being cost effective.

COWEB

CoWeb is conceptually based on the WikiWikiWeb[*] (or Wiki) by Ward Cunningham (Leuf & Cunningham, 2001). The Wiki is a web-site that invites all users to edit any page within the site and add new pages using only a common web browser; the text is edited in an HTML text area without special applets or plug-ins. The Wiki is an unusual collaboration space in its total freedom, ease of access and use, and lack of structure. The Wiki is inherently democratic—every user has exactly the same capabilities as any other user.

Like the Wiki, CoWeb looks like a fairly traditional web-site, except that every page has a set of buttons at the top that allow the user to do various things such as edit the page, (un)lock the page, or view the history of the page over time. Links between pages are easily created by referencing pages within the same site by name (e.g., *Page Name*). If a page with the given name doesn't already exist, a *create* link shows up next to the name upon save; clicking on this creates the new page (see Figure 1). CoWeb shares Wiki's democratic philosophy of equal power to all users. Though our usage is mostly set in classes, where there is someone in charge (the instructor), we find little reason to give more interface power to the instructor than to the students. The instructor naturally has social power that does not need to be reinforced by the interface. As one professor commented: "I just like the interaction that it enables. It's basically a whiteboard that everyone can write on. Protections are always kind of a pain."
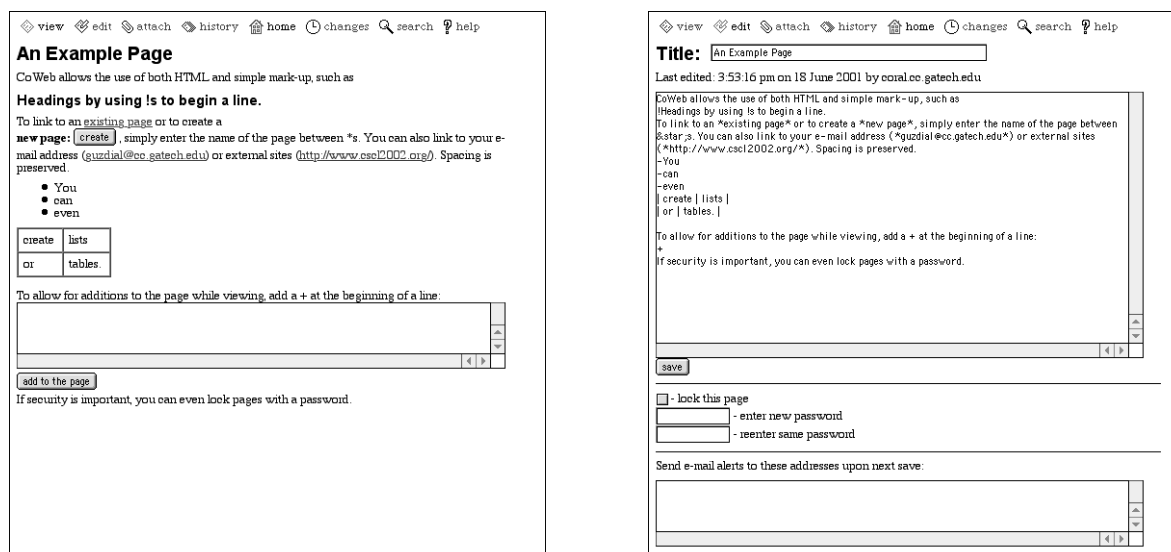
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[*] http://c2.com/cgi-bin/wiki

Figure 1: Viewing / Editing a CoWeb Page in a Web Browser

Through over a dozen iterations in the last three years, CoWeb has had features added and the interface streamlined to fit well into classroom use (Guzdial, Rick, & Kerimbaev, 2000). Over 100 class CoWebs are now in use at Georgia Tech. A wide variety of educational activities have been invented by instructors for their classes (Guzdial, Rick, & Kehoe, 2001), and we have catalogued some 25 common activities that we see tailored to meet specific class needs (Collaborative Software Laboratory, 2000).

COWEB USE IN ENGLISH COMPOSITION

In English composition, CoWeb is used for an activity called *close reading*, where prose or a poem for discussion is posted, and students comment upon it by inserting links directly into the prose or poem. Students then comment upon each other's comments and even use the same technique to comment upon each other's essays. Figure 2 illustrates two kinds of close reading activities. The left picture shows part of a CoWeb close reading assignment based on a chat session. Students completed a computer-based chat session based on classroom topics and assigned reading. The instructor then posted the contents of that chat session into the CoWeb. From there, students were instructed to find interesting parts of the discussion and create pages associated with the section. Basically, the students would find an interesting fragment and surround it with *s. When saving the page, they could create a new CoWeb page with that fragment as the title. So, the original chat session was preserved, but comments could be made on the most important sections of the chat session. The right picture of Figure 2 shows the same activity, except that the text to be annotated is a classroom reading, in this case from Karl Marx's "The German Ideology."
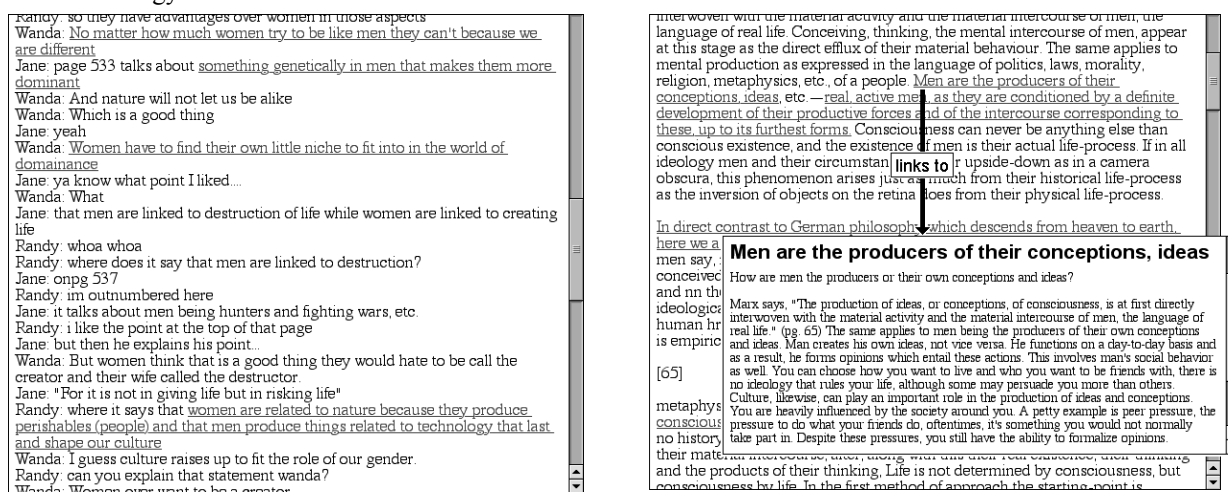

Figure 2: Close Reading Exercises on CoWeb (left picture based on a chat session, right picture base on literature). Names have been disguised from the original.

LEARNING EFFECTIVENESS

Learning effectiveness is the amount learned in relation to the cost for achieving that learning (i.e. time on task). In this section, we show our evidence for learning through use of CoWeb. Then, in the next section, we show that this learning benefit is achievable at a low cost.

We studied two sections of an English 101[1] class, taught by the same instructor. The first section (24 students) used CoWeb to complete various assignments[2]. The comparison section (25 students) did the same activities, but the students worked in a threaded-discussion on-line environment[3] on the close reading activities and individually on the essays. As each section did the same activities, student cost (effort) should be identical. To confirm this, we paid several students in both sections to track their time spent on the class; no notable differences between the groups were observed.

Through surveys, we find that the CoWeb section had significantly better attitudes toward collaboration than did students in the comparison section (Table 1). In addition, the CoWeb section received higher grades (grade breakdown: 7 A's, 10 B's, 3 C's, others F or W) than the comparison section (grade breakdown: 19 B's, 3 D's, others F or W), which indicates better performance and suggests better learning. In particular, the instructor noted that the CoWeb section showed more variance, thereby allowing A's to be assigned.

Statement	CoWeb Section	Comparison Section
I would rather work independently on assignments than in groups or teams.	3.83	2.81
I feel working with others on assignments is more helpful than working alone.	2.00	2.75
When working on team projects, I feel motivated by my sense of responsibility to the group.	1.78	2.69
I like doing teamwork.	1.89	2.75
I found it useful to relate my work to that of others.	1.56	2.50

Table 1: Attitudes toward Collaboration, where 1 is strongly agree and 5 is strongly disagree. $p < 0.05$ on a two-tailed t-test for all of these statements

We recognize that grades are not a precise measure of performance, and they are too large-grained to inform us about where any learning benefit may have come from. As such, twelve students were selected randomly from each section and their work rated by various criteria (Table 2). Five assignments were rated: two close reading assignments based on student-generated chat sessions (rated for the first 6 criteria, which we refer to as chat close readings), two close reading assignments based on literature (rated for the first 10 criteria, referred to as literature close readings), and one formal essay (rated for all 15 criteria). To keep individual bias to a minimum, two raters (one the course instructor, the other a colleague in the same department) rated each assignment on a scale of one to four (four being highest performance). No statistically significant differences were found in their ratings, and all criteria had better than 70% of the ratings identical. In each rating category, the CoWeb section outperformed the comparison section (in most, by a large statistically significant amount):

Category	CoWeb Section	Comparison Section	Difference
Engagement with Class Material	2.52	1.88	0.64
Foundation for Research	2.49	1.68	0.82
Reflective / Recursive Writing Practices: Authorial voice	2.30	1.58	0.73
Reflective / Recursive Writing Practices: Reflection and Exploration	2.24	1.49	0.75
Critical Vocabulary: Understanding	2.30	1.54	0.76
Critical Vocabulary: Application	2.28	1.33	0.95

[1] English 101 is a fictional course number, but the course is the Georgia Tech equivalent of English 101

[2] The CoWeb section was chosen at random and students did not know a priori which section would use CoWeb, so selection bias was minimized.

[3] The comparison class's on-line environment was similar to a Usenet newsgroup. The close reading text was the original posting and students replied to it with their annotations.

Formation of Critical Questions: Engagement with Topic	2.39	1.94	0.44
Formation of Critical Questions: Quality of Questions / Arguments	2.24	2.21	0.03*
Critical / Close Reading Skills: Analysis	2.29	1.97	0.32*
Critical / Close Reading Skills: Identification of Issues	2.36	2.06	0.31*
Research Skills: Locating Information	3.04	2.54	0.50
Research Skills: Using Information	2.75	2.00	0.75
Identification of Critical Sources	2.75	2.08	0.67
Engagement and Integration of Research Sources	2.71	1.75	0.96
Effective Use of Formal Essay Writing Conventions for Argumentation	2.79	2.21	0.58

Table 2: Writing Performance. *p* < .05 on a two-tailed t-test for all except *

On average, the students in the CoWeb section did significantly better on writing essays than the comparison section, particularly on issues of vocabulary and essay organization. Several categories show near 1.00 differences in performance; on a scale of one to four, one point of difference indicates a large difference in performance. For instance, on critical vocabulary application, the CoWeb section average is between 2 (chosen when "the student deploys these terms where appropriate in his/her writing, but most are misused") and 3 ("the student deploys most of these terms where appropriate in his/her writing, but occasionally misuses them"), while the comparison section average is between 1 ("the student never successfully deploys these terms where appropriate in his/her writing") and 2.

Clearly, CoWeb seems to engender better performance on these activities; however, we also wanted to get an idea as to whether there was a cumulative effect of CoWeb use over the term. As such, we looked at performance over the term on similar assignments. If CoWeb has a cumulative effect, the difference in ratings (i.e. performance-gap) should increase over time. Figure 3 shows that for each of the two assignment types noted earlier, the performance-gap increased over the term, though not by a large margin (.29 and .07 respectively).
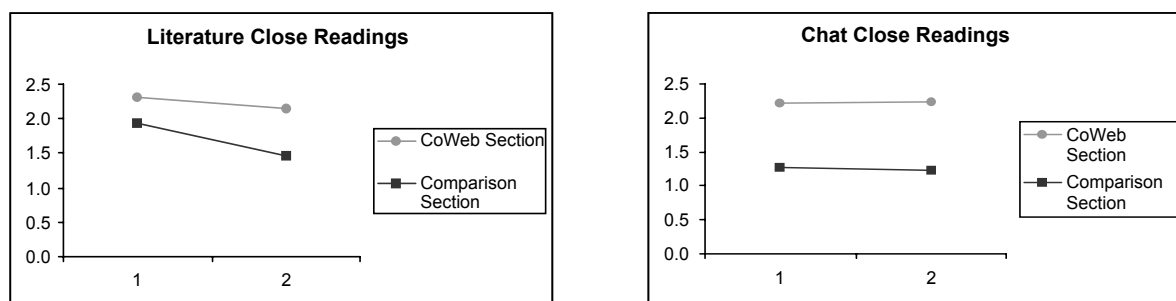

Figure 3: Graphs demonstrating that the performance-gap between CoWeb and comparison section increases over
        time on two different types of assignments

So overall, we conclude that CoWeb usage in close reading activities was effective for learning in this study. The performance of the students in the CoWeb section was significantly better by many key subject criteria over the comparison section. At the same time, attitudes towards collaborative learning improved. We speculate that these two factors are not independent; instead, as the use of collaborative learning proves beneficial, more learning will happen, which in turn improves the attitude towards collaboration. Furthermore, instead of just improving performance on the activity itself, CoWeb students show a cumulative learning effect.

COST EFFECTIVENESS
Now that we have shown learning effectiveness, it becomes important to look at costs. We aim to show that CoWeb use has both low infrastructure and human costs.

Infrastructure costs are negligible. Though a server was bought for this study, that server can support at least a dozen classes over many terms. CoWeb is a cross-platform and lightweight server application that can be run on virtually any hardware (in some cases, old 486's), so even a $1000 server can easily support many classes. Student access to internet-enabled computers is essential for CoWeb use; at Georgia Tech, there was no need to provide any infrastructure for this since it was already present. Nor is use of that infrastructure markedly increased, considering that students would need similar amounts of time for other applications for the same class (i.e. word processing). At other locations where the infrastructure is not in place, that cost may be prohibitive; however, this infrastructure is becoming very common. The CoWeb software is open-source freeware[4]; thus, there are no software costs.

Administration costs too are negligible. Besides the tracking software (specifically used for gathering study data) and a couple of software upgrades (the CoWeb software is still actively being developed), an English professor (not a computer specialist) was able to administer the server without assistance. In total, the amount of administration time over the semester was less than an hour.

By far, the dominant cost factor in CoWeb use is instructor time. The instructor for the two sections, using self reporting, averaged about 2.5 hours per week devoted to CoWeb usage; this is quite reasonable as it is about the same amount of time as an office hours session. However, this does not give us a clear idea of how she spent that time or how student usage relates to instructor involvement.

In the term following our learning study, we set up CoWeb to log usage time. We did this for two instructors, teaching the same class (English 102[5]). The first (instructor 1) was the instructor for the original class, and here taught the follow-up course (class 1: 24 students, with 1 withdrawing). The second (instructor 2) was the second rater for the performance assessment. This was the first time this instructor used CoWeb, using one CoWeb for three sections of the same class (class 2: 64 students, with 5 withdrawing). As she was getting used to CoWeb, instructor 2 still relied on another web environment for the class; in contrast, all on-line activities for instructor 1 were done with CoWeb[6]. The instructors did different activities with their class and have different styles of using the technology, so this data is a good cross-section of instructional uses. Table 3 summarizes instructor and student time on CoWeb.

	Class 1	Class 2
Average Not-Withdrawing Student Time	17.95 hours	8.13 hours
Total Student Time	412.84 hours	484.82 hours
Total Instructor Time	41.30 hours	57.35 hours
Total Student Time / Instructor Time	10.00	8.45

Table 3: Instructor and Student Time using CoWeb

What is most notable is that in both cases the ratio of total time spent by students to total time spent by the instructor is similar (10.00 and 8.45). One way to measure the cost effectiveness of an educational activity is to contrast the ratio of student to instructor time. By this criterion, lecture is cost effective. For each hour of instructor time input, there are *n* hours of total student time (24.00 and 21.33[7] respectively in our case) spent engaged in the learning activity. This number estimate is a bit high, considering it does not include preparation time for the instructor or absenteeism for the students. While lecture scores high marks on efficiency, it loses in learning effectiveness, as student involvement tends to be passive (particularly for large classes where cost efficiency would be high). In contrast, one-on-one tutoring, as may occur during office hours, can be quite active and engaging. Unfortunately, one-on-one tutoring is not economically feasible, with a ratio of 1.00 hour of instructor time to student time. The CoWeb ratios (around 9) on the other hand seem a reasonable compromise of the cost effectiveness of lower instructor time with the learning effectiveness of more active learning (as students construct artifacts).

Unlike lectures that have a high attendance level, time-spent using an educational technology can be highly varied. One scenario could have an exponential drop-off, with only a few students using the technology often. While the technology might have marked effects on these few students large enough to affect the class average, it probably wouldn't be considered a healthy situation in most schools. What we want to see is that the technology is reaching most if not all students.

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[4] It can be downloaded from http://minnow.cc.gatech.edu/swiki

[5] Again, English 102 is a fictional course name.

[6] In the future, instructor 2 plans to only use CoWeb.

[7] 64 students / 3 sections = 21.33 student class hours per instructor hour

To look at the distribution of usage across students, Figure 4 plots student time on CoWeb from most usage to least usage. The vertical axis is the number of hours spent in CoWeb, and the horizontal axis represents different students, ordered in terms of the amount of time they spent in CoWeb.
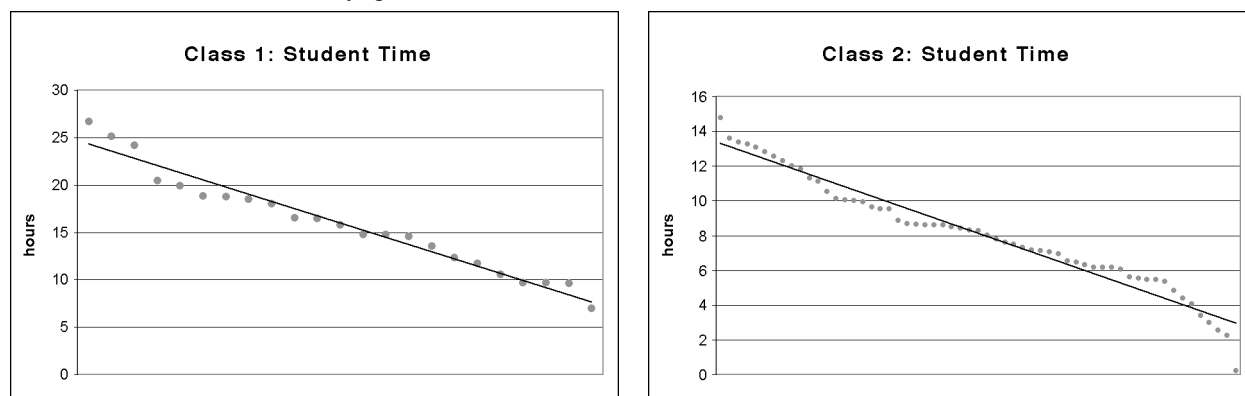

Figure 4: Distributions of Students' CoWeb Usage (from most use to least use)

What it shows is that while usage varies quite widely, it does so in a near linear way (for both classes). Also, in both cases, there seems to be a grouping around the class average with only a few doing significantly less or more. This grouping can be seen in the right graph where there is a dip below the line to the left of the center and a dip above the line to the right of the center. For an activity, like homework, a roughly linear distribution with a few doing significantly more or less than the average seems acceptable.

Are some activities more cost effective than others (i.e. requiring less instructor time for equal student effort)? If so, efficiency could then be improved by focusing on certain activities and dropping less efficient activities. To test this hypothesis, we recorded student and instructor time on CoWeb over the term (Figure 5—horizontal axis represents week intervals over the course of the term, and vertical axis represents time spent in the CoWeb during that interval). After looking at the data, interviews with the instructors were conducted to find out what activities occurred and how their time was spent.
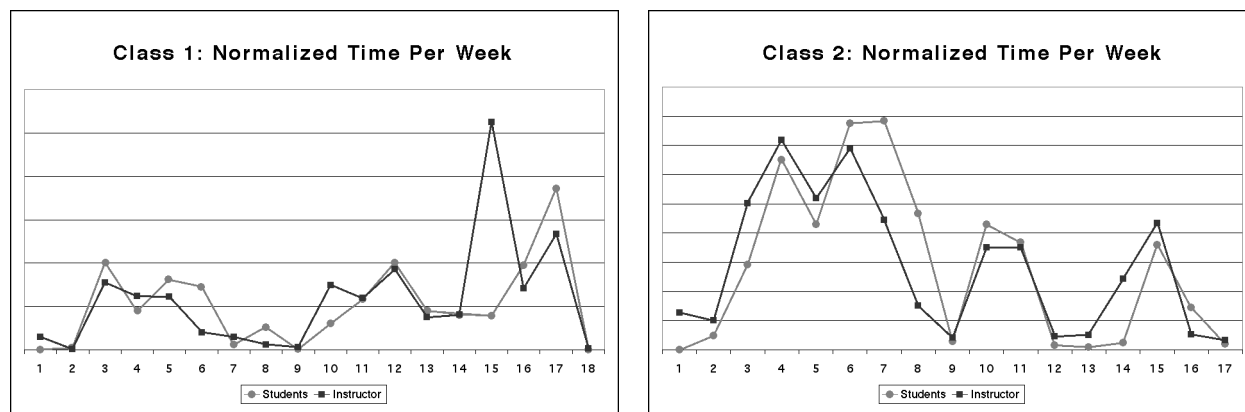

Figure 5: Distribution of Time per Week for Both Classes (Note: Week 9 is Spring Break)

A couple of conclusions can be drawn from this data. First, almost all of the time, the instructor put in some of the effort before the students; this can be seen particularly well for instructor 2, where instructor time seems almost shifted a week off the student time. So, a significant proportion of instructor time is spent on setting up the space; this observation was confirmed by both instructors during the interviews. Second, instructor time is closely linked to student time for each assignment. The only exception is week 15 for instructor 1, where she spent just over 10 hours on CoWeb; this time was mainly spent on grading. Instructor 2 did grading throughout the term. As such, there is no assignment for either instructor that is far more or less efficient. One way to explain this is that the amount of time that instructors and students spend on an assignment is closely related to the point value of the assignment; so, the original hypothesis about more efficient assignments is flawed.

Instructor 2 mainly used CoWeb for one large assignment worth 35 percent of their grade (weeks 2-12). Students worked in small groups (2-3 members) to investigate a decade from 1800-1912. Each group posted a timeline with a minimum of 10 significant science or technological innovations or discoveries identified in that decade; each member of the group researched one of these events in depth and wrote a five page paper on it. The purpose of this project was to provide a database of information about science and technology in the 19th century that students could use as background for their

final project—to create a web-site to understand a 20th century phenomenon in terms of its origins or background in the 19th century. As such, CoWeb served as a research space where students could benefit from the work of their classmates. Although students had to link their final project to the class CoWeb for other students to see, the final projects were required to be traditional web-sites and could not be built in CoWeb. However, the instructor encouraged students to use CoWeb as a way to collaborate on their final project. Most of the use in weeks 13 through 16 is attributable to that voluntary collaboration.

Instructor 1 used CoWeb throughout the term for multiple smaller assignments. Students were required to complete three chat-based and one literature-based close reading assignments. Also, students posted summaries and discussion about the class reading. Instructor 1 also used the space as a way to distribute class readings and communicate deadlines and activities to the students. The largest chunk of student use came during weeks 15 through 17, when they worked on a final project. Like class 2, the final project for class 1 was for groups to build a web-site.

Unlike instructor 2, instructor 1 allowed students to do their web project entirely in CoWeb; four out of six groups decided to complete their projects entirely in CoWeb. So, students found interaction on CoWeb useful enough to use it instead of traditional web-site tools, such as Microsoft FrontPage™. As students tend to choose the most effective ways to accomplish their goals, this is further evidence of CoWeb's cost effectiveness (this time for students). Furthermore, Instructor 1 commented that the quality of the final projects was higher than previous classes as CoWeb-using students concentrated more on content than on looks. Although the instructor has always stressed content over looks, students creating web-sites tended to spend much of their time on looks. Since most web-page creation tools allow you to "mess around" easily with looks, it is only natural that students would find this aspect interesting. In contrast, it is almost painful to "mess around" with looks on CoWeb. Instead of being a detriment in this case, it was an advantage for learning effectiveness. If CoWeb usage were not seen as cost effective by the students, they would not have used it for their final projects, and the final assignment would not have been as effective for learning. So, it is important that instructor *and* students see a classroom technology as cost effective. In addition to CoWeb being a good environment for the final projects, instructor 1 observed a significant cumulative effect—the CoWeb class was already used to concentrating on content.

For instructor 1, all class activities, besides office hours and lecture, including grading, were conducted on CoWeb. Considering that lecture time was about 50 hours, roughly 40 hours spent on the class outside of lecture during a semester is quite efficient. The 41 hours observed through system logs also matches closely to instructor 1's self reported time of 2.5 average hours per week spent on CoWeb for the previous term, where the learning effectiveness was closely examined. While CoWeb's interface is easy to learn and we (the developers) have produced several guides on how to use it in the classroom, we expect a certain significant cost to be incurred from using a new technology for the first time. As instructor 1 already used CoWeb before and had taught this course before, her level of efficiency (10.00 total-student-time-to-instructor-time ratio) may have reached a stable efficiency saturation point. In contrast, this was the first time instructor 2 used CoWeb. As such, her total-student-time-to-instructor-time ratio would be expected to rise (slightly) over time, as she becomes more comfortable with the environment. Also, instructor involvement is highly dependent on teaching style. Instructor 1 views her CoWeb interaction as setting up the space for the students to work and then letting them "loose." In contrast, instructor 2's style is one of tighter control of what occurs in the space; she is actively involved in the running of the activities and likes participating along with the students. This difference in styles might cause instructor 2's saturation efficiency to be somewhat below instructor 1's. Even with different styles and uses, CoWeb usage remains cost effective for both instructor and student.

DISCUSSION

Use of CoWeb in the introductory English classes studied is a success, both from a learning perspective (the students were able to engage the curriculum actively) and a cost perspective (both fixed and variable costs were quite low). Collaborative learning activities are realizing their potential as a way of leveraging the numbers in the classroom to create a dramatically improved learning situation without a dramatic rise in costs.

The use of CoWeb in English composition has been remarkably independent of CoWeb development. Using CoWeb for close reading activities based on literature was invented by Greg VanHoosier-Carey, a fellow professor in the School of Literature, Communications, and Culture (Collaborative Software Laboratory, 2000). Close readings based on chat session were invented by the English 101 instructor. While we who developed CoWeb provided support such as answering questions and setting up monitoring programs, we did nothing to specify the usage of CoWeb in that domain. So, a simple collaboration tool (such as CoWeb or Wiki) can allow educators to take ownership of the technology and invent new uses that will be useful in their domain.

Though performance and learning improved in the collaborative learning case, student effort (time-on-task) remained the same. Guzdial and Carroll investigated this phenomenon; they found three possible causes for this effect (Guzdial, Carroll, 2002). First, vicarious learning can occur as students view each other's postings and try to understand the issues that their fellow classmates are engaging. Second, posting assignments to a real audience (i.e. fellow learners) provides an opportunity for reflection: students think deeply about the content before they post. Third, the on-line environment can

provide support for and an extension of the in-class activities. By discussing the in-class activities in a forum where each student has a better chance of being heard, the average class performance is raised. The on-line environment gives students a clearer understanding of what is expected of them and how the lecture relates to the assignments.

ACKNOWLEDGMENTS

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