When Collaboration Doesn't Work

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Abstract: The CoWeb is an easy-to-use collaboration tool that has been used successfully in several courses in a variety of disciplines at Georgia Tech. At the same time, the tool has been used unsuccessfully in a variety of Math, Engineering, and Computer Science courses, using some of the same activities and with activities invented just for those course contexts. Our surveys of faculty and students point to a variety of causes for the lack of collaboration, including too much competition, a sense of *learned helplessness*, and faculty issues.

CoWeb: Collaborative Website

We have been using the CoWeb (Collaborative Website) for over four years, with over a hundred classes and thousands of students. The results have been quite positive.

- In a comparative study (Rick, Guzdial, Carroll, Holloway-Attaway, & Walker, 2002), we described learning benefit for an English class using the CoWeb, compared to a comparison class engaging in the same activity but without collaboration. Students did collaborative *close reading* where they marked up and commented upon compositions posted in the CoWeb. We also showed that the collaborative close reading activity was implemented at a surprisingly low cost: No additional time for the teacher, little extra time for the system administrators (less than an hour per term), and *less* time for the CoWeb-using students than those doing the same learning activity alone.

- In Computer Science, the CoWeb has been used in a variety of classes for many different activities—literally, thousands of students in dozens of classes. For semester-long projects (e.g., in a *Digital Video Effects* class), the CoWeb can serve an important role in benchmarking progress and leaving a trail of design decisions and partial artifacts. A particularly popular activity (e.g., in a class on object-oriented analysis and design) is the *Midterm Exam Review* where potential midterm exam questions are posted, and students respond with answers, questions about the questions, and questions about each others' answers. Even in large classes, the on-line exam reviews can be a whole-class study session.

- The CoWeb has been used by Architecture students to conduct on-line design reviews. The on-line design reviews have been so successful that they have been recognized by an international architecture journal and by the America Association of Architects (Craig, ul Haq, Khan, Zimring, Kehoe, Rick, & Guzdial, 2000). Architecture students like the CoWeb, feel it integrates well with the class, and tend to use it more than is strictly required. Said one student:

> `"The best part of this course was using *trescool* [their CoWeb]. It helped in keeping up-to-date with the class and upcoming assignments. It was also helpful to have a question and answer page for our midterm papers and final research projects… At Georgia Tech, the classes that I am taking do not use their websites as much. I think if a class is going to create a site at all, it should be as helpful as *trescool*.'"

- We have found that the CoWeb not only gets adopted by teachers at Georgia Tech, but the teachers invent new uses with it — quite a surprising result among educational technologies (Guzdial, Rick, & Kehoe, 2001b).

The CoWeb is a technology that provides perhaps the simplest possible model for collaboration. A CoWeb is a website where (to oversimplify slightly) (a) each page is editable by simply clicking an *Edit* button on the page and (b) new pages can be created by simply referencing them in the page's text, e.g. `*New Page*`. Through over a dozen iterations in the first three years, the CoWeb has had features added and the interface simplified to fit well into classroom use (Guzdial, Rick, & Kerimbaev, 2000). A wide variety of educational activities have been invented by teachers for their classes (Guzdial, et al., 2001b). We have catalogued some 25 CoWeb-based learning activities that we have seen tailored to meet specific class needs (CSL, 2000)

All of that said, we have also had some significant failures with trying to use the CoWeb in many classes at Georgia Tech. Students in some Engineering, Mathematics, and Computer Science classes refuse to participate, or only participate to the minimum extent required. Teachers and teaching assistants ignore the CoWeb or actively fight against it.

This paper describes what happens when the CoWeb fails and our analysis of why. The paper is based extensively on a paper presented at the ASEE/IEEE Frontiers in Education conference (Guzdial, Ludovice, Realff, Morley, Carroll, & Ladak, 2001a).

CoWeb Failure Stories

We have trialed many different activities in Engineering, Mathematics, and Computer Science classes using the CoWeb over the last three years (CSL, 2000). Our most successful activity in Engineering and Mathematics was the *Puzzle* activity where the teacher posts a challenging problem on the CoWeb, and offers extra credit for the solution *or* for posting a partial solution or lead that results in the solution. Approximately 40% of the class voluntarily participated in that activity, which is still a far cry from the 70-100% participation that we see with other kinds of classes (e.g., Guzdial & Turns, 2000). One of the factors leading to decreased participation was the short time that the puzzles were viable in class, which was due to the large variance in ability among Math and Engineering students. While the faculty chose problems that should have been just beyond the scope of the course, advanced student correctly solved the puzzle problems in each trial relatively early in the term, thus ending the viability of activity earlier than was expected.

Some anecdotes highlight the kinds of *active resistance* that we have seen.

- To encourage collaboration in the CoWeb, we created a mandatory assignment that required collaboration between a Chemical Engineering and a Mathematics course. The students in Chemical Engineering created simulations that generated data for the Mathematics students to analyze, and then provide the results back to the Chemical Engineers. 40% of the Mathematics students accepted a zero on the assignment rather than collaborate with the Chemical Engineers.

- One semester, we started using the CoWeb in an Freshman Architecture course (n=171) at the same time that we started in a Senior Chemical Engineering course (n=24). After ten weeks into the semester, the Architecture students had generated over 1500 pages, with some discussion pages having over 30 authors. In the Chemical Engineering course, not a single student had made a single posting yet. In another semester, in a Computer Science course of 340 students, only 22 students participated.

- We had a hypothesis that part of the inhibition to participate in the Engineering and Mathematics class was a technical one. The content of many of these courses involves equations, and equations are difficult to post on the Web. If students couldn't "talk" in the modalities that were the most comfortable for them, it would make sense that they would avoid our tool. So, we created an applet-like tool that allowed users to create equations by simply dragging and dropping components from palettes, and then drop the equations into a bucket for rendering to a GIF format that could be easily posted. We installed it in a CoWeb for a Mathematics class and for a Chemical Engineering class, with a total of over 70 potential users. Faculty used it and praised it. Not a single student even *tried* it in either class.

These anecdotes paint a stark picture of active resistance to collaboration. These students simply showed no interest in collaborating at all, and at times, willingly accept a decrease in their grade rather than collaborate. Several engineering faculty have told us that they don't consider collaboration an important part of undergraduate learning. We don't see that students *want* to collaborate but are having trouble with the technology or with figuring out how best to collaborate—if that were true, we would expect to see students *trying* the technologies and more than 22 students out of 340 students posting. Rather, we see students actively avoiding collaboration, which poses an important problem for engineering educators who want to use computer-supported collaborative learning.

Explaining the Resistance

We have been conducting interviews and distributing *ad hoc* questionnaires to try to understand what's going on in these classes. For example, we recently introduced the CoWeb into an English Composition class (same class described earlier in a comparative study), a Mathematics class, and a Chemical Engineering class the same semester. Some of the results of an end-of-term survey are summarized in Table 1. We see that the Composition class was more positive about the CoWeb and about collaboration in general than the Mathematics and Chemical Engineering classes.

Table 1: Comparing average responses between English Composition, Math, and Chemical Engineering classes (1 is strongly agree, 5 is strongly disagree)

Statement	**English Composition**	**Math**	**Chemical Engineering**
I enjoyed using the CoWeb	2.17	2.52	3.18
I would rather work independently on assignments than in groups or teams.	3.83	3.40	3.59
I feel like working with others on assignments is more helpful than working alone.	2.00	2.36	2.41
I found it useful to relate my work to that of others.	1.56	2.52	2.47

In another study, we used a *Midterm Exam Review* activity in a Chemical Engineering class and in a Computer Science class—and in both classes, there was almost no participation. We used a targeted questionnaire to explore our hypotheses for why there was so little participation, and some of the results are summarized in Table 2. In the Chemical Engineering class (n=24), 90% of the students said that they were aware of the Midterm Exam Review, and 70% said that they found the review useful—but mostly to do on their own. In the CS class (n=150), 87% of the students said that they were aware of the Midterm Review, but only 55% found it useful. However, note that the students generally agree with the statement that "Posting solutions for comments or questions to the CoWeb is useful." We will return to these results as we describe what we see as the explanations for the active resistance to collaboration in these classes.

Table 2: Average responses between a Chemical Engineering and a Computer Science class (1 is strongly agree, 5 is strongly disagree

Statement	Chemical Engineering	Computer Science
Posting solutions for comments or questions to the CoWeb is useful	2.5	2.6
I find the course to take a lot of time outside of class time	1.8	2.2
I view [this field] as intensely competitive	2.1	2.6
I view [this class] as intensely competitive	3.6	2.5
Most of the problems in this class have only one correct answer	2.1	3.7
The CoWeb is primarily an information resource	2.8	2.9
I print pages from the CoWeb regularly	3.7	3.8

Competition and Single-Answer Assignments

Students in the classes where there was little collaboration tended to view the class or the field as competitive and demanding a lot of time and effort. The results of Table 2 support that result, as did interviews that we did with students. Quotes from the targeted questionnaire on why students did not participate in the Midterm Exam Review activity provide more evidence for this claim.

"1) didn't want to get railed 2) with the curve it is better when your peers do badly"

"since it is a curved class most people donÕt want others to do well"

Students in Engineering and Mathematics, particularly, tended to see their homework as having only one correct answer (Table 2)—even when faculty told us that this wasn't true. It was simply the students' perception. If there's only one correct answer, and the class is highly competitive and/or curved, it's only rational *not* to collaborate or help others. It is in the students' best interests not to participate.

Research on collaborative learning in general also tells us that the perception of single-answer assignments is a hindrance to collaboration. Cohen (1994) in her review of the literature on collaborative learning found that open-ended, ill-structured problems tend to encourage productive group learning. If the students perceive that there is only one answer, there isn't as much need for the group.

The Challenge of Seeking Help

The literature on educational psychology has pointed out a paradox in students behaviors when choosing to seek help: If a student is confused, he may not want to seek help, perhaps to avoid admitting the confusion, a condition called *learned helplessness* (Bruer, 1993). Seeking and receiving help does lead to achievement, but students have to seek the help (Webb & Palincsar, 1996). Quotes from the targeted questionnaire support the belief that the students may have felt that they were so confused that they could not ask for help.

"I haven't posted about questions because I am confident that my answers are wrong"

"I thought, I was the only one having problem understanding what was asked in the exam."

"who am I to post answers? "

Or, they may have felt that if they asked questions, they would be punished in the very competitive atmosphere.

"What was I suppose to do with it. Those who answered questions were severely criticized by [the teacher]."

"The overall environment for [this class] isn't a very help-oriented environment"

Faculty Attitudes and Models of Collaboration

One Civil Engineering faculty member, upon hearing about our findings, responded, "But undergraduate students *should* have only single-answer problems! Design comes much later! " When posed the issue about ill-structured problems supporting collaboration better, he said that he didn't believe that collaboration was important. We have had similar responses from other faculty and teaching assistants with whom we've spoken. If undergraduate learning is about learning facts and skills, then where is the role for collaboration?

If faculty are not supportive of collaboration, they may not convey to students what collaboration is about or how or why they should collaborate. Or even if the faculty are supportive, a traditional lecture-style class may not provide students with the models for what they are supposed to do in a collaborative learning situation. Engineering and Computer Science students told us in interviews that they didn't collaborate in the CoWeb because they simply didn't know what to do there. The students had no models for how to collaborate nor how to learn collaboratively (at least, with technology).

Offering the Faculty an Opportunity to Change

After these studies, we realized that the best opportunity for change was to directly address the faculty who might be interested in using the CoWeb. In Spring 2001, we offered a workshop to Georgia Tech faculty who wanted to use the CoWeb. During a two-hour lunchtime session, we led a dozen faculty through using the CoWeb for themselves (each had their own station). We had three faculty talk about how they used it. We also offered the faculty support documentation, including a copy of the catalog of the activities that teachers had invented in their own courses (CSL, 2000). At end of Summer 2001, we followed up with each of the faculty and offered them additional support, including offers to create and host CoWebs for them on our own servers.

In November 2001, we followed up with the faculty who took our workshop. Only one faculty member (from Psychology) had started using the CoWeb. The rest (including Mathematics and Engineering faculty) had not adopted it. We surveyed all of the faculty about the CoWeb (e.g., did they feel that they knew how to use the software? Was it easy enough to use?), about curriculum (e.g., did they have ideas for what they might use the CoWeb for?), and about their own practices. The common explanation was a lack of time to explore new options in their classes. They claimed to want to use collaborative learning in their classes, and they found the CoWeb to be easy enough to use.

Summary: Collaboration works when culture and context supports it

Based on these results, it might be surprising that collaborative technologies are *ever* adopted in courses! We can point out a few issues that help to highlight the differences between positive and negative adoptions of the CoWeb.

- The courses where the CoWeb has been most successful have been focused on design with a high value placed on discussion. The courses where the CoWeb have not been successful have focused significantly on rote learning with little discussion. When there is more than one answer to a question, it's easier to collaborate.

- While faculty interest certainly plays a role, it's not the only factor. We should point out that some of these negative results came from classes taught by authors on this paper! Content of courses and culture of a field can have a significant impact. If students do not *expect* to collaborate in a course, they probably won't.

- It's certainly not the case that it's just the particular students. During one term, we actually had students in common between a successful use in English and a section of Calculus where no one was using the CoWeb! While student reticence to collaborate may be a factor here, we believe that other factors are more significant.

- While it's also easy to simply blame the faculty, that's too simple an answer, too. The faculty are under harsh time constraints and a large list of curricular objectives to cover. Collaboration can seem like a distraction from simply telling the students what they need to learn. While finding that faculty are busy is certainly not new, it is notable that they did not find problems with usability or with ideas for learning activities. It's important to know where the problems are *not* in order to focus where the problems *are*.

Finally, we point out that ours is certainly not a definitive study. More careful questioning of a wide variety of student and faculty collaboration users and non-users would provide better insight into the questions of how and when collaborative activities are adopted. Our surveys and interviews were developed quite literally in direct response to the success or failure of specific activities that we were trialing. Our findings suggest a set of hypotheses which should be explored further to determine their generality.

References

Augustine, N. and Vest, C. M., editors (1994). *Engineering Education for a Changing World*. Joint Project Report by the Engineering Deans Council and Corporate Roundtable by the American Society for Engineering Education. American Society for Engineering Education.

Bruer, J. T. (1993). *Schools for Thought: A Science of Learning in the Classroom*. MIT Press, Cambridge, MA.

Cohen, E. G. (1994). Restructing the classroom: Conditions for productive small groups. *Review of Educational Research*, 64(1): 3–35.

Collaborative Software Lab (2000). A catalog of coweb uses. Georgia Tech GVU Center Technical Report GIT-GVU-00-19, Georgia Tech GVU Center.

Craig, D., ul Haq, S., Khan, S., Zimring, C., Kehoe, C., Rick, J., and Guzdial, M. (2000). Using an unstructured collaboration tool to support peer interaction in large college classes. In *International Conference of the Learning Sciences 2000*, pages 178–184. Ann Arbor, MI.

Guzdial, M., Ludovice, P., Realff, M., Morley, T., Carroll, K., and Ladak, A. (2001a). The challenge of collaborative learning in engineering and math. In *Proceedings of IEEE/ASEE Frontiers in Education (FIE) 2001 Conference*. IEEE, Reno, NV.

Guzdial, M., Rick, J., and Kehoe, C. (2001b). Beyond adoption to invention: Teacher-created collaborative activities in higher education. *Journal of the Learning Sciences*, 10(3): 265–279.

Guzdial, M., Rick, J., and Kerimbaev, B. (2000). Recognizing and supporting roles in cscw. In *Proceedings of CSCW'2000*, pages 261–268.

Guzdial, M. and Turns, J. (2000). Effective discussion through a computer-mediated anchored forum. *Journal of the Learning Sciences*, 9(4): 437–470.

Rick, J., Guzdial, M., Carroll, K., Holloway-Attaway, L., & Walker, B. (2002). Collaborative learning at low cost: CoWeb use in English Composition*Proceedings of the Computer Supported Collaborative Learning 2002*. (pp. 435-442). Mahwah, NJ: Lawrence Erlbaum Associates.

Webb, N. M. and Palincsar, A. S. (1996). Group processes in the classroom. In Berliner, D. C. and Calfee, R. C., editors, *Handbook of Educational Psychology*, pages 841–873. Macmillan, New York.

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