Use of Collaborative Multimedia in Computer Science Classes

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Abstract

While there is a lot of speculation about the benefits of multimedia exploration, research on learning and technology suggests that the *creation* of media by students has even greater benefit for learning. Students learn through articulating their knowledge in their multimedia documents, reviewing their own work, and receiving comments and critiques on their work. In the research of the Collaborative Software Lab (http://coweb.cc.gatech.edu/csl), we are particularly interested in exploring the creation of media through collaborative technology. By having students work together in creating diverse media, we encourage review and critique, and create opportunities for joint learning. We have been using an environment for collaborative multimedia in several computer science classes, and in this paper, we describe some of the activities that teachers have invented for using the CoWeb.

1. Introduction: The Role of Collaborative Multimedia for Learning

The best evidence that we have indicates that multimedia presentations play little or no role in learning. When media are *equivalenced* (i.e., designed such that each medium sample contains exactly the same information as the other), empirical results show no benefit of any medium over any other medium [1]. However, while research shows that multimedia presentations *have* played no difference, there are theoretical stances which suggest that they still *might* make a difference [2-4]. In general, research informs us that learning is not a passive process, so simply watching multimedia is unlikely to make a significant learning impact [5].

However, there is little doubt that *student creation* of multimedia can play a significant role in learning. Cognitive science has long known that the act of writing changes the writer [6], and that articulation (synthesizing an expression for an audience) plays an important role in reflection and learning [7, 8]. Multimedia provide new opportunities for new kinds of student articulation and reflection that may lead to significant new ways to learn [9]. What's more, the ease of desktop multimedia creation allow us to define the need and meaning of *multimedia literacy* in the same way that we talk about text and numeric literacy today [10].

However, that ease of creating multimedia on the desktop belies the complexity of actually composing multimedia [11]. While it is relatively simple to use a sophisticated multimedia package to combine a video and audio track, that package tells us little about *what* to put in our video or audio. We have found collaboration technologies to be important in answering these questions. By working together, students can help one another determine the appropriate media to use in their multimedia compositions. By creating a collaborative space where all students work, we create a forum for students to serve as audience for each other compositions. By making review and critique simple, we provide feedback for students' articulations, which can improve learning.

In this paper, we describe our work with the *CoWeb*, a tool for creating *co*llaborative w*eb*sites, which we have used with undergraduate students in Computer Science, Architecture, Chemical Engineering, Mathematics, and English Composition at Georgia Institute of Technology (*Georgia Tech*). I present several of the activities that Computer Science teachers have invented for using the CoWeb in their classes, to enable students to compose multimedia in support of their learning.

2. Introducing the CoWeb

The CoWeb allows creation and modification of web pages through a Web browser without any specialized software on the client side [12, 13]. Each CoWeb page looks and feels like a normal Web page, and it can contain any media that Web browsers can present. What makes a CoWeb unusual is that each page has an *Edit* link. Clicking "Edit" opens a page with a text area for renaming the page and a large text area containing the content of the page. By typing new text into the large text area then clicking "Save," the author changes the contents of the page. (Figure 1)

Figure 1. A CoWeb Page (left) and its "Edit" view (right).

Users do not have to know any HTML to create a CoWeb page. Plain text, separating paragraphs by blank lines (two returns in a row), will be translated into HTML. Any HTML that a user does know, e.g., `<b>boldface</b>`, can be used. In addition, some simple plain text notations get translated into HTML as well (based on the notations used in the original edit-any-page website, the WikiWikiWeb, by Ward Cunningham). For example, starting a line with a dash creates an unordered list item, and `|1|2|3|` creates a table with three cells.

Pages are referenced in a CoWeb by name, not by URL. Inserting `*Mark Guzdial*` into a page creates a link to a page named for the author in the CoWeb. If the page does not yet exist, it gets created, and the first visit to the page leads to the Edit view of the page for creating the page. The *-* notation is used generally to create links and multimedia connections. For example, `*http://www.cc.gatech.edu*` creates a live link to that URL, whatever kind of content is available at the URL. Reference to an image URL (e.g., ending in *.gif*) is inserted in-line. In addition, CoWebs accept attachments (using MIME multi-part uploads), and attachments are referenced via a similar simple notation, e.g., `*+myFile.ppt+*`.

The CoWeb is implemented in Squeak [14] (http://www.squeak.org), an open souce and highly portable programming language. We teach Squeak in our *Objects and Design* course, where we both use the CoWeb as support for the course and as a case study. There is a fascinating synergy in students using a tool and then taking the tool apart and critiquing its design. Many of the students in this class have gone on to add features or bug fixes to CoWeb (which is itself an open source project) and to run CoWebs off their dorm room computers.

3. CoWeb Uses in Computer Science Courses

The CoWeb's features make it simple for students to easily compose and share multimedia on the course website [12, 13]. Teachers and students have invented a wide variety of activities using the CoWeb's shared pages.

Distributed Information Creation: The CoWeb is well-suited for distributed information gathering. In a class on *Ubiquitous Computing*, students collaboratively create bookmark pages with links to relevant sites (http://triton.cc.gatech.edu/ubicomp). The class is structured around student presentations of papers and research topics. Before each presentation, the student presenter creates a page with links to additional resources associated with the presentation. Afterwards, continued discussion can continue on the presentation page.

The use in the UbiComp class is also striking because the class is taught in an *eClass* [15]. All presented slides, presenters' markups on the slide and whiteboard, URL's visited, and audio/video in the classroom is captured for later review by students. A modification to the CoWeb and to eClass software was made to facilitate connections between the spaces [16]. A student annotates a lecture slide by providing a CoWeb page title. A thumbnail of the slide is inserted at the bottom of the CoWeb page, as a link back to the original slide.

Figure 2. A group's storyboard page

Process Guides: The CoWeb can also be used to track student progress in classes organized around large projects. One such class at Georgia Tech is *Digital Video Effects* (http://swiki.cc.gatech.edu:8080/dvfx2000). In this class, student groups write up case studies on video effects in current movies, generate story boards of their

movies (Figure 2), and create (and update) project schedules. The CoWeb serves as place for each group to list their current status and to link in the appropriate resources for the groups' efforts. The common-linking ground aids in group communication, lets other groups see what everyone else in the class is doing, and makes it easier for the teacher and teaching assistant to shepherd the group's process and evaluate their progress.

Case Library Creation: In our *Objects and Design* class, students post their assignments with commentary to serve as a *case library* for future students (http://coweb.cc.gatech.edu/cs2340/Cases). Our use of case studies in that class is based on our prior work suggesting that use of cases led to better design learning and better programming [17]. We wanted to see how well the cases would work if students were formatting the material themselves. While we have not evaluated learning yet with the student-generated cases, we know that they get used extensively by the students. In particular, we have found the cases have engendered cross-class discussions between cohorts of students. Students will tell us about contacting past students to ask further questions about their cases. Creating such integrating discussions is an important side benefit of this activity.

Review Activities: A significant role for the CoWeb is its use as a review space where students can post their work and invite other students to comment on it. Figure 3 is an example of such a review activity from a course on *Objects and Design* class where students were invited to share screenshots of their user interfaces and then discuss them with each other. The review activity worked to get students talking to one another about their projects, but it also gave the teacher the opportunity to *model* review and critique, and to show students the standards to which they would be held.

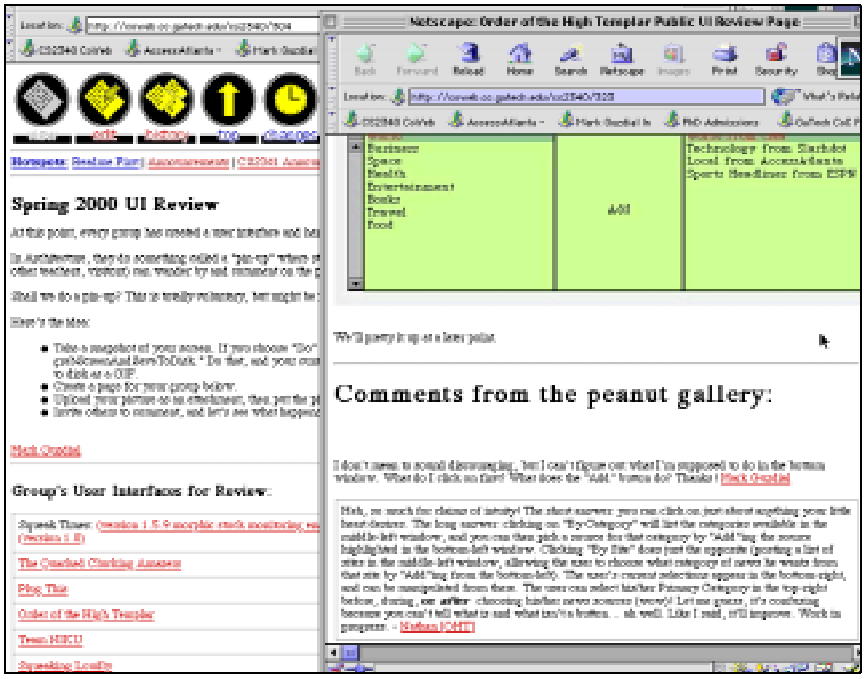

Figure 3: A User Interface Review Activity in a Computer Science Class

4. Conclusions: Easing the Barriers to Collaborative Multimedia

The CoWeb has been used in over 120 classes at Georgia Tech in the last three years. It is a cross-platform, open-source project which has been adopted by teachers all over the world. It has been developed iteratively with teachers and students so that it addresses needs of classrooms explicitly [18]. (The latest version is available through links off of http://coweb.cc.gatech.edu/csl/.)

The CoWeb makes it very simple for large groups of students to create Web pages that share their multimedia efforts (e.g., graphical storyboards and screenshots of user interfaces) and that enable review and critique by others. The real advantage of such a technology is that it enables to invent activities that utilize collaborative multimedia, without having to invest any development time. We have been amazed at the inventiveness of teachers in Computer Science, but also Architecture, English Composition, and other disciplines, who create powerful new learning opportunities for their students based on the CoWeb.

If collaborative multimedia wasn't as easy as it is on the CoWeb, we doubt that teachers (even those with the ability to develop their own tools) would invent as many different kinds of activities as they do with the CoWeb.

We have been exploring new kinds of collaborative tools allowing for more easily shared diverse media, such as equations, graphs, animations, and even live data sources. Our results with the first generation of these environments, *MuSwiki* [19], was decidedly mixed. Our first use was in a design course where students created on-screen CRC Cards for object-oriented analysis and then critique other analyses. We found that, with a free-form graphical space, it is difficult to structure students' activities. Students often "scribbled" on key shared pages, often by accident, simply because it wasn't clear where they were supposed to "post" and where they weren't. It's an important research goal to define how to structure new kinds multimedia spaces to support teaching and learning activities.

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