AC 2012-4725: ONLINE LEARNING COMMUNITIES FOR DESIGN

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Abstract

Web 2.0 tools can enhance a team's knowledge development through social collaboration. Integration of web 2.0 collaborative tools, such as web blogs, wikis, podcasting, social bookmarking, and social networking sites can be especially useful in supporting collaborative and project-based learning. Our goal in this study is to gain a better perspective on how these technology tools can provide a robust infrastructure to support the social interaction between teams involved in co-constructing their knowledge about a project and reporting their results. We've adopted a "cultural beliefs dimension" perspective from the Social Infrastructure Framework (Bielaczyc, 2006). This framework provides multiple dimensions to systematically characterize the social infrastructure that emerges in any learning setting that can help determine the role of technology in that infrastructure. Preliminary analysis indicates teams use wikis to perform specific phases of their design process. Some students used it to guide the entire evolution of their design where others used it to facilitate a portion of their design process. We provide a case study describing teams' use patterns.

Keywords: CLEERhub, web 2.0, online learning communities, collaborative knowledge building

Introduction

Teams working on science or engineering projects, adopt a workflow involving group meetings, generating documents, e-mail exchanges of these documents for refinement of main points, and sometimes text messaging for scheduling/organizational purposes. A central premise of technology support for collaborative learning is that ubiquitous access to the teams' information would provide better support of their workflow. Team members would "stay connected" throughout the project's life. Therefore, teams have the potential to co-develop their knowledge about the project by contributing to the iterative refinement of the synthesis of information.

In our research we used the group space tools in CLEERHub.org, in an undergraduate science course designed for non-science majors. CLEERHub.org (Collaboratory for Engineering Education Research) is an NSF-funded research project aiming to build an online community of practice for engineering education researchers to foster interaction, collaboration, knowledge sharing and creating. It emerges from a growing cyberinfrasture called HUBzero with an open source environment originally designed to support research communities' ability to share resources. In this paper we consider the ways in which students used the collaborative online group space to support their project work. In particular, we present and analyze the data on student's usage patterns of the wiki group feature to facilitate their productivity and collaborative knowledge building during their work on a shared research project for the semester. Although wiki is widely used in various educational settings not much research has been done to explore the opportunities to integrate wikis into design and project-based courses. Wikis are weblogs that can be

contributed to by anyone who has access to them. Contributions range from adding and refining text to sharing media resources. Also, wikis contain features such as editing histories of content change, information about who authored them and when the edits were performed. These features lend themselves to many educational opportunities including team-based engineering design. In our pilot study each student had an account on CLEERhub.org and each team had their own unique group space where they could use a wiki for working documents and a resource manager to store, share and organize resources.

Presented data was analyzed using the "cultural beliefs dimension" perspective from the Social Infrastructure Framework (Bielaczyc, 2006). This framework provides multiple dimensions to systematically characterize the social infrastructure that emerges in any learning setting, which can help to determine the role of technology in that infrastructure. Cultural beliefs dimension refers to "the mindset that shapes the way of life of the classroom." (p. 303) In particular, we see our work aligning with aspects of cultural beliefs focusing on "how the purpose of the tool is viewed" by students.

We anticipated the results from this descriptive study would define use patterns of how the wiki was used by team members to achieve their goals. Our findings contribute to building knowledge about educational technology design, in particular design of the shared workspace on cyber technologies like CLEERhub. We see these tools supporting collaboration and scaffolding group-thinking processes in science and engineering projects developed in an online environment.

Background

Web 2.0 tools enhance a team's knowledge development through social collaboration. Integration of web 2.0 collaborative tools, such as web blogs, wikis, podcasting, social bookmarking, and social networking sites can be especially useful in supporting collaborative and project-based learning[4,5]. Our conjecture is that ubiquitous access to the teams' information, shared editing privileges of documents and the potential to centralize resources provide better support of the workflow and allow students to "stay connected" to the project at anytime.

We are specifically interested in how we can build a learning environment with wiki technologies that would support a team's co-construction of knowledge for a term-long design project. This work is a descriptive study of the general use of the wiki system observed by all teams. This study controls the instructor as variable by not having them participate in processes beyond simply making the wiki available and recommending the students use the wiki. No special instructions were given on how to use it or how to structure it to support a collaborative process. This allowed the teams to invent their own workflow around the tool and capitalize on its current affordances.

The following section presents results of team members' usage patterns of a wiki system to facilitate their workflow on a semester-long research project. We will describing the

pilot study, data sources for this study and the methods used to systematically code this data into categories of use-patterns.

Pilot Study

In the fall of 2010 we conducted a Pilot Study to test the feasibility of using the collaborative space in CLEERhub to support team collaboration in an undergraduate science course. Participants were undergraduate students enrolled in an undergraduate semester-long Climate Change and Energy in the 21st Century course designed for non-science majors. The majority of the students taking this class were pursuing a variety of non-science degrees, such as accounting, marketing, advertisement, English, sociology, theater, finance, government and public relations, to name a few. Participants' ages ranged from 19 to 22 years old. The Climate Change and Energy in the 21st Century course satisfies one of the University's science credit requirements for many of the students.

The implications of this particular demographic for the course design was that the content progression had to be made accessible to beginners. Science and mathematics foundations necessary for understanding of the material had to be explained to students either during the class time or as part of supplemental course materials. Another important issue to consider was the importance of motivating students initially and throughout the semester about the topics of discussion.

The overall goal of this course was to engage students in a scientific dialog about the effects of our current US energy production and consumption methods on climate change. It was also to explore the impact of dependence on foreign oil and fossil fuels on our environment and economy. In the first half of the course, students explored the topics of energy, sustainability and the role of technology and the engineering design process in scientific advances. In the second half of the course, students worked collaboratively on projects. In the fall of 2010, students were asked to design hands-on educational experiments to explore energy-related topics. Six teams worked on topics of their choice, including wind energy, solar energy, potential and kinetic energies, and energy efficiency.

The CLEERhub online platform was introduced to students as a way to support their work on group projects. Each student had an account on CLEERhub.org and each team had their own unique group space where they could use a wiki to manage working documents and a resource manager to store, share and organize resources (e.g. documents, images, urls, multimedia resources etc).

Results

We begin by reporting data on students' general use of web 2.0 tools for personal and academic goals. Table 1-1 shows summative results from the Internet Usage Survey we administered during our pilot study. The purpose of collecting such data was to find out

the students' experience level with the use of online technologies as well as to gain a better understanding about the context of where online tools were used.

Internet Usage Survey

	Frequently	Occasionally	Rarely	Very rarely	Never used
Facebook					
Personal	80	20	0	0	0
Academic	8	40	12	20	20
Twitter					
Personal	12	28	0	4	56
Academic	0	4	8	0	88
Podcasts					
Personal	4	4	4	20	68
Academic	4	0	4	12	80
Blogs					
Personal	4	8	8	20	60
Academic	4	32	12	16	36
Wiki pages					
Personal	20	16	12	12	40
Academic	16	20	12	16	36

Table 1-1: Internet Usage Results for Personal and Academic Purposes. The data is shown in percents.

For personal communication tasks, these preliminary results indicate the majority of students favor Facebook as the primary Web 2.0 tool, and do not use the other resources as actively. For example, only 12% said they used Twitter frequently, and 28% used it occasionally. For Podcasts and Blogs, only 4% of participants indicated frequent usage, and 68% and 60% correspondently never used these tools. Twenty percent of students indicated frequent and 16% occasional use of Wiki pages. In the Academic usage category, we can see that students do not rely as much on Web 2.0 tools. For occasional usage, Facebook again leads with 40%, blogs 32%, and 20% of students indicated they used Wikis.

The original survey also asked participants to indicate to what extent they used these technologies for work purposes. Since participants of this study were undergraduate students, who mostly held jobs unrelated to their academic interests, the results for the work category were not very informative and will not be discussed in this report.

General Use of Wiki system observed by all teams

Open coding methods were used to evaluate the data logs of students' use of the wiki space. Data logs were compiled from observations made of each of the entries of the wiki editing history from each team, types of contributions and the work outcome. Wiki editing history includes information about the number of total entries, contributors' information, number of contributions from each of the team members, as well as the time period of the wiki activity for each team. Work outcome data includes information about

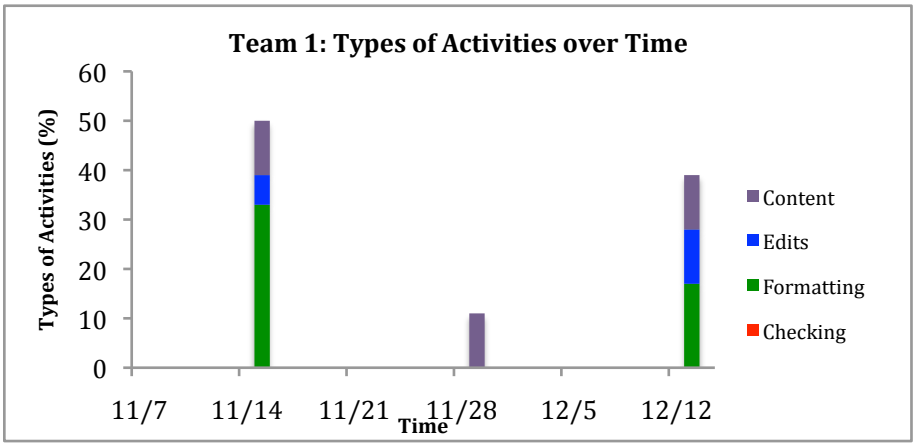
the type of final product that each of the teams produced. Types of contributions data include categorizations of wiki usage. Table 1-2 below shows information about the use of the wiki system by each of the six teams in the pilot study. The activity of wiki usage by each of the groups was categorized based on the type of contributions each member of the group made. These categories are *content*, *edits*, *formatting* and *checking*. Contributions of new material to a shared wiki page were coded as *content*. Making changes, such as text correction/addition, to the existing material were coded as *edits*. Stylistic edits to the "looks" of the document were coded as belonging to the *formatting* category. Activities such as visiting shared wiki document with the purpose of checking if any of the updates were made by other members of the group was coded as *checking*.

Teams	Content (%)	Edits (%)	Formatting (%)	Checking (%)
Team 1	33	17	50	0
Team 2	32	27	18	23
Team 3	20	29	51	0
Team 4	67	33	0	0
Team 5	53	23.5	23.5	0
Team 6	48	26	26	0

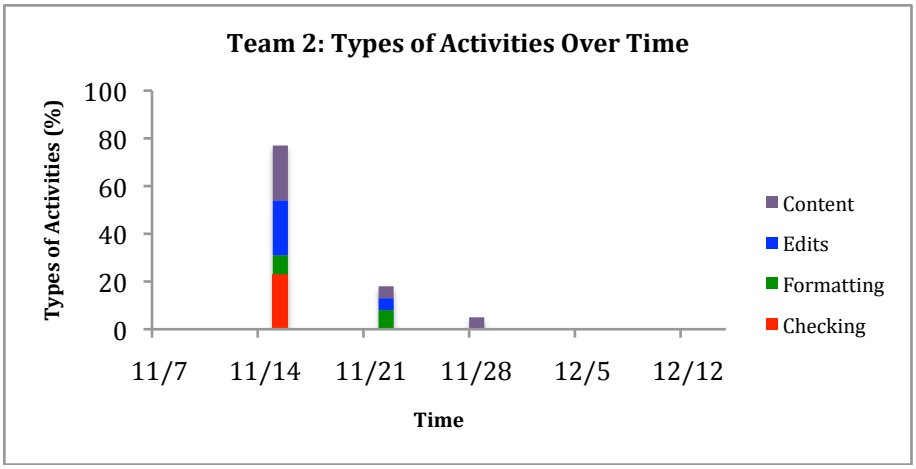
Table 1-2: Usage of Wiki system by each of the teams.

To represent the information about the type of activity of wiki usage and time distribution showing when such activity occurred for each of the teams, we used stacked bar graphs. See Graphs 1-2 through 1-7.

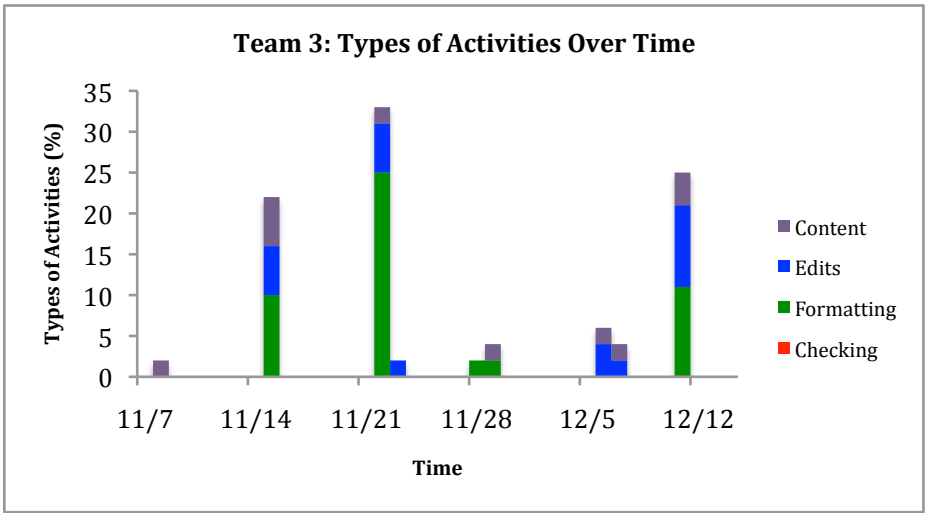
Color selection used for each of the categories is analogous to the energy of the light quanta decreasing from purple (*content* category) being the highest to the blue (*edits* category), green (*formatting* category) and red (*checking* category) being the lowest.



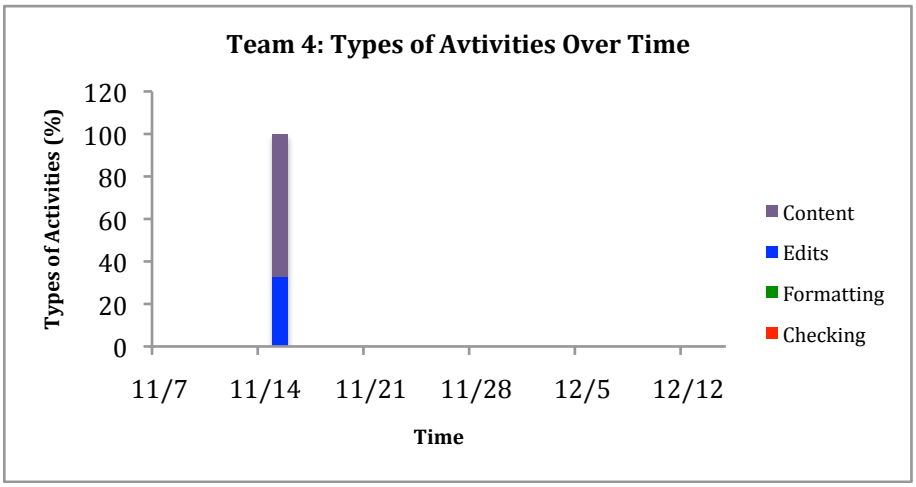
Graph 1-1: Wiki use for team 1



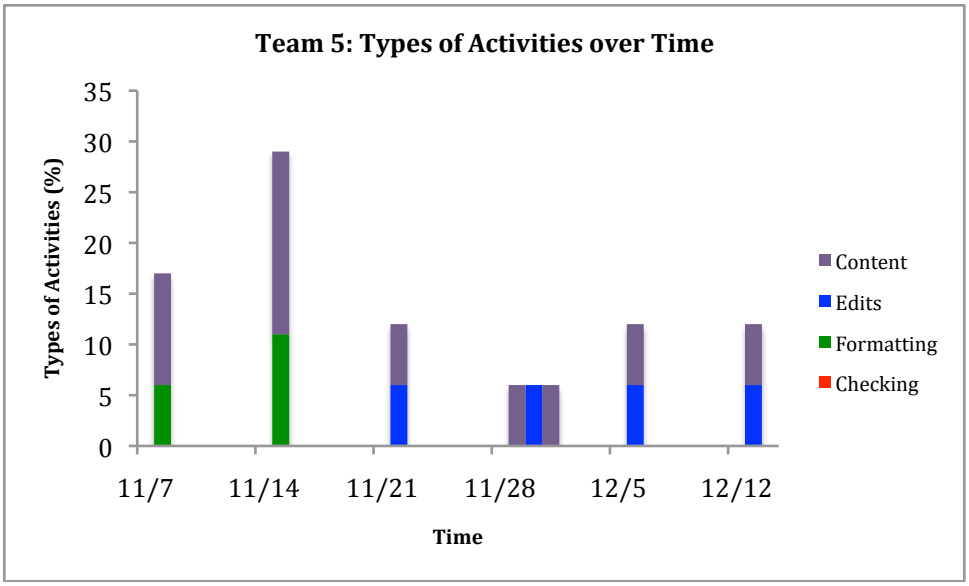
Graph 1-2: Wiki use for team 2



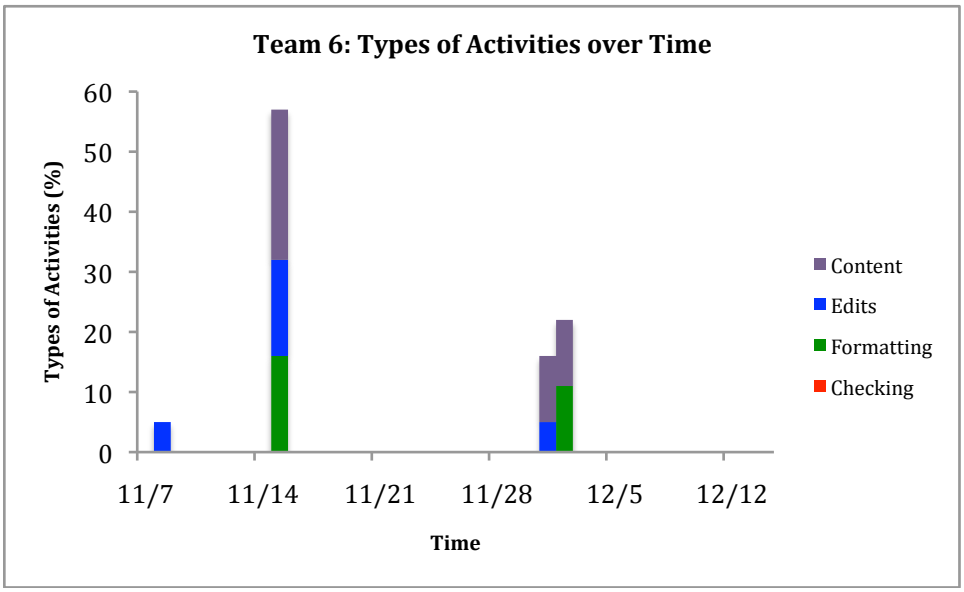
Graph 1-3: Wiki use for team 3



Graph 1-4: Wiki use for team 4



Graph 1-5: Wiki use for team 5



Graph 1-6: Wiki use for team 6

Discussion

From the summative results of the contributions to the shared wiki documents presented in Table 1-2, we can see that groups differed in their usage patterns. For example members of team 2 contributed to their wiki document by adding content 32 % of time, making changes to the existing document 27 %, formatting document 18 % and 23 % of activity resulted from reviewing or checking the document to see if any updates were made. In contrast to this pattern usage, team 4 primarily focused on contributing the content and making edits to the document while team 3 added content 20 % of the time, 29 % made edits and 18 % of activity was about formatting the document.

To explain such diversity in wiki activity patterns it is important to discuss the purpose of using shared wiki documents for each of the groups. As mentioned earlier in this paper, no special instructions were given to students on how shared online space should be used. Wiki space, as part of the CLEERhub environment, was made available and recommended to students to use for their projects. The goal was to allow teams to invent their own workflow around the online technology. Evaluation of the wiki workspaces identified several usage outcomes, such as using shared online space for brainstorming of the ideas for the final project, for writing an outline of the paper and keeping a record of tasks for each of the team members, or for using the space to co-write the final paper.

Variability of wiki usage purposes by teams for the common project can be reflective of different beliefs about technology tools by team members. As mentioned earlier, the cultural beliefs dimension from the Social Infrastructure framework refers to the "mindset that shapes the way of life of the classroom" and according to Bielaczyc such beliefs "influence how a technology-based tool is perceived and used." From the results of our pilot study, we can only infer about students beliefs about the purpose of wiki technology from Internet Usage survey (*see* Table 1-1) that shows results of student experiences in personal and academic settings with web 2.0 tools. Our preliminary analysis of the results pointed to interesting findings, such as that social media technology is not actively used in the academic environment. For example, Facebook is primarily used for personal communication, and technologies such as podcasts, wikis and blogs are not actively used in either academic or personal settings. Online technology is perceived by students more as a way to communicate with peers rather then to learn from.

Since the majority of the students did not have much experience using wiki technology and no specific instructions were given to guide students on how wiki space can be used for their project, except for the overview of wiki features, the results of our pilot study show what affordances of online tools each team capitalized on during their work. For some teams, online wiki space became a place to organize their workflow and keep track of weekly assignments for each of the team members. In such cases, wiki was used primarily as an organizational tool that everybody could access. For example, team 2 primarily used wiki space for project organization purposes. Twenty three percent of their wiki activity was dedicated to *checking* of the shared document to see if any updates were made. Because this team used wiki to organize their workflow it makes sense for team members to keep checking the document in case any changes were made. For other teams, wiki space became a shared place to come up with ideas and co-write the project paper. For example, teams 4 and 6 used the shared document primarily for brainstorming purpose, while teams 3 and 5 used wiki to co-write their papers.

In addition to the data on wiki usage type of activity for each of the teams, graphs 1-1 through 1-6 show how the wiki activities were distributed over the three weeks period. The distinction between what purpose shared wiki document was used for becomes more apparent from these graphs. Graphs 1-1, 1-2, 1-4 and 1-6, representing the work of teams 1, 2, 4 and 6 show less activity over time in comparison to graphs 1-3 and 1-5, representing the work of teams 3 and 5. The more infrequent use of shared workspace

was primarily by those teams that used it for project organization purposes. While more frequent activity was representative of teams working on co-writing the team paper. Although team 1 used wiki for writing the paper, their activity was less frequent in comparison to teams 3 and 5. Team 1's wiki history contributions revealed that only half of the team members were writers of the paper for the most part. Their activities primarily were *content* contributions and f*ormatting*. With only 17 percent of activity attributed to *edits.* In contrast, teams 3 and 5 had higher percentages attributed to edits, emphasizing more dialog between team members rather then individual contributions. Contributions history for teams 3 and 5 also showed that there were contributions from each of the team members, making their work experience more of a collaborative process.

The meaning of collaborative process for each of the team members is an important consideration for the successful use of online tools to support it. How students used wiki-shared space for their projects could be indicative of how they conceptualize and value the collaborative process. Collected data for this pilot study does not include information about students' beliefs about collaboration. Further investigation and data collection are needed to study this relationship.

In conclusion, our analysis identified teams' usage patterns of a wiki system during their work on a shared research project for the semester. The usage patters were dependent first on the emerged purpose of the online tool for each of the teams and second on the teams' attitude about collaboration. The purpose of a wiki system emerged for each of the teams as they started working on their projects. The most apparent purposes were use of online tool for teams' productivity by emphasizing workflow organization and use of wiki for co-writing the final report. For two of the three teams, using the online tool for writing the paper meant not only contributing content, but co-editing each others work as well. Co-editing by building on each other's content contributions could be considered representative of a collaborative approach to knowledge building.

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