BRINGING BACKCHANNELS UP FRONT:
SUPPORTING IN-CLASS COMMUNICATION WITH CLASSCOMMONS

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by

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ABSTRACT

In many college classrooms, students are passive spectators and the transmittal model of teaching is prevalent. In contrast to the transmittal model in which students are understood to be passive information recipients, Vygotsky’s social-constructivist theory (Vygotsky 1978) emphasizes the importance of placing students at the center of the learning process – that is by becoming active learners. Many active learning techniques have been developed, primarily focused on making students active participants in various kinds of in class activities like discussion, writing and talking.

However, there is evidence that the typical university classroom setting presents some obstacles for realizing maximum effectiveness of active learning techniques like class wide discussion, debate, questioning and explaining. These obstacles include the effects of production blocking and the lack of sense of community. An emerging trend in classroom technology research is the use of computer mediated communication (CMC) tools to encourage students’ in-class participation. As part of this research thread, I have been investigating the potential of public digital backchannels for building feelings of community among students in university courses.

Through an iterative design process, a digital backchannel discussion tool – ClassCommons, was designed and implemented to encourage students to easily raise questions, make comments, provide feedback for others in the class and interact with the teacher as well as other students. A design research based approach was adopted to understand the factors that influence students’ adoption of public digital backchannels in classrooms, and the real world impacts of digital backchannels in classrooms.

The findings of this dissertation study show that students have a high interest in using public digital backchannel tools in classrooms. They also indicate that the amount of attention the teacher has paid to the content in the digital backchannel and the relevance of the content are
important predictors of students’ adoption of this tool in classrooms. Finally the results show that use of public digital backchannel is positively related to students’ sense of community in classrooms. Overall, the study results suggest that pedagogical changes are needed on teachers’ end in order to achieve the maximum effectiveness of public digital backchannels in classrooms. This study contributes to classroom education technology research literature by offering a substantial, long-term study that evaluates the impacts of digital backchannels in classrooms. The results should be beneficial to both practitioners and researchers in this field.
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Chapter 1

Motivation

A Shift from Passive Learning to Active Learning

In many college classrooms, students are passive spectators. The professor arrives, gives
a lecture and students learn individually, listening and taking notes. This model of teaching in
classes is called the \textit{transmittal model} in which students learn by passively receiving knowledge
from the teacher.

Transmittal model of learning is prevalent and has been used for centuries by educators.
Its advantages include that: a) it is less demanding on the teacher’s side. The teacher just needs to
prepare his/her lecture and lecture it; b) it is cost effective. The teacher can give a lecture to
hundreds of students at once. It is an easy way for schools to control their budget.

However, from students’ perspective, transmittal model of learning might not be the best.
According to social-constructivist theories of learning (Dewey 1910; Vygotsky 1978), knowledge
cannot be simply pulled from textbooks or be poured from teachers’ heads to students’ heads.
Instead knowledge is \textit{constructed} by engaging individual learners to actively bring their prior
knowledge to make sense of the new information which will further be constructed as knowledge
embedded in their minds. In these theory views, the knowledge construction process is influenced
by the learner’s surrounding community (the social context). In contrast to the transmittal model
in which students are passive information recipients, the social-constructivist model emphasizes
the importance of placing students at the center of the learning process – that is by encouraging
them to become active learners. Currently, active learning has been recommended as one of the
seven principles for good practices in undergraduate education (Chickering and Gamson 1987).
According to Bonwell and Eison, active learning has the following characteristics (Bonwell and Eison 1991):

“Students are involved in more than listening, less emphasis is placed on transmitting information and more on developing students’ skills, students are involved in higher-order thinking (analysis, synthesis, evaluation), students are engaged in activities (e.g., reading discussing, writing), and greater emphasis is placed on students' exploration of their own attitudes and values.” (p. 1)

Many active learning techniques have been developed, primarily focused on making students active participants in various kinds of in-class activities, such as discussion, writing and talking. Some of the exemplary active learning techniques include: (i) Class wide discussion, debate (Bonwell and Eison 1991) and brainstorming (Frederick 1987). (ii) Think-pair-share (King 1993), where students take a minute or so to think about previous questions, discuss with one or more of their peers and finally share it with the whole class. Teachers will identify and clarify the misconceptions when students are sharing their thoughts with the class. (iii) Learning cell (Goldschmid 1971), where a pair of students study and learn together, alternately asking and answering questions on shared materials. At the same time, the teacher will go around the classroom from dyad to dyad to give feedback and answer questions. (iv) Short written exercise where students write a one-minute paper so as to review course materials and the teacher provides feedback and comments. These are common examples of strategies for promoting active learning but the list is by no means exhaustive. Through these various activities, students are no longer positioned as passive listeners in classrooms. They become active participants, engaged in reading, thinking and discussing.

The effects of active learning have been promising. Prior research has shown that active learning has a positive impact on students’ learning experiences. The most immediate result
associated with active learning experiences is that the enhancement of students’ knowledge and understanding of course content (McKeachie 1986; Chickering and Gamson 1987; Johnson, Johnson et al. 1991); active learning is superior to traditional lectures in promoting the development of students’ skills in thinking and writing (Bonwell and Eison 1991). As a consequence, such students are more likely to view their learning experience as personally rewarding. Further, students may invest their psychological effort to establish membership in this community because the community is judged to be rewarding (Milem and Berger 1997). A broader impact that is associated with active learning is that students who frequently experience active learning can allot more time to relaxation and social activities because they feel that they may choose to spend less time on class preparation. Finally, the student attrition rate is lower for students who experience active learning than for those who do not (Braxton, Milem et al. 2000).

Of the various active learning techniques reviewed above, class discussion (including discussion, debate, questioning and explaining, etc.) is often noted as a common and effective strategy for promoting active learning (Boyle 2003). However, there is evidence that the typical university classroom setting presents some obstacles for realizing maximum effectiveness of active learning techniques like class wide discussion, debate, questioning and explaining. In the following section, a hypothetical scenario is used to illustrate the challenges faced for class discussion as an active learning strategy in a university classroom. This scenario illustrates the essential motivation behind my dissertation research project.

**An In-Class Discussion Scenario**

Steve Brown is a professor in computer science. This semester he is teaching the course “Data Structure” to 45 students. Today he is going to talk about hash tables. Because of his many years of experience teaching this course, he knows that many students have some difficulty in
understanding this concept. So he plans to organize an in-class discussion to review a real example of using a hash table to solve a telephone number look-up problem and to use this example to invite students’ questions.

After lecturing for about 25 minutes, Professor Brown begins introducing the telephone number look-up problem: “How to use a hash table to look up people’s telephone number using people’s name?” And he encourages all the students to share their thoughts freely. Just after he finishes describing the problem, he sees Mike raise his hand. He knows Mike very well. He is an active student in the class. He works hard and he is also very smart. Professor Brown nods to him and Mike starts sharing his thoughts. After Mike finishes, Tom, another very active student, starts talking; he does not agree with Mike so they start debating. The debate goes on and on without resolution. Because Professor Brown wants to hear more students’ thoughts, he intentionally disrupts the debate and asks if Alice would like to share her thoughts with the whole class. Alice is a little bit shy and feels that she was caught by surprise. Her face goes red quickly and she defers, saying that she was listening to Mike and Tom’s discussion just now and needs some more time to think about it herself. So far it has taken much time and there is not much time left. Only a few more students get a chance to express their ideas in the remaining part of the class.

After the class, Luke comes up to Professor Brown and says that “Hi, Professor Brown, I have a related question about a concept you mentioned in the class. It is different from what is implied in the textbook. So I am not quite sure which one is right, but I did not have an opportunity to ask during the class. Could you help me with it now?” “Sure, of course”, Professor Brown says. Luke then brings his question. To Professor Brown’s pleasure, that is really a very good question and it points out a mistake in his slide. Professor Brown thinks to himself that “I like this question. I really wish you had brought it up during class”. Instead Professor Brown plans to raise the question himself in the next class. After Professor Brown goes back to his office, he finds an email from Alice. Through this he learns that Alice actually does have some thoughts
in mind but these thoughts are not fully formed; because she did not have time to formulate her thoughts, she felt that she was caught by surprise when he called on her, and when she was forced to speak up she felt embarrassed and unhappy.

**Research Goals**

The phenomena depicted in this scenario are common in university classes. They include (a) vocal students consume most of the scarce in-class discussion time; (b) the teacher acts as a “sage on the stage,” controlling everything going on in the class; (c) some students may have negative feelings when they are caught by surprise; (d) some students suppress their often very useful questions until the end of the class. Having realized all these problems, the question for educators and researchers is how to overcome such problems so as to give students a better learning experience. The goal for an active learning environment is that a broad number of students are able to participate and are willing to engage in class in class discussions and related active learning activities.

Prior research on learning theories, social psychology and computer-mediated communication (CMC) has invested considerable effort in solving the above mentioned problems (Siegel, Dubrovsky et al. 1986; Nunamaker, Dennis et al. 1991; Bordia 1997; Kraut 2003; Reay, Bao et al. 2005). One focus of recent work is the opportunity provided by computer-mediated communication (CMC)(Nunamaker, Dennis et al. 1991; Gallupe, Dennis et al. 1992). Researchers have shown considerable potential for the use of CMC to improve group discussions in enterprises, particularly in small group brainstorming (Nunamaker, Dennis et al. 1991). Thus the design goal of the current research is to tackle the challenges for in-class active learning by integrating CMC technologies into the classroom context.
In the balance of this thesis, I will first survey existing theories and prior studies relevant to the use of CMC for increasing in-class discussion participation. After identifying a research gap in the current literature, I propose the research questions that I seek to address in this thesis study. Based on that, I will describe the digital backchannel system – ClassCommons – and the series of studies that I have conducted to evaluate the impacts of using the system in different classes and to address the research questions of interest. This thesis concludes with a discussion that aims to provide suggestions for practitioners who wish to adopt tools of this kind in the classroom and to other researchers pursuing similar research questions in other contexts, such as corporate trainings in the industry.
Theoretical Foundations – Social Constructivist Theory

Social constructivism is a set of beliefs about learning that emphasizes the active role of learners in constructing their knowledge, and the importance of the learner’s social context, interaction with others and the culture. According to the social constructivist theory of learning (Dewey 1910; Vygotsky 1978), knowledge cannot be simply extracted from textbooks or metaphorically “poured” from teachers’ heads to students’ heads. Knowledge is constructed when individual learners actively refer to their prior knowledge to make sense of new information; the result of the sense making is a further construction of knowledge embedded in people’s minds. Although learners must construct their knowledge, a significant portion of an individual’s understanding is socially constructed - in response to interactions with other human beings, like the teacher and other learners (Dufresne, Gerace et al. 1996). In this view, an important role of the teacher is to facilitate the Zone of Proximal Development (ZPD), entering into a dialogue with the learner, trying to identify the knowledge problems a learner is experiencing, and providing any necessary “scaffolding” to help learners construct new knowledge (Vygotsky 1978). Learners together with the teacher can be viewed as a learning community which supports the knowledge construction process (Bielaczyc and Collins 1999).
Zone of Proximal Development

The theory concerning the zone of proximal development (ZPD) was developed by Vgotsky (Vygotsky 1978). This theory view emphasizes the importance of a teacher’s guidance in students’ learning. Proximal means “next”, and the ZPD refers to the potential knowledge and skill space students can reach when they are properly engaged and guided by the teacher or in collaboration with other more capable peers. For example, Vygotsky observed that when children were working independently on some tasks, they rarely did as well as when they were working in collaboration with adults. It is not that the adults teach the children to perform the task well but that by observing how more advanced people engage with a task, the children are able to refine their thought processes to be more effective. The same is true for people of all ages. Thus, Vygotsky and many other researchers suggest that the role of education is to provide students with opportunities to transition into their own ZPD as much as possible, thereby advancing their learning.

![Figure 2-1. Illustration of ZPD (after(Atherton 2009)).](image-url)
Scaffolding

While ZPD suggests a high-level educational goal of helping individual learners move as far into the ZPD as possible, it offers no concrete suggestions on how it could be done. Another theory that parallels Vgotsky’s ZPD is the scaffolding theory developed by Bruner (Bruner 1984). Scaffolding is defined as “a framework for construction in progress” (Cazden 1983, p. 6), representing the helpful interactions between teacher and student and among students that help students reach learning achievements that are beyond their individual capabilities. It is generally agreed that both scaffolding theory and ZPD are founded on similar ideas about learning, but that the scaffolding paradigm offers more guidance for how movement through ZPD might be achieved.

Over the past several decades, various scaffolding techniques have been developed and evaluated. These scaffolding techniques can be classified into two levels: soft and hard (Saye and Brush 2002). Soft scaffolds are contingent on the type and amount of support students need during the time of instruction (Berk and Winsler 1995; Roehler and Cantlon 1997). An example of soft scaffolding is when the teacher circulates around groups of students, questions them to assess their understanding, and provides custom feedback and intellectual discussions (Simons, Klein et al. 2004). In contrast, hard scaffolds are assistances that are planned in advance. Examples of hard scaffoldings include hints or cues that are carefully planned to guide learners toward learning (Hannafin, Land et al. 1999), other sources of information like a reading list, tutorials, web links, or help pages, advice from experts, recommendations of certain tools that can help students perform the tasks (Hannafin, Land et al. 1999; Yelland and Masters 2007).
The Classroom as a Learning Community

The concept of a learning community has been important to researchers focused on higher education (Brower and Dettinger 1998). According to Lenning and Ebbers, historically there have been many noteworthy proponents of learning through community. These include Quintilian in the 1st century, Lancaster and Bell in the 16th century, Comenius and The Common School Movement in the 17th century and Dewey and Meiklejohn in the 20th century (Lenning and Ebbers 1999).

There is not a definitive definition of learning community (Zhao and Kuh 2004). As reviewed in (Smith, MacGregor et al. 2004), Meikejohn on the other hand aligned curriculum with the notion of community. However, it is generally accepted that a learning community is a group of people (including both students and the teacher) working on a shared set of learning goals (Brower and Dettinger 1998). Dewey’s work focused on student-centered approaches to active learning, emphasizing learning as a social process.

Further, Lenning and Ebbers (Lenning and Ebbers 1999) classified learning communities into four generic types: curricular learning communities, classroom learning communities, residential learning communities and student-type learning communities. Curricular learning communities include students co-enrolled in two or more courses that are linked by a common theme. Classroom learning communities are students taking the same course in one classroom, so that they meet each other regularly and learn together. Residential learning communities are students taking two or more common courses, who live in close physical proximity on-campus, and thereby enjoy an increased opportunity for interaction. Student-type learning communities include students from targeted academic groups, for example honor students, freshmen interests group, historically underrepresented groups, and so on.
The focus of this dissertation is the classroom learning community. According to Brower and Dettinger’s pyramid model, a learning community has three basic elements: physical elements (students are physically proximal); academic elements (students come to the class for the common goal of learning); and social elements (the interpersonal relationship among students) (Brower and Dettinger 1998). Applying this pyramid model to the classroom context, we see that two of the three necessary learning community elements, namely the physical component and the academic component, are already in place. What is weak in current classroom settings and needs to be enhanced is the social component. Currently students in a classroom operate mostly as relatively passive individual learners. They come to the class, they listen and take notes and they leave. Although at times there are in-class interactions or activities, the amount of interaction offered to students is often limited.

**An Integrated Social Constructivist Learning Model**

Drawing on the social-constructivist theories of learning and considering both the learners’ and teachers’ roles in learning, Williams and Burden suggested a coherent social constructivist model of the learning-teaching process. In this model, four key factors are identified - teacher, learner, task and multiple types of context (Figure 2-2). Teachers select tasks, which are conceptualized as hard scaffolding that is planned by teachers in the hope of facilitating students’ learning. Teachers and learners interact with each other through tasks and learners also interact among themselves in tasks.

In addition, the context in which the learning takes place plays an important role in shaping the learning process. According to Williams and Burden, learning cannot happen in a vacuum. The immediate physical environment of the classroom and students’ personal relationships can have a profound influence on learning (Williams and Burden 1997). Contexts
include the physical environment or classroom arrangement; the emotional environment, like trust and sense of belonging; and the wider social environment, including the current political environment and cultural factors.

Figure 2-2. A modified social constructivist model of learning-teaching process (Williams and Burden 1997)

Williams and Burden classified these varying contexts into three levels. At the closest level is the \textit{microcontext}, which contains students’ relationship with parents, teachers, peers, and siblings. The level in the middle is the \textit{mesocontext} which contains a range of interactions of significant people in students’ life, for example the home-school relationship. The third level is the \textit{macrocontext} which concerns the whole culture of the society in which students live (Williams and Burden 1997). It is argued here that the interaction among teacher, learners and tasks is a knowledge construction process and it is surrounded by its supporting community.

\textbf{Social Constructivist in University Classrooms - The Challenges}

Research and education practitioners have applied the social-constructivist approach in teaching practices and have achieved some successes (Lave 1988; Hewson, Kerby et al. 1995). The application of this model in daily education and learning experience is often summarized as
taking an active learning approach, where teachers aim to build an active learning environment in which teacher and students participate in various activities. However, there are many challenges to creating such environments and activities. For example, soft scaffolding, which is an important aspect of an active learning environment, can be difficult when the classroom is large and students have various needs. In this subsection, I use the scenario presented in Chapter 1 to consider the challenges for the application of social constructivism to university classrooms. I focus on the active learning goal of supporting classroom discussion, analyzing this goal from the perspective of production blocking and power relationships. In general, I argue that these two factors create persistent challenges for an active classroom culture that includes free-flowing discussion, and that this in turn interferes with the knowledge construction component of social-constructivist model. I also consider how feelings of community amongst students and teachers (or the absence of such feelings) may influence the social construction of knowledge.

Production Blocking in Class Discussions

In the scenario presented in Chapter 1, students meet face to face and communicate through verbal communication. They are encouraged to speak up freely. However, at any given time only one individual can talk and other people are “blocked” because they have to wait for their turns to talk. This phenomenon has been termed production blocking and has been analyzed as an inhibiting factor in group discussions and brainstorming (Lamm and Trommsdorff 1973). Production blocking is considered to be one of the major reasons for the productivity loss in group meetings and discussions (Diehl and Stroebe 1987). Productivity loss (Steiner 1976) refers to the fact that although groups usually perform better than their average members, for tasks like group discussion, groups do worse than the theoretical maximum level one would expect. A review of 18 studies comparing the performance of nominal groups (isolated members
workings alone) to interacting groups whose members meet and talk face to face, noted that 14 of the 18 studies reported that interacting groups generated fewer ideas than nominal groups (group members working independently); the other 4 cases reported the same number of ideas for groups and nominal groups. In terms of the quality of the new ideas, the quality from nominal groups is generally higher than ones generated in the interacting groups (Diehl and Stroebe 1987). The earlier scenario illustrated the case when a few vocal students dominate the discussion, such that others do not have an equal opportunity to bring up their points and thoughts; this is a typical example of production blocking in a class setting, and has been reported in empirical work as well (Brush, Bargeron et al. 2002).

Studies of group work have shown that production blocking interferes with discussion because it disrupts the organization of idea generation due to attenuation blocking and attention blocking (Lamm and Trommsdorff 1973; Diehl and Stroebe 1987; Nunamaker, Dennis et al. 1991). **Attenuation blocking** refers to the fact that when group members are unable to contribute comments as the ideas occur, they forget or suppress them later because they seem less original, relevant or important. This phenomenon has been found to be common in other studies as well (Anderson, Anderson et al. 2003). **Attention blocking** refers to the fact that members must constantly listen to others speak and cannot pause to reflect on their own thoughts (Lamm and Trommsdorff 1973; Diehl and Stroebe 1987; Nunamaker, Dennis et al. 1991). In the scenario, Alice’s case is an example of this, in that her attention is blocked by the need to listen to the other people who are speaking, thus giving her little time to think for herself. Further, the delay between the time when a new idea comes up and the time that the person with the idea can verbalize it is another factor that causes the reduced number of ideas and participation (Nijstad, Stroebe et al. 2003).

In traditional class discussions, process losses caused by production blocking increase rapidly as group size increases (Steiner 1972). The optimal group size seems to be 3-5 members
(Shaw 1981). However, in most universities a typical undergraduate level courses has far more than 5 students. Indeed large classes are prevalent in universities and colleges today and seem likely to remain so in the foreseeable future. It is common to find dozens of classes that are regularly taught to more than fifty students on many campuses, and many carry an enrollment of hundreds of students (Cooper and Robinson 2000). Classes of large size are economically important from university administrators’ point of view; given the current economic state of affairs at most colleges and universities, there is pressure to increase class sizes even further.

Teachers have already realized the problems with discussions in large groups and have taken some steps to ameliorate the problems. However, these solutions are not always effective. For example, teachers sometimes will adopt a hybrid approach to active learning by organizing students in their large classes into groups of 4-5 students. These groups have their own discussions, and the teacher walks around from group to group to participate and give feedback. However, the time the teacher can spend with each team is limited and at times the teacher may repeatedly answer the same questions in different groups, an unfortunate waste of valuable classroom time. On the other hand, the individual groups spend most of their time discussing without the teacher. The inherent problem with student group discussion is that questions raised by students can not always be solved by other students due to lack of knowledge about the topic or time (Kam, Wang et al. 2005). So generally speaking the active techniques that can be used effectively in small class environments become ineffective and inefficient in large classes.

In sum, the way that class discussions are organized and managed in current classrooms is featured by high production blocking, which makes the in class discussion less effective than it could have been.
Sense of Community (SOC) in Classes

From a social constructivist perspective, people learn best not by assimilating what they are told, but by a knowledge construction process, which is supported by the surrounding community (both peers and more advanced individuals like teachers or mentors) (Vygotsky 1978). Production blocking issues discussed in the previous section are obstacles that must be overcome in the knowledge construction process. The classroom is the place where students and teachers meet regularly, where they interact with each other and participate in various in-class activities with the common goal of learning. Through these regular meetings and interactions, the students and teacher connect to one another as a classroom learning community, recognized as one of the four generic forms of learning community in education (Lenning and Ebbers 1999). In this section, a technique for assessing the well-being of a community – a measure known as sense of community – will be introduced. This measure provides a mechanism for evaluating students’ sense of the classroom as a learning community, and these feelings in turn will be investigated for their role in the mediation of learning.

The term sense of community (SOC) is an important concept in social psychology. It focuses on community members’ experience with the community, rather than its structure, setting, or formation. It has been defined to be the “feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members’ need will be met through their commitment to be together” (McMillan and Chavis 1986, p.9). It suggests the most essential elements of a community: mutual interdependence among members, sense of belonging, connectedness, trust, shared value and goals.

Research over the past decade has established the importance of SOC as a mediating factor in people’s group interactions. In neighborhoods, SOC helps to build social capital (Pooley, Cohen et al. 2005), encouraging neighbors to request and offer help to one another in times of
need. In workplaces, employees with strong SOC realize that they are expected to be responsible citizens in the organization as well as in the larger society (Burroughs and Eby 1998).

In educational settings, the need to feel securely connected with others in the environment and to experience oneself as worthy of love and respect is a basic human need that can be fulfilled socially (Osterman 2000). Studies have found that a strong SOC in classrooms increase students’ persistence in courses, and that it can increase the flow of information among learners, availability of support, commitment to group goals, cooperation among members and satisfaction with group efforts (Dede 1989; Bruffee 1999). According to Ryan and Powelson, class SOC is a fundamental aspect of motivation in school activities (Ryan and Powelson 1991). Similar results have been reported by other educators (Ryan, Connell et al. 1985; Connell and Wellborn 1991).

Unfortunately, students in most classes report a low SOC. Currently, mid-size (40-50) to large size (100+) classes are prevalent in universities. As class size increases, students become faces instead of people. In classes of this size “feelings of disconnectedness are common among students” (Sanders, Basham et al. 2006). In a pilot study, we found that in an introductory class with about 150 students, toward the end of the semester, students still mentioned that “I had hardly known anyone outside of my group in such a big class” (Du, Rosson et al. 2009). This leads to reduced feelings of individual accountability (e.g., “It is easier to do anything you want, sleep, not attend, or lose attention”) and to an increase in the impersonal nature of classes (e.g., “no one knows I’m here”). Such factors work against SOC and thus lead to decreases in learning motivation (Wulff, Nyquist et al. 1987). As students’ motivation decreases, so does their effort and resultant learning.

In sum, the production blocking that results from the fact that only one person can speak at one time makes class-wide discussion a utopian hope. On the community level, the reduced SOC that is typical of moderate to large classes leads to decreased learning motivation.
Technology Mediation of Active Learning

We are now living in an information age in which the developments of information technologies have brought great change in every aspect of our lives. Currently, classrooms have evolved to employ a large number of educational technologies. Ceiling-mounted projectors, PCs, laptops and handheld devices are commonplace in classrooms. With the advent of Web 2.0, the emergence of various social software (blog, microblog, wiki and many social networking services) have brought educators and students even more channels for communication and interaction. This part of the dissertation presents a review of the literature describing how information technology can be used to facilitate the interaction between teacher and students and among students. In course of doing the review, the existing education technologies were classified into five categories: presentation tools (projects, write boards), discussion forums and chat rooms, class response systems, note-taking systems and the recent advances in social software (blogs, wikis, podcasting).

ICT as Presentation Tools - The First Step

PowerPoint

The information technology that was introduced first into classrooms was the ceiling mounted projector, used in concert with presentation software like Microsoft PowerPoint (Daniels 1999). One of the most important feature of PowerPoint is that it provides structure for the lecturing task (Joshua 2005). Teachers can project the PowerPoint slides on wall screens in the front of the classroom. With the use of such presentation aides, the teacher can save much time in writing on blackboards or transparencies, and the lecture flows more smoothly (Daniels 1999; Mantei 2000). The use of PowerPoint slides also makes it easier for teachers to provide clear
summaries (Lowry 1999). Another advantage of PowerPoint presentations is that they support multi-media presentation including texts, tables, pictures, graphs, sound effects, and video clips, and so on – such media may help to attract students’ attention in the class. Several studies found that graphics improve student recall (ChanLin 1998; Lowry 1999; ChanLin 2000). However, it is argued that the mere introduction of PowerPoint can not change the teacher-centered nature of traditional lecture classrooms. Students are still passive learners, who come to the class, take note and leave. “Boring” is perhaps the most cited word that characterizes students’ common experience with simple PowerPoint supported classroom.

**Interactive Whiteboard**

Motivated by the current call for the social-constructivist view of learning, significant efforts have been devoted to development of more sophisticated technologies. One of these is the Interactive Whiteboard (IWB) that can support a more active learning environment, thereby enhancing in-class interactions. An IWB is a large display connected to a computer and a projector, and the projector is used to display the computer screen onto a board, in a fashion similar to a PowerPoint presentation. The difference between IWB and PowerPoint is that IWB supports interactions between people and the board. Teachers or students can use a pen, finger or other devices to control objects on the IWB, as well as for writing on the board. Another important feature of the IWB is that it usually comes with a feature that allows teachers to record notes and annotations on the board for later distribution. IWB is becoming increasing popular. According to the market research firm Futuresource Consulting, one of every seven classrooms in the world will feature an interactive whiteboard by the end of 2011 (Davis 2007).

Yet, what IWBs support is technology-human interaction, instead of teacher-students and students-students interaction. IWB is advancement from PowerPoint, but it is still mainly used to
support lecturing activities. Further, most IWBs have limited capability to support multiple-user interaction. Typically it is the teacher who is controlling the IWB. Another issue with student-IWB interaction is that it usually requires students to come up to the front of the classroom to write on the IWB, while other students are watching. This can put the student in an awkward social role (Ballagas, Rohs et al. 2004), which decreases students’ motivation to actively participate in using the IWB in the class. What is more, the production blocking level is still high with the use of IWB because only one person can interact with it at a time.

Class Response Systems

With the goal of supporting the in-class interactions that lead to a more active learning environment, and seeking to leverage the increased availability of handheld devices, researchers and practitioners have invested significant effort in building and evaluating Class Response Systems (CRS). The general aim of a CRS is to enhance in-class communication, but many variations have been proposed and studied, including audience response systems (Miller, Ashar et al. 2003), voting machines (Reay, Bao et al. 2005), wireless keypad response systems (Burnstein and Lederman 2001), classroom communication systems (ClassTalk; (Dufresne, Gerace et al. 1996), electronic response systems (Hall, Waitz et al. 2002) and Active Class Project (citation?).

Typically a CRS has three components: transmitters that students use to send response; receivers that collect the responses; and a server that processes those responses and aggregate those responses in real time. For example, the instructor can raise a multiple choice question using the system and students submit their responses. The instructor would normally have the choice as to whether or not to display students’ responses and whether their answers are public or anonymous.
CRSs have been successful to some extent. The reported benefits of CRS include increases in student engagement, better understanding of complex subject matter, and higher reported interest and enjoyment (Fies and Marshall 2006). There are a number of CRSs in the market, like einstruction®, Qwizdom®, Turning Point® and H-ITT®.

At the same time, several problems with CRSs have been discussed. First, the interaction model is simple and limited. What the instructor can discover is how many students choose the right answer, as well as individual student’s answers. However, an instructor can not obtain a rich understanding of what students are thinking. Second, the interactions are only initiated by the teacher. While a touted benefit of using the system is to support students who are too shy to raise their hands in the class, it is the teacher who initiates the interaction; only then do students respond, which makes this specific promised benefit difficult to assess. Students continue to be relatively passive actors who react to teacher-initiated prompts. Further, CRS interactions are teacher-student interactions, not student-student interactions (except indirectly, as when a student discovers that he or she is part of a majority or minority of students responding in some way). In terms of in-depth understanding, there has been little understanding of how different students might react differently to the technology (Fies and Marshall 2006). There are many interesting questions, for example, concerning how CRS might contribute to normative behavior (e.g., through social influence processes) or in contrast how it might promote feelings of community (e.g., if many students agree about a value-related issue).

**From Discussion Forum to Knowledge Forum**

Apart from their omnipresent role in distance learning, online discussion forums are on occasion created as an augmentation for face-to-face courses. Such forums are relatively easy to provide and use (Guzdial and Turns 2000). If they are hosted on the web, online discussion
forums can have the advantage of platform independence. Any student or teacher with an internet connection can participate, wherever and whenever it is convenient to do so. In these discussion forums, the topics are often pre-assigned by teachers, and students are able to work together on projects in small groups, participate in on-going discussions focused on course content, and "present" group project products to the rest of the class. In addition to the pre-assigned topics, students may also self-initiate new topics for discussion. The teacher may also play an active role in online discussions by posting messages. Another role for teacher is as a moderator of online discussion forums. Students’ participation is independent of students’ location and time of actual participation in the discussion forum (Harasim 1993; Barnes and Greller 1994).

An important advancement in the online discussion forum paradigm is the Knowledge Forum described and studied by Scardamalia and Bereiter (1991, 1994); this is a discussion forum that has more structure and provides more scaffolding to guide students’ learning. These educational researchers have developed a model they call Knowledge-Building Communities, later known as the Knowledge Forum. The model is supported by computer software that encourages students’ knowledge building in a forum format. Students work together to make sense of the world around them and work towards advancing their own state of knowledge. The Knowledge Forum guides students to investigate a problem of interest over a period of weeks or months. Students start by entering their own ideas and discoveries into a knowledge base. The Knowledge Forum then supports students in constructing notes about a topic through features such as theory-building scaffolds (e.g. "My Theory," "I Need to Understand") or debate scaffolds (e.g. “Evidence For”). Students can read through the knowledge base adding new information, such as text, graphics, questions, links to other notes, and comments on each other’s work. The system automatically notifies students when someone has commented on their notes. Thus the central activity of the learning community is contributing to the communal knowledge base. When students feel a note makes an important contribution to the collective knowledge base, they
can propose the note for publication. The teacher then decides whether to publish the note. At the end of the school year the class may decide on a selection of notes to remain in the knowledge base to be used by classes that come after them.

The benefits of online discussion have been touted by many, yet in reality such forums face a variety of problems. First, participation level is low. Most students choose to become lurkers instead of leaders. According to Hara, Bonk and Angeli, a typical student posts just one message per week, and only to fulfill class requirements (Hara, Bonk et al. 2000). Second, the social presence in online forums is low; this reduces the feeling of belonging. In most online forums, people work individually and asynchronously. When the forums are instead used in a classroom setting, they compete with live discussion (Brush, Barger et al. 2002). There seems to be a need to better integrate online and in-class discussion (Brush, Barger et al. 2002).

**Web 2.0 Social Software: Blog, Wiki, Microblog**

With the advent of Web 2.0, various new interactive technologies and services have appeared on the Internet. They can expand discussion beyond the classroom and provide new ways for students to collaborate and communicate within their class. Two of the most important technologies are blogs and Wikis, which can facilitate communication, interaction and collaboration in larger communities (Cress and Kimmerle 2008). Students can reflect on their own experiences and write about these experiences on the blog, in effect publishing their thoughts for others to read. Other people, perhaps also members of the class or perhaps not, can comment on the blogs. The blogs created by students are archived online and teachers can use previously created blogs for new students as introduction or orientations (Bryant 2006).

While blogging supports learning mostly by providing a space for students to publish their individual reflections, the wiki framework is regarded as a media that supports learning due
to its debate-based nature and its ability to support collaboration (Chong and Yamamoto 2006; Notari 2006). Wikis are websites to which users not only have access but also can modify directly. Users jointly create a webpage. Anyone can extend or revise a web page by adding, deleting, or changing content as desired (Raitman, Augar et al. 2005); the argument is that this co-editing process allows the collaborative generation of knowledge (Fuchs-Kittowski and Kohler 2005). However, just like discussion forum, what blog and wikis can support are mainly out-of class discussion and interaction.

Microblogging is a new form of blogging wherein users may publish brief text updates online. The posts may be created, edited and accessed online, or they may be sent as SMS, e-mail or instant messaging. Microblogging is intended to promote real-time interaction between users, using different devices, technologies and applications. Due to its ease of use and the ability to directly address a large audience of users, several related services for microblogging (e.g., Twitter, Jaiku, Tumblr) have become increasingly common in scientific conferences as a back-channel for participants.

Microblogging is also starting to emerge in classroom settings. In one study of microblogging in a summer school, the technology was observed to be an effective channel for immediate communication (Costa, Beham et al. 2008). Microblogging can also facilitate in class discussion when students can post anonymously. According to a study which employed anonymous microblogging for in class discussion, the teacher received questions that he had never heard before in a course that he had taught for years (Young 2009). What is more, students enjoy microblogging because they feel that they are in control (Young 2009). Another study of microblogging in education – but in this case an out of class context – found that students were very open in their Twitter postings and a strong community soon grew (Cann, Badge et al. 2009). However, one criticism with microblogging is the limited length of the messages (Costa, Beham et al. 2008). Another challenge of using microblogging in classrooms is that although there are
great potential with using microblogging in classroom, there are also potential problems. For example it might distract students with a lot of class-irrelevant content on microbloggings. So far in the literature no effective way to incorporate microblogging into classroom settings has been reported.

**In-Class Interactive Technologies**

Researchers and educators have explored various options for technology interventions that can facilitate richer interaction between teachers and students in classrooms. For instance, CRS allow the teacher to present multiple choice or true/false questions; students can then respond to these with specialized handheld “voting” devices, perhaps resulting in a public display of aggregated results (Dufresne, Gerace et al. 1996; Robertson 2000; Miller, Ashar et al. 2003; Fies and Marshall 2006). While such systems can increase class participation, they have drawbacks. First, they need special hardware, typically purchased by or provided for each student. Second, the teacher-student interaction is very structured and limited. The instructor cannot obtain a rich understanding of what students are thinking. Third, interactions occur only at the teacher’s initiative. While a touted benefit of using these systems is to support students who are too shy to speak up in class, it is still the teacher who initiates the interaction. Students continue to be relatively passive actors who react to teacher-initiated issues.

Other text-based classroom technologies offer students an opportunity to engage in richer interactions with the instructor. Active Class uses PDAs for classroom communication: Students can post text questions to the teacher during lectures, using a handheld device. A teaching assistant (TA) may respond to these questions during class, or the teacher may choose to address some questions. When this system was used in undergraduate computer sciences classes, the researchers found that it helped teachers get timely feedback from the students, overcame student
apprehension in large classes, and enabled multiple students to ask questions at the same time (Ratto, Shapiro et al. 2003).

With the goal of supporting more interactions in class, some other systems have been developed, providing class feedback to the teacher and answering teachers’ questions. LiveNotes (Kam, Wang et al. 2005) is a cooperative note-taking system through which students in small groups can take notes together. Students’ tablet PCs are connected to a server and students can download the PowerPoint slides from the server and take notes together in small groups. In the early versions of this system, there was only student-student interaction. In more recent versions, some amount of teacher-student interaction was added, for example students can give feedback to the lecture about the speed of the lecture. Another similar system is Classroom Presenter; it is also tablet PC based and enables instructors to write on slides with digital ink and display the slides to students’ personal devices. The system can support complex problems and rich responses (students can write, draw on their tablet PCs and submit to the teacher), instructors can select answers or students, students and instructor can use the saved responses after class, student can work simultaneously and privately and students control their workspace. A further extension of the Classroom Presenter – the Ubiquitous Presenter, can support wireless submission as well (Lindquist, Denning et al. 2007). Students can submit their answers using mobile phones through SMS and MMS. A trial of this system found that it increase class participation in classes from multiple disciplines (Anderson, Anderson et al. 2003; Linnell, Anderson et al. 2007).

There are several inherent problems with these systems. The problem with LiveNote is that the interaction is mainly student-student interaction; questions raised by students could not always be resolved by other students due to the lack of knowledge about the course material or time. The teacher-student interaction that was added is still quite simplistic - students can only indicate whether the speed of the lecture is too fast or too slow. While Classroom Presenter and Ubiquitous Presenter can support rich response from students, the interaction continues to be
teacher-driven instead of student-driven. The students were asked to solve a problem or answer a question at various points during a lecture. It was the teacher who initiates the use of the application instead of the students.

The Harvard Live Question Tool allows students to submit answers to questions that are raised by the teacher; the answers are displayed publicly in the class. No formal evaluations have been conducted to study the impact of this tool, although it has been recommended by Educause as an effective way to encourage students’ participation and students-teacher interaction (EDUCAUSE 2011). Similar results have been found in ClassCommons and Fragmented Social Mirrors(Bergstrom, Harris et al. 2011).
Chapter 3
Conceptual Framework and the Research Space

Conceptual Framework

The goal of this thesis research is to explore the idea of integrating public digital backchannels in the classroom to engage students, to support class discussion and to facilitate community in classrooms. In this section, I will introduce the conceptual framework that guides this research.

Backchannels

The term “backchannel” is used to describe a non-primary communication channel between the speaker and the listeners, in which feedback is given to the speaker in un-intrusive ways from the listeners to show their interest, attention and provide feedback (Yngve 1970). Examples of face-to-face backchannels are short utterances like “uh-huh”, “yeah”, “right”, “okay”, or spontaneous longer feedback and body language like head nods, eye gaze or facial expressions. Research has shown that backchannels are important for maintaining communication efficiency (Krauss 1977).

In classrooms, backchannels are an efficient and un-intrusive way for students to interact with the teacher. For example students use backchannels when they nod their heads to show they understand a topic being discussed, and the teacher may adjust his or her communication based on such feedback. However as the size of audience increases, backchannels are harder to establish and the communication between the speaker and the audience loses quality. It is hard for a
speaker to perceive multiple simultaneous feedback from different listeners; visual signals are quickly lost in a crowd (Bergstrom, Harris et al. 2011). As a result, speakers tend to focus only on a few audience members and their individual backchannels. In situations with a large audience (e.g., a large lecture class), it is common that just a few individuals engage actively in backchannel communications with the speaker.

With the popularity of Instant Messaging (IM) and Internet Relay Chat (IRC) tools, the meaning of the term “backchannels” has shifted. Instead of referring to the non-primary channel that support teacher-student interaction, the term is commonly used to refer to online chats among students that take place while the teacher is giving the lecture. Studies have found that backchannels of this sort can support peer-to-peer learning (Cogdill, Fanderclai et al. 2001; Yardi 2006). Note that these backchannels do not have the teacher involved at all.

Backchannels might be more helpful for both the students and the teacher if the teacher is also engaged in the process. For students, although a backchannel might support peer-to-peer learning, according to Vygotsky’s theories on Zone of Proximal Development (Vygotsky 1978), without teacher’s guide students are unlikely to achieve their potential development level. For the teacher, he/she can be aware of students current situations, based on which the teacher can adjust the lecture, answer students’ questions in a timely fashion and address students’ concerns.

**Sense of Community**

According to Gusfield, community involves two dimensions: shared territory and social relationships (Gusfield 1975). To build community, people who share a space must also build and maintain relationships. Sometimes people who live in the same neighborhood do not engage in the social interactions that can be a basis of relationships (Lee and Newby 1983); this may lead to what is known as “absent ties” in social network theory (Granovetter 1973).
The social relationship dimension of a community is missing in current university classroom. As discussed in the Social Constructivist in University Classrooms - The Challenges section in Chapter 2, currently the interaction between students and the teacher and among students is very limited. In the transmittal model of learning, students are individual learners, listening to the lecture, taking notes. It is rare for students to interact with other students in the class. The production blocking issue in traditional classrooms makes the interaction between the teacher and the students limited to just a few vocal students.

**Public Digital Backchannels**

Weaver and Qi found that faculty and student interaction is an important factor that influences students’ class participation (Weaver and Qi 2005). It is expected that by bringing backchannels “up front”, it may be possible to involve more individuals in backchannel discussions, as well as to support more interaction between the teacher and the students and among students.

Currently public displays have become pervasive in university classrooms. If the backchannel chats among students are displayed on the public display, the content is not only viewable to all the students, but also to the teacher. While the teacher is giving the lecture, s/he can refer to the public display to see what is being talked about, what students’ concerns are. In addition to this, if a class has a teaching assistant (TA), that individual can monitor the backchannel discussions and answer questions, provide feedback, or even raise questions to the teacher on behalf of the students. In this way, it offers an opportunity for the teacher and the TA to get involved in the backchannel discussions and support the interaction between the teacher, TA and the students. In the meanwhile, the students can still talk with other students in the public digital backchannels, interacting with other students.
Conceptual Framework

The purpose of the conceptual framework guiding this thesis research is to leverage the potential of backchannels to support communication efficiency among the speaker and his/her audience. In a classroom setting, I expect that bringing the backchannel up front will make the conversations viewable to both the students and the teacher and by so doing:

a) It will offer opportunities for students have more interaction with other students as well as the teacher, so that a stronger social relationship could be formed, which can eventually lead to increased sense of community in the class, improving students’ classroom learning experience;

b) The computer-mediated form of the communication may encourage more students to participate in class discussions, offering them opportunities to become active learners.

c) By enabling the teacher to become more involved in the backchannel discussions, s/he can provide timely feedback to students, be aware of students’ activities and thoughts, providing guidance and scaffoldings to students to help them achieve their potential development level (ZPD). Figure 3-1 illustrates these expectations about public backchannels in classrooms.

![Figure 3-1. The Conceptual Research Framework](image-url)
Research Methodology and the Problem Space

Generally this thesis research focuses on integrating public digital backchannels in classrooms to provide an additional channel for students and teachers to interact with each other, and to facilitate classroom community building in the class. Design Based Research (DBR) methodology is adopted in this current research.

Design Based Research (DBR)

Design Based Research (DBR) is a kind of research methodology widely adopted by learning scientists, wherein interventions are conceptualized and implemented in natural settings so as to test the effectiveness of the new interventions, to generate new theories and frameworks for guiding education research, and to gather experiences from the natural deployment that can be used to inform future endeavors. Improvements are made based on earlier results and are further tested again in the field in an iterative process. DBR differs from a traditional iterative design process. The core difference between DBR and iterative design is that initially in DBR, the design is informed by theory and further the design and result will inform the development of the theory.

Design based research is different from the traditional lab experiment in the following three aspects (Barab 2006). The first is that it is for conducting research and design work in real-life settings and the result can provide system-level understandings. The second is that the belief of factoring assumption of experimental psychology is not valid in learning environment. Instead, individuals and learning environments are inseparable. In DBR frameworks, the context in which the learning takes place is an important component that should receive significant attention. The third is that it improves learning for those participants in the study. DBR is very likely to produce local impacts but almost always faces the challenge of scaling up and generalizing.
Some criticism of DBR is that since the result is not generated using experimental methodology, it could at best provide formative insights that can be tested through more controlled experiments. As such, it would be difficult for DBR researchers to convince policy makers. This challenge can be addressed to some extent by providing a number of converging measures that point to a single conclusion, but even such a conclusion would normally require a focused test to argue for general adoption.

In this thesis research DBR is selected as the research methodology because my work is inspired by learning sciences theories like social constructivist learning, and the primary goal of my research is to understand the impact of integrating public digital backchannels in classrooms in real world settings. The expected contribution of this research would be filling the gap in learning theories on public digital backchannel and classroom community based on real world deployment experiences and the lessons we learn from this study would inform both researchers and educators working in this field. Thus, Design Based Research is regarded as the best methodology to be adopted in this research.

The Problem Space

Although there have been several studies theorizing the benefits of backchannels in the classroom (Cogdill, Fanderclai et al. 2001; Yardi 2006; McNely 2009), the integration of public digital backchannel in classrooms is an emerging idea in education research, and little has been discovered about its potential impacts.

Earlier experiences and studies on public digital backchannels in classrooms have found that it could encourage students to participate more in class and encourage students’ initiatives (Bergstrom, Harris et al. 2011; EDUCAUSE 2011). The Harvard Live Question tool has been recommended by Educause as an effective way to encourage students’ participation and students-
teacher interaction (EDUCAUSE 2011). However, all the studies cited above have only evaluated public digital backchannels from a Question and Answer (QA) perspective; little is known about the role of a public digital backchannel in community building. Second, the cited studies have evaluated the effects of classroom backchannels for only a limited period of time (usually 1-2 class periods), leaving longer term impacts unknown. Third, previous studies have tended to focus on the potential benefits and it is not clear what are the advantages and disadvantages with public digital backchannels in classrooms.

The goal of this thesis research is to investigate the potential of public digital backchannels in classrooms from a community perspective in both short term and long-term field studies, and to gain a more extensive view about advantages and disadvantages with public digital backchannels in classrooms, from both the teachers’ and the students’ perspective. In addition to that, I will study the communication patterns in public digital backchannels to understand the dynamics of public digital backchannels in classrooms.

In the following sections, I will first describe the design and general system architecture of the public digital backchannel system – ClassCommons – that I designed and implemented to support my research goals. After that, I will report the results from two studies that I have conducted. There were different research questions in those two studies, but they all fall into the general problem spaces that I am aiming at addressing.
Chapter 4

The ClassCommons System Architecture

The design of ClassCommons is drawn from a more general design concept of providing a common area for people in a shared physical environment to submit and receive comments about content currently in view. Thus one might imagine an ArenaCommons for sports events, a MallCommons for shopping, or a CafeCommons in a bistro or coffee shop. For this project we focused on support of a semi-public shared space: a university classroom. In this setting, the people present are teachers and co-students in a class, so they may already feel a sense of community due to shared learning goals and activities. However, we expect that additional interaction mediated by the public display may enhance such feelings.

In this thesis research, ClassCommons has been used in two different classroom settings and the client interfaces differ due to the differences in pedagogical and physical requirements. However, the ClassCommons systems in those two studies shared same architecture. In this chapter, I will discuss the core system architecture of the ClassCommons system.

The general requirements for ClassCommons were simple: to present content in a controlled fashion, to accept input from audience members, and to manage the display of this input. As seen in Figure 4-1, ClassCommons accomplishes this with three basic components: a client device (any device with web browsing capability can be used, e.g., web-enabled mobile phones, laptops), a server and a large public display.
Any device with access to the Internet can serve as a client. To send comments, users log in to the ClassCommons posting website for their class. The server processes are implemented using JSP and MySQL database. All user messages are sent to the server, which schedules the sequence and timing for presenting messages on the public display. Although the messages are also viewable on the user’s web client, the design of ClassCommons assumes that a public display will be the focus of attention for participants. All the messages posted are displayed on the public display, viewable to anyone in the classroom.

AJAX is used to update the content on the display. Ajax is an acronym for Asynchronous Javascript and XML. It refers to a number of related web development technologies like Javascript, XMLHttpRequest, Document Object Model(DOM), XHTML and CSS, which are used on client-side (browsers) to create asynchronous web applications. With Ajax, a web application can interact with the server in asynchronous manner without interfering the display of the existing webpage (Garrett 2005). AJAX allows page content updating on the display without a requirement to reload the page; this means that new comments can appear in a seamless and non-interruptive fashion. The whole system is implemented using JSP, AJAX and MySQL database. Because it was built as a web application, it is platform independent and can be quickly deployed in any public display setting.
In the next two chapters, I will report the two studies that I conducted, one being a short term study using ClassCommons for a freshmen class to support two video viewing sessions and another long-term study to support two senior level undergraduate classes. The detailed designs of the ClassCommons system will be reported in those chapters separately.
Chapter 5

ClassCommons for Video Viewing Sessions: A Short Term Study

In the first study, ClassCommons was used in a freshmen introductory class to support their video viewing experiences. The course was IST 110, “Information, People and Technology”. Much of the work in IST 110 is accomplished by small teams that are formed early in the semester; one tradition in the course is that teams are required to produce a brief (i.e., 5-minute) video as part of their final project; the last week of class is reserved for sharing these videos. In earlier versions of the course, students just sat and watched the videos; we wanted to use ClassCommons to support a more active viewing experience.

The ClassCommons Video Commenting System

This section discusses the design rationale and the details of the design of the client side as well as the public display side of the ClassCommons system.

Design Rationale of ClassCommns Video Commenting System

The general idea of the ClassCommons video commenting system is to provide students an opportunity to have their voice heard in the class by displaying their comments on the public display while they are watching the videos. In addition, students can also interact with other students by conversing with each other on the public display. The potential benefits include a) it provides an outlet for students to voice their opinions in the classroom and increases their feeling
of personal influence in the class. According to McMillan and Chavis, feelings of personal influence are an important element in people’s sense of community (McMillan and Chavis 1986) and b) it provides an virtual ground for students to interact with each other. By interacting with other students, students’ social relationship in the class gets developed which can lead to increase feeling of sense of community.

However, there are several challenges with designing the system. What the public display should look like? How are the comments displayed on the public display and how often are the comments updated? Should students’ real name be displayed? See Table 5-1 for a complete design rationale of the key features.

The public display is designed following the TV caption displaying pattern. Since the public display would mainly be used to play the video, the space left for displaying the comments is very limited. Following the traditional TV design where the upper part of the screen is the video and the captions show at the bottom of screen, we designed the layout of the public display in similar patterns with the upper part showing the video and the bottom part shows the comments (See Figure 5-2).

Table 5-1. Design rationale of the key features

<table>
<thead>
<tr>
<th>Design Feature</th>
<th>Design Rationale (+: upside, -: downside)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The comments show at the bottom like TV captions</td>
<td>+: It is a format that most people are already familiar with</td>
</tr>
<tr>
<td></td>
<td>+: The level of distraction for viewers is minimal</td>
</tr>
<tr>
<td></td>
<td>-: The amount of information that could be displayed is very limited</td>
</tr>
<tr>
<td>Displaying one comment at once and it stays on the screen for 5 seconds (fixed amount of time)</td>
<td>+ Each message gets enough exposure time</td>
</tr>
<tr>
<td></td>
<td>+ Contributors would feel more encouraged to post because their contribution is likely to get other people’s attention</td>
</tr>
</tbody>
</table>
If a lot of comments are posted simultaneously, the messages waiting queue would become longer, some messages might be displayed out of the context. Could not see the history of messages on the public display.

| Show students’ real name in the message on the public display | +: Establishing one’s identity is an important part of building a community  
+: Students would act more responsibly in the system  
 -: Students who are shy might not want to have their name displayed  
 -: Students who are not so confident might opt not to post messages |

Another challenge is how long each message should stay on the public display. If every comment is displayed on the public display for a fixed amount of time, it would guarantee that every message would get equal amount of attention from the audiences, but if multiple messages are posted in a short period of time, the waiting queue would become longer. The implication with long waiting queue is that a message might be displayed on the public display long after the time it was posted. Since the class is ongoing, the message might then be displayed out of the context.

The third design conundrum is regarding whether students’ real name should be displayed on the public display or not. The upside with displaying students’ real name is that is good for students to establish their identity in the classroom and students might be more concerned their appearances on the public display and would act more responsibly. However the downside with this is that it might actually discourage students who are shy or not so confident from using this system. See Table 5-1 for a detailed analysis regarding this matter.
Having realized the design rationales of the key features discussed above, the ClassCommons video commenting system adopted a TV caption showing design on the public display, allowing every message to be displayed for an equal amount of time on the public display and students’ real names are displayed. This design served as our design starting point and we iterated on this based on the feedback from students.

ClassCommons Video Commenting System

The ClassCommons system used in this study instantiated the general system architecture described in Chapter 4. Because the system was intended to support video viewing, some course-specific design changes were implemented. In the large classroom used by IST 110 students (the course typically had 100-150 students), not every student was provided with an independent computer, so we focused on developing a mobile version of the ClassCommons system that was suitable for smartphones as well as standard web browsers running on PC workstations.

Figure 5-1 shows the mobile client operating on an Apple iPhone. To send comments, users log in to a posting website. Figure 5-1 shows the user interface of this website. To entice participation, we also displayed a list of the top 10 posters at any given time (Figure 5-1 (d)). After a comment is submitted, the system alerts the user that “Your message is posted. You will see it on the screen in 4 seconds. Please submit more”. (Figure 5-1 (c))
As described earlier, the server is implemented using JSP and MySQL database. In this system, in addition to scheduling the displaying of the comments and logging the comments in the database, the server also takes care of marking to which video each comment is posted and controlling the video player on the public display. Currently, the system supports two kinds of video players. One is Windows Media Player and the other is QuickTime Player.

The public display is the focus of attention for users. They watch videos, view comments as they are posted, and submit comments, either about the videos or in reaction to other comments. Figure 5-2 shows the layout of the public display. The upper part of the display is the video playing area; this covers about 90% of the screen. In the bottom is the commenting area, termed the “ticker”. A comment author’s first name together with his/her comment is displayed here.

AJAX is used to update the content of the ticker display every four seconds. New comments scroll up from the bottom of the ticker area, each displayed for four seconds.
Research Questions

One way to facilitate community development is to increase the amount of social interaction among members. For example, studies have found that an environment that allows community members to interact in a cohesive manner can build a sense of community (Graves 1992; Westheimer and Kahne 1993). ClassCommons offers university students a lightweight mechanism for interaction, namely a large public display. For this study, the video view sessions took place over 2 continuous class periods, in two different sections of the same course (with the same instructor). The following exploratory research questions guided the work:

RQ1: How will the interactions enabled by ClassCommons in this setting build or enhance students’ feelings of community over the two-session video viewing activity?
RQ2: What are important features of the usage experiences for students who use ClassCommons to support their video viewing experience?

The Classroom Setting

We designed the video commenting system for use by students currently enrolled in IST 110; this course is mainly intended for first semester students considering IST as a major, though it also included a more diverse subset of students who were enrolled to fulfill more general university requirements. We used ClassCommons in two sections of the same course taught by a single instructor. Section 1 had an enrollment of 120 students and Section 2 had 134 students. The class met in a large auditorium with a stage area at the front and seven tiers of seats with tables angling up to the back of the room (see Figure 5-3). Early in the semester, the students were organized into teams of 6-7 students who subsequently would sit together and spent considerable time working as a group. Both sections met on Mondays and Wednesdays, Section 1 in the morning and Section 2 in the afternoon.
Figure 5-3. ClassCommons in use, the dark rectangle under the video at the bottom of the display is the message line.

We selected this particular course as a venue for exploring ClassCommons usage for two reasons. One is that in large classes “feelings of disconnectedness are common among students” (Sanders, Basham et al. 2006). Toward the end of the semester, students still mentioned that “I had hardly known anyone outside of my group in such a big class”. We expected that enhancing students’ sense of community with their peers in a large class such as this might significantly improve the quality of their educational experience.

We deployed the system in the final week of class (during the first week of December 2008; Figure 5-3). Each section viewed their own and peers’ videos on two different days for periods lasting about 45-60 minutes. Across the two viewing days, there were 19 team videos viewed by the first section and 21 by the second.

Every student was given a login account. In this case, the login accounts were created specially to support the activity. However, there are about only 64 desktop computers in the
classroom. So students were encouraged to bring their own laptops or web-enabled mobile devices (iPhones, iPod touches, Blackberry phones, and so on) to class in order to participate.

During the class, students were invited to log in to the system using a classroom computer or any other device with web access. Once logged in, as the videos were played at the front of the classroom, students were able to post comments. In a few seconds, each comment would be displayed in order of submission. For this study, students’ names were determined through their logon process and appended to each comment. This was done to increase their sense of accountability for what they said.

**Data Collection**

We used multiple methods for data collection, including a pre- and post-survey, usage logs, and informal observations.

**Background survey**

An email invitation was sent to the students through the course’s roster before the video sessions were to begin. In the email, the ClassCommons project was introduced and students were invited to complete an online background survey; they were also offered extra credit in the course for agreeing to serve as research participants (all students were able to use the video commenting system regardless of their participation in the evaluation process). In this survey, information about participants’ age, gender, major, and year at the university were gathered. We also measured their sense of community before using the system (PreSOC). The background survey was closed the night before the video sessions began.
To assess SOC, we began with an established survey instrument (Peterson, Speer et al. 2008). The items we used can be found in Table 5-2. All rating scales in the survey were Likert-type scales, with participants indicating strength of agreement or disagreement on a 7-point scale (1: Strongly Disagree, 4: Neutral and 7: Strongly Agree).

Table 5-2. Sense of Community Scale

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need fulfillment</td>
<td>I can get what I need in this class.</td>
</tr>
<tr>
<td>Need fulfillment</td>
<td>This class helps me fulfill my needs.</td>
</tr>
<tr>
<td>Group Membership</td>
<td>I feel like a member of this class.</td>
</tr>
<tr>
<td>Group Membership</td>
<td>I belong in this class.</td>
</tr>
<tr>
<td>Influence</td>
<td>I have a say about what goes on in my class</td>
</tr>
<tr>
<td>Influence</td>
<td>People in this class are good at influencing each other</td>
</tr>
<tr>
<td>Emotional Connection</td>
<td>I feel connected to this class.</td>
</tr>
<tr>
<td>Emotional Connection</td>
<td>I have a good bond with others in this class.</td>
</tr>
</tbody>
</table>

Post-usage survey

After the video viewing and commenting sessions were over, students were invited to complete a second survey. This one measured their sense of community after using the system (PostSOC).

For the post-usage survey, the SOC items were modified slightly to refer to the video commenting system. For example, we asked: “The use of this video commenting system makes me feel like a member of this class”; “The use of this video commenting system helps me have a say about what goes on in my class” and “The use of this video commenting system makes me feel more connected to this class”.
Other information gathered in the post-usage survey included: their ratings of the video commenting system (Block 2005), their actual usage of this system and the usability of the system (Lewis 1995). We also included four open-ended questions, probing students’ feelings while they were using the system and suggestions for improving it. See Table 5-3 for details of the questions asked in the post survey.

Table 5-3. Questions asked in the post survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Reaction (URT)</td>
<td>I think the Video Commenting System …</td>
</tr>
<tr>
<td></td>
<td>1) is desirable.</td>
</tr>
<tr>
<td></td>
<td>2) is favorable.</td>
</tr>
<tr>
<td></td>
<td>3) holds my interest.</td>
</tr>
<tr>
<td></td>
<td>4) is valuable.</td>
</tr>
<tr>
<td></td>
<td>5) is helpful.</td>
</tr>
<tr>
<td></td>
<td>6) improves class participation.</td>
</tr>
<tr>
<td></td>
<td>(1: Strongly Disagree, 4: Neutral and 7: Strongly Agree)</td>
</tr>
<tr>
<td>Read</td>
<td>How many comments did you read?</td>
</tr>
<tr>
<td></td>
<td>(1: I did not read any of them, 3: I read some of them, 4: I read most of them, 5: I read every comment)</td>
</tr>
<tr>
<td>Attention</td>
<td>How much attention did you pay to the comments?</td>
</tr>
<tr>
<td></td>
<td>(1: Not any, 2: Little, 3: Somewhat, 4: Much, 5: A great deal)</td>
</tr>
<tr>
<td>Distracting</td>
<td>While I was watching the videos, I found the comments to be…</td>
</tr>
<tr>
<td></td>
<td>(1: Not Distracting at all, 2: Of Little Distraction, 3: Moderately Distracting, 4: Distracting, 5: Very Distracting)</td>
</tr>
<tr>
<td>Interesting</td>
<td>I think the comments posted to the system are …</td>
</tr>
</tbody>
</table>
(1: Not Interesting at all, 2: Of little interests, 3: Moderately interesting, 4: Interesting, 5: Very interesting)

| User Acceptance (UA) | 1) Being able to share my comments via the public display real time helps me better interact with my classmates.  
2) I would like to see the system used for more classes.  
3) I only need to watch the videos, I don't want to see other people's comments.  
4) I only need to watch the videos, I don't want to post my own comments.  
(1: Strongly Disagree, 4: Neutral and 7: Strongly Agree) |

Log data

All the comments students posted to the public display were logged on the server in order of their arrival. Each logged record included name of the author, the comment text, the video that had been in play when that comment was submitted, and the time a comment was posted. Note that because of the lag between when a comment was posted and the video program underway, an individual comment might refer back to video content not currently in view – even in some cases an entirely different video.

In-class observations

Observations were carried out during the class. Two researchers were in the classroom during all four video viewing sessions to observe the general characteristics of students’ use of ClassCommons. One researcher was in the front of the classroom and the other in the middle of the classroom. The researcher at the front was unable to see students’ screens or specific activity,
so could only gather general information about whether students were engaged in some activity at their seat or watching the video, and so on. The researcher in the middle had a better view of what was taking place at the students’ seats, but again could only gather relatively general observations.

**Results**

Our initial field trial of ClassCommons was successful. Students participated at relatively high rates and seemed to enjoy the experience. In the following we detail our findings with respect to the patterns of commenting, the content of the comments posted, and the consequences for SOC.

**Survey Results Overview**

We gathered several demographic variables: gender, age, year at the university and major. The survey result revealed that 72.7% (64) of our participants were male and 27.3% (24) were female. Most of them (92%) were between the age of 18 and 21. 5.7% (5) were aged from 22-25 and 2 (2.3%) were between 26 and 30 years old. 52.3% (46) were freshmen; 28.7% (25) were sophomore; 17% (15) were junior and 2.3% (2) were senior. In terms of major, 52.8% (46) were already declared as majors in IST. 47.7% (42) were majoring in other programs, typically either business or liberal arts (e.g., business management, marketing, health policy and administration, finance and Spanish). It is of particular interest to note the diversity in the population – although IST 110 is a course required of all new students in IST, it also can fulfill general university requirements. A positive side effect of diversity is that the resulting student sample is more general than we would find in a typical all-majors course.
As described in Date Collection part, the psychological variables we investigated were SOC (gathered both pre- and post- the viewing sessions) and their reactions to the video viewing system.

For PreSOC, the internal consistency was tested by computing Cronbach’s alpha coefficient which turns out to be 0.86. According to (Nunnally 1978), a value of over 0.5 is acceptable for a scale intended to measure a single psychological construct. We obtained a Cronbach’s alpha of 0.92 for the PostSOC items. The mean score of all the items was computed for each subject and assigned as his/her PreSOC and PostSOC scores. The Cronbach’s alpha coefficient for User reaction (URT) and User Acceptance (UA) is 0.93 and 0.84 respectively.

Table 5-4. Summary of the main variables measured in the pre and post survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean(S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreSOC</td>
<td>4.79(0.93)</td>
</tr>
<tr>
<td>PostSOC</td>
<td>5.08(1.05)</td>
</tr>
<tr>
<td>URT</td>
<td>5.17(1.26)</td>
</tr>
<tr>
<td>Read*</td>
<td>3.70(0.67)</td>
</tr>
<tr>
<td>Attention*</td>
<td>3.83(0.82)</td>
</tr>
<tr>
<td>Distracting*</td>
<td>2.90 (1.10)</td>
</tr>
<tr>
<td>Interesting*</td>
<td>3.61(0.90)</td>
</tr>
<tr>
<td>UA</td>
<td>4.80(1.29)</td>
</tr>
</tbody>
</table>

*: Measured on a 5 point scale. All the other variables are measured on 7 point scale.

Students’ SOC increased from 4.79 to 5.08. A detailed analysis on SOC is reported in the Sense of Community section in this chapter. Students showed high acceptance to the system (UA: 4.8(1.2)) and highly positive reaction to the system (URT: 5.17(1.26)). Students paid considerable attention (Attention: 3.83(0.82)) to the messages posted in the system and felt the messages posted in the system interesting (Interesting: 3.61(0.90)). Students’ feeling of distraction of the
system is 2.9, hovering around the level of moderately distracting. Table 5-4 showed details regarding the variables.

**Log data**

To examine general use of the system, we combined the data across the two sections, as initial summary statistics showed very similar patterns of use. We found that students participated at a high level: across the four video review sessions (about 250 minutes), students posted a total of 3115 comments. Averaging the comments across minutes available yields a commenting rate of approximately one comment every five seconds.

To examine breadth of participation, we examined the number of students who were contributing comments. Across the two sections, the number of students who enrolled in the study was 192. The log data revealed that 129 (67.2%) of these students posted comments, with an average of 24 comments each (the standard deviation was 32.57). However, the posting data were not normally distributed, as can be seen in Figure 5-4.

The distribution of the comments per student revealed a familiar exponential distribution (Figure 5-4): 20% of the most active participants contributed 80% of the comments and the remaining 80% contributed 20% (Du, Rosson et al. 2009).
Figure 5-4. The per-student distribution of comments

One factor that may have prevented some students from posting comments was the limited number of workstations in the classroom (in this setting 6-7 students must share two computers, and often at least one of the computers is not functional). Although students were encouraged to bring their own laptops or web-enabled mobile phones, not all chose to do this, and a number of students indicated that they did not participate simply because they could not access the system. Thus we expect that if there were more desktops in the classroom, the proportion of participating students would increase even further.

*Comment content*

On an initial survey of the comments contributed, we observed that most of them were short; the average length was 4.97 words (standard deviation was 3.79). The distribution of the length of the comments is not normally distributed, with median 4 and mode 1.
Internet shorthand was common. For example, acronyms like FTW(for the win), FTL(for the loss), ROFL(roll on the floor laughing), PWNED(previously owned), lol(laugh out loud), and similar abbreviations were often included in the comments. Also, many text-based emoticons (e.g., :(, >_<, (sad), and i<3) appeared in the comments.

To investigate the nature of the comments submitted, we conducted an informal content analysis. A card sorting approach was used. A researcher read through all the messages and labeled each of them. Finally, all the labels were clustered into four categories: content comments, theme comments, functional comments and spam. Content comments refer to messages that referenced specific content in the video, often raising questions or critiquing what the teams had produced. For example, “I like the Italian music”; “Did they have cell phones in Sparta?!?!”; “Why are they on their knees?” and “(It is) a bit disappointing after the intro.”

Theme comments reflected on the general video message – the videos had been created to demonstrate concepts learned and studied in the course’s team project. For instance, in one video that showed a concept for improving wireless security, a student commented “You don’t learn hacking from college. You learn it from shady websites and by not having a life.” Functional comments were requests directed to the teaching staff. For example, the comment “Need more volume and less blur” notified the teacher of sound problems in the back. Spam comments contained content that was irrelevant and even at times inappropriate. These messages are annoying and interfere with harmony and sense of community. For example, in the post survey one student said that “I was disgusted … for inappropriate comments not even remotely related to the videos or the class”.
Figure 5-5. Content Types

As seen in Figure 5-5, a large majority of messages were content comments (73%) that referred to specific details in the videos. Our informal observations indicated that a typical behavior was for a student to make a brief extemporaneous comment as he or she saw something in the video that caught his or her attention. It was interesting that these continued to be shared even though the specific feature observed tended to be transient and “in the recent past” by the time the comment appeared on the public display. Theme content comments were less frequent, perhaps because the videos were played non-stop, and more reflective comments tended to be overwhelmed by more specific reactions to the video underway.

The fact that there were so many spam comments in this classroom setting was surprising to us. We noted that spamming occurred most often when students thought the current video was boring. In this sense, the students seemed to be submitting spam messages to “vote against” those videos, and on occasion they seemed to be deliberately intended to provoke an individual or an
entire team. Some were even quite offensive, enough so that one or more students subsequently sent out an email to the rest of the class encouraging better behavior in the next class.

**Sense of Community**

We now turn to an exploratory data analysis of how system usage (posting or reading comments) might be related to psychological variables that are important to our design process (SOC and general reactions toward the system). Specifically, we examined the extent to which usage of ClassCommons might be related to increases in students’ SOC.

These questions were investigated using a series of correlational analyses of the survey data collected before and after the video sessions. These data were available for the 90 students who completed both the background survey and the post-usage survey. Two outliers were identified. They were identified as outliers based on the Z-score of their pre and post SOC score. The two outliers are deleted, so our analysis dataset included 88 participants.

In addition to the Read and Attention variable reported earlier, a third variable represented the percent of a student’s comments that were relevant to the course. To create this variable, one researcher read through each comment posted by a participant and classified it as 0: not relevant or 1: relevant. This classification borrowed from the earlier content analysis: comments in the content, theme or function categories, were counted as relevant. Other comments (spam) were counted as irrelevant. Using this classification, the percent of relevant comments posted by each student was calculated (e.g., 0.6 means 60% percent of the comments were relevant to the videos or relevant to the class). This measure was constructed only for 129 students who posted comments. The mean of the variable Percentage of Relevant Messages is 0.71, and the standard deviation is 0.34.
Changes in SOC

A focus of this study to explore whether the use of ClassCommons would facilitate classroom community building, so in this part the analysis on SOC is reported.

A paired-sample t-test was used to compare students’ PreSOC and PostSOC, comparing the means for the 88 students who completed both versions of the survey. This contrast revealed that students’ SOC did increase significantly after using the ClassCommons system (mean PreSOC: 4.79, mean PostSOC: 5.08; t(89)=-2.96, p<.01; see Table 5-5).

Table 5-5. Comparison between PreSOC and PostSOC

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>PreSOC</th>
<th>PostSOC</th>
<th>t-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>88</td>
<td>4.79</td>
<td>5.08</td>
<td>2.96</td>
<td>.01</td>
</tr>
<tr>
<td>Non-posting Group</td>
<td>39</td>
<td>4.7</td>
<td>5.0</td>
<td>1.79</td>
<td>.08</td>
</tr>
<tr>
<td>Posting Group</td>
<td>49</td>
<td>4.86</td>
<td>5.15</td>
<td>2.38</td>
<td>.02</td>
</tr>
</tbody>
</table>

As a secondary analysis, we divided the 88 participants into two groups, according to whether or not they had posted comments. The log data revealed that of the 88 students who agreed to be research participants, 39 never posted a comment and 49 did. A repeated measures ANOVA on students’ SOC in the two groups was performed. It revealed a significant effect of time, $F_{1,86} = 8.56$, $p=.004$($p<.01$), namely PostSOC is significantly greater than PreSOC. The effect of group was not significant, $F_{1,86} = .57$, $p=.45$, which indicates that whether students’ posted messages or not does not influence students’ SOC. Finally, the interaction effect was not significant, $F_{1,86} = .0001$, $p=.999$.

Exploratory Analysis of SOC

Beyond noting that the video commenting activity increased students’ SOC, we wanted to explore more carefully whether and how students’ usage patterns were related to felt SOC.
Thus we used multiple regression procedures to explore the relationship of reading and posting behaviors to the PostSOC (Pedhazur 1997). Because many of the predictor variables are correlated, we used stepwise regression; in this approach multiple dependent variables are used to predict a single outcome variable, and are added to the model only when they account for variance not already accounted for by other variables.

The design goal of ClassCommons is to promote interaction among students by having them share their thoughts and comments about what they are viewing. Thus we expected that simply reading the comments should have a positive impact on SOC. We also expected that students with higher PreSOC will have a higher PostSOC after using this system given the interactions afforded by this system. As a result in this model PreSOC was used as a control variable to account for initial differences in SOC among students. The regression analysis supports our hypotheses as shown in Figure 5-6, where the arrows are used to indicate significant predictors in the regression equation and the numeric annotations the value of the standardized Beta or regression equation coefficient. The $R^2$ value indicates the percent of variance in PostSOC that is accounted for by this two-variable regression model depicted in the figure. The pattern indicates that even after controlling for initial variation in PreSOC, the extent to which students paid attention to the comments (recall that this was a self-reported variable on a scale from 1-5) was predictive of their PostSOC.
A secondary exploratory regression examined the patterns of reading and posting for only the subset of 39 students who did post comments. In this case, we included a third predictor variable, the percent of relevant comments posted (relevance is determined by whether the comment has some relation with the video or not as defined above). As shown in Figure 8, all three variables had significant and independent relationships with PostSOC. Of particular interest to us is that students with the greatest proportion of relevant comments reported the highest values of PostSOC. This suggests that community members may increase their sense of community through contributions of meaningful comments. Of course we recognize that these are correlational analysis and a competing explanation is that students who are generally higher in SOC are more likely to post comments. However the fact that the SOC increased over the activity gives credence to the first interpretation.
Figure 5-7. Students who Posted Comments PreSOC, and Reading on PostSOC

The path model analysis indicates that students’ PostSOC is not only influenced by their PreSOC but also influenced by how often they read the messages posted in ClassCommons. Students who read more of the messages tend to have higher PostSOC. In addition, for students actually posting messages in ClassCommons, the percentage of the relevant comments is a positive indicator of their PostSOC. The results suggest the importance of the quality of the contents in fostering students’ SOC in classrooms.

**User Experiences**

We have described initial findings that emerged from the logged comments and the survey. The open-ended questions in the post-usage survey provided an opportunity for students to describe their own feelings, attitudes and understandings of the system in their own words. In this section, we summarize students’ answers to these questions, with an intention to provide rich description of participants’ attitudes and behaviors involving the ClassCommons system. These data help to explain, confirm, reflect on and augment the regression models presented above.
Having Specific Goals in Posting

Enticing people to take the initiative to interact with public displays has been a major barrier in designing interactive public displays (Agamanolis; Agamanolis 2003). The reasons for this are various. The usability of the system, the novelty of the application, the presence of encouragement, and the nature of how the tool is introduced or demonstrated – all of these may play a role in usage decisions (Churchill and Les Nelson 2003). However, we suggest that people who choose not to participate in the interaction may be evidence of selective behavior arising from a lack of motivation or goals related to the new interaction (Becklen and Cervone 1983; Carter, Mankoff et al. 2002).

In our case, most of the students reported specific goals related to posting. For example a common report was that they posted comments to discuss the quality of the videos, so as to provide feedback to their peers. For example: “My goal was to let people know what I was thinking about the videos and this system allowed the whole class to understand my thoughts”; “My goals was to compliment the groups of aspects of the project that they did well and to give advice on how they could have been improved”; “My goals was to make intelligent comments about the videos”. This is consistent with the fact that most of (73%) comments are reactions to video content (Figure 5-5).

From these responses, we argue that if a public display tool or related activity design can clearly convey its goals to potential participants, they will be more likely to engage in public display interactions.
Increase Interaction between Students

Students’ answers to the open-ended questions consistently reflected their engagement with the ClassCommons and an increased interaction between students. “(I felt) intrigued”; “It added some fun to the class so I enjoyed it”; “It was an interesting way to go about watching the videos. I found it to be a lot more fun than just sitting there watching videos. It got people to interact and be awake and alert”; “It was fun and entertaining. There was a lot of interaction between students”; “I felt a connection between classmates”; “I felt like a contributing member of the class”; “I felt like I was bigger part of the class than normal”; “I felt like it allowed the class to become more personal since we could share our opinions and see what others were thinking”; “It seemed fun. I really like that it was real time. It just made the environment seem fun to interact with everyone and everyone in the class could see it”. The interpretation of these comments is simple and self-evident, namely that the more engaging the content or class activity can be made to seem, the more likely students will contribute comments.

Students Felt More Empowered

According to McMillan, to build a sense of community, it is important that the community members can have some way to honestly present their feelings to others(McMillan 1996). Students consistently reported that the use of ClassCommons system made it easier for them to speak their opinions to the whole class. “I feel like I could add my opinions to the group and to the class. It was great”; “It’s hard to talk aloud and express your opinions(in class), but over the video commenting system, it makes it much easier and more convenient”; “I felt like my opinions was more widespread and expressed to everyone”; “I felt more empowered. It felt less like I was anonymous in a huge cybertorium, but that I was a contributor to the class”; “I felt
more empowered, like I could have my opinion heard”; “I feel free to put anything down”; “I felt like I had a voice in the class, and my thoughts were expressed on the video.” These comments emphasize the potential for a system like ClassCommons to provide an alternate channel for expressing course-related ideas or reactions. We were particularly interested to see these comments in this large-class setting, because it was a primary goal for providing the public commenting facility in the first place. We were also interested in these reactions in light of the non-anonymous nature of the comments (recall that each was prefaced by the student’s name): students can receive social credit for their contributions but also are accountable for contributions that are irrelevant or even inappropriate.

**Students Learned Something New**

Some students reported that they learned something new by reading others’ comments. For example, “Some comments helped further explain or enforce what was being seen in the videos”; “by reading those posted, I got a glimpse of how some people think, i.e. how their minds work and how they process what they see”; “People noticed a lot of different things than I did when we were viewing it, or used terminology I didn’t know, so when I went home I looked up anything I could remember”; “A few people commented on the user of copyrighted songs in our videos, which made me think about my business law class”; and “There was a comment about the terrorism video that made me think more deeply into the meaning of the video itself”. This is complementary to the experience of empowerment felt by contributors, in the sense that these specific comments or reactions seemed to enrich the ideas and content presented to students in this educational context.
Self-organized Counter-Spam Actions

As reported earlier, 19% of the comments were spam messages. Not only were we surprised by this (given the non-anonymous postings), but also students expressed their opinions on the spam messages. “I felt sort of uncomfortable because of the inappropriate comments that people were posting”; “I was ... scared to post commentaries in “improper English way” and perhaps be a subject of mean commentaries to my person from other students”; “I felt a little bit of frustration from people using the system as a way to mock people”.

We were also delighted to see that a few students took the initiative to fight against the spam messages. During the video reviewing sessions, if a number of spam messages started to appear, one or more individuals would take a stand, posting messages trying to stop the spammers. Some of these messages were directed at a particular individual, e.g., “xxx, stop posting!”; “seriously, 3rd row, stop playing now”. Some messages were also posted at the beginning of the video playing session to remind people not to post spam messages. For example, the message “Good comments only” appeared at the very beginning of the second video reviewing session for one section, and the comment “Keep it clean” appeared at the beginning of the other section’s second review session.

In the post-survey, one student stated explicitly: “My goal was to antagonize other commentators because they were simply wasting space on the screen/time”. Interestingly, it is possible that this student might never have participated at all if all of the comments had been useful, because his/her orienting tendency might have been one of policing or maintaining an effective community.

Our informal scanning of the log data suggests that these counter-spamming behaviors did have some effect in stopping spamming. However such effects were not long lasting. In future,
especially in public places, some external spamming controlling mechanisms (e.g., automatic filtering, moderation) are needed.

Summary

To conclude, we have shown the great potential of the public commenting idea in classrooms to facilitate classroom community building. The regression models show the dynamics of how students’ sense of community is influenced during the process and confirm that students’ sense of community increases in using the system, e.g., reading the comments and posting relevant comments instead of spam messages. In addition, students gained a new learning experience by using this system. We showed that the commenting idea can provide added value for public display applications, which open a new chain of thoughts in the field of interactive public display research. We have also learned some lessons from this initial deployment experience, including the necessity to deal with spamming, and the need for a deeper investigation of the offline interaction that maybe afforded by the public display interactions.

However, the challenge is how to apply the public digital backchannel idea into general classroom settings. In this study, students were using ClassCommons during the video viewing sessions. How could ClassCommons be used in more general classroom settings, where a lecturer is talking while other students are listening? How to sustain students’ engagement and participation in the many different activities and topics that arise during an 18-week course? In this study, students were posting using their real name, what would happen if they are allowed to post anonymously? With these questions to be addressed, we conducted another long-term study to evaluate the effectiveness of the public digital backchannel ideas in two undergraduate courses for an entire semester, which will be reported in the next chapter.
Chapter 6

ClassCommons for the Entire Semester: A Long-term Study

In prior work we have demonstrated that teachers can organize an event and use some technology tool to increase students’ participation and sense of community. For example, in (Du, Rosson et al. 2009; Du, Rosson et al. 2009), the instructor organized a video viewing session, and used the ClassCommons video commenting system with which students were able to post their comments on the videos as they were watching the videos; the comments appeared on the public display below the video in real time. We found that students used this tool to make comments, raise questions, provide feedback to the teachers and interact with each other. We also found that students’ sense of community was increased after the activity and that the increases appeared to be associated with active use of the commenting system.

However, an event like video viewing and commenting would normally take place over a limited period of time (unless the class topic was one such as the history or aesthetics of video as a communication channel). Thus for educators, a more challenging practical question is how they might engage and sustain students’ participation in the many different activities and topics that arise during a semester-long (e.g., 18 weeks) course (Du, Rosson et al. 2012).

My second evaluation of ClassCommons focused on the longer term effects of using a backchannel commenting system in a classroom setting. In this study the goal was to bring students’ backchannel discussions “up front”, to provoke more students to participate in class discussions and interact more with each other. As in the shorter term study, another goal was also to enhance students’ sense of community within their classroom.

In this second study, students were able to post their questions/comments during any class. In the meantime, the message will be displayed on the public display in the front the
classroom, viewable to all the people. The teacher in the classroom may choose to reply by posting a comment him- or herself, or by addressing it verbally to the whole class. Other students can also reply to previous comments or add new comments as desired.

As a concrete but hypothetical example of use, consider this ClassCommons design scenario: Jane finds that she does not quite understand a concept just discussed in class, but she is too shy to raise her hand. Instead she uses ClassCommons to post a question. The teacher then addresses the question orally; meanwhile other students contribute to the discussion by posting their own thoughts on the public display. They can easily initiate in-class interactions and they can appropriate the use of the system as they wish.

In the following sections, I will first report the design process that produced the public backchannel version of ClassCommons, the research questions addressed in the semester-long study, and the methods, findings and implications of the field trial.

**Design of the ClassCommons Public Backchannel System**

**The Design Rationale**

Using ClassCommons to support a semester long course is different from the video viewing study reported in Chapter 5. First, the public display might not always be available. In university courses, power point is the most widely used presenting technology. The instructor usually uses the public display to project the power point slides. Second, instead of displaying each message for a few seconds, it is more desirable to display the messages for a longer period of time. The goal of ClassCommons is to support class discussion, if the messages are only displayed a few seconds, the ephemeral nature makes it a less effective tool to support class discussion because a) if other students and teacher/TA are focusing on other things happening in
the class, the messages will never be noticed, b) to get discussions going, it is necessary for the teacher/TA and other students to find the context of conversation by being able to look at the history messages, c) if some messages are worth discussing, the teacher might need to refer to it on the public display.

Having considered the differences, a new design idea to support using ClassCommons in semester long courses was proposed. It is argued that setting up a separate public display, which is dedicated to display the messages posted in ClassCommons, will be able to address the challenges discussed above. There are several benefits with using a second display in the classroom. **First**, in this way the instructor can use the one display to project the power point slides and use the second public display to show ClassCommons contents. **Second**, instead of just having a ticker space on the public display, in the new design a whole public display is dedicated to displaying ClassCommons content and more information could be displayed here. Students can post longer messages, and even videos or images. Allowing students to post videos or images might be able to enrich the class discussion. The adage "a picture is worth a thousand words" suggests the power of pictures in conveying complex ideas. Students can post images or videos that are related to course subject to enrich the course content and discussion. **Third**, on the public display the history messages can also be displayed, which helps to provide more context information to support class discussion.

Threading is another important feature to be included in the public digital backchannel system. From the video commenting study, we found that students were conversing with each other on ClassCommons. However, since the messages were posted independently, it is hard to identify the messages that were in the same thread. By allowing students to reply to the messages already posted, messages that are in the same thread will come together naturally. It would be easy for students to digest the conversations later.
Finally, voting is another feature included in the new system. Students can simply click a button or link to vote for a message posted by other students. It is a light way to participate in the ClassCommons discussion and could potentially differentiate the good contributions (for example, good questions, things that need to get more people’s attention, insights etc.) with those that are not so good.

Public Anonymity and Private Accountability (PAPA)

In the video commenting study, students’ real names were displayed on the public display along with the messages posted. As analyzed in the Design Rationale section in Chapter 5, there are both benefits and drawbacks with displaying students’ real names and allowing students to post messages anonymously.

To investigate students’ preferences regarding using real name or posting anonymously, a pilot study was conducted in a senior undergraduate course in the spring semester of 2010. The course used was IST413, a project-based usability engineering course in the College of Information Sciences and Technology at Penn State University. IST413 had 45 students; 40 were males, 5 were females. The class met in a large classroom for 75 minutes on Mondays and Wednesdays. The instruction was delivered in workshop style, with participation by teacher and students.

A prototype of the ClassCommons system was developed and used in IST413. In the initial system, students’ real names were displayed on the public display. After using it for 10 weeks, a focus group interview was conducted to collect students’ feedback on ClassCommons and a focus of this interview was regarding their feelings about displaying their real name on the public display and how it would influence their participation in ClassCommons discussion.
Eight students participated in the focus group; one female and seven male students. Two were active users (posting>15); three were modest users (posting<10); and three had never posted messages. The focus group lasted about 30 minutes. Generally, students found ClassCommons to be entertaining and to enable communication with teacher.

The results showed that students have concerns about displaying real names but also mixed feelings about being anonymous: Students have mixed feeling about having their names displayed along with their comments. “For people who are shy, they do not want to post with their names on there”. However, posting anonymously also “makes more mischief”. Anonymous posting is not appealing to students who want to have their names displayed. “You have no incentive to watch what you write”. A detailed report of the pilot study could be found in (Du, Jiang et al. 2010)

To address students’ concerns regarding displaying real names but also at the same time reducing the level of mischief students might make in complete anonymous mode, the public anonymity and private accountability (PAPA) feature is suggested. Students can choose whether to use their real name or use an alias when posting a message. Even when the student uses an alias, the teacher can still track who the real person is. This PAPA feature could ensure that students can maintain public anonymity from other students but still could be held accountability by the teacher.

**The ClassCommons Public Backchannel System**

Based on the design rationale discussed above and the pilot study investigating students’ feelings towards using real name and alias, the new ClassCommons public backchannel system was developed. In this section, the detailed design of the system will be reported.
Following the system architecture reported in Chapter 4, and considering the design rationale discussed above, the ClassCommons public digital backchannel was implemented. Any device with access to the Internet can be a client. To contribute, students log in to a posting website (Figure 6-1) with their university account and credentials. Students can post text messages, images and Youtube videos from the client interface. Students can choose to post with their real name or use an alias at the point of posting. The messages student posted are further displayed on the public display in the front of the classroom. Students can reply to messages already posted on the client interface as well as like particular messages. The number after Like on Figure 6-1 indicates how many students have liked that message.

The contents posted will be displayed in real time on the public display, viewable to all the students as well as the teacher in the classroom. In this prototype, the messages are displayed in a “First In First Out” (FIFO) fashion, namely the messages posted earlier will be displayed first. The latest messages will be displayed at the top the public display with a red new icon in the front. Whenever a new message is posted, the old messages will be pushed downward. If a video or image is posted, the video/image will be displayed at the right side of the display. The instructor can further decide whether to play the video or not in the class. Figure 6-2 shows the layout of the public display.
Figure 6-1. Client Interface of ClassCommons in the Long-term Study

Figure 6-2. Public Display View of ClassCommons in the Long-term Study
Research Questions

Previous studies have found that public backchannel tools can increase students’ in-class participation and initiatives. For example, earlier studies on ClassCommons showed that it could increase students’ participation in video viewing events (Du, Rosson et al. 2009; Du, Rosson et al. 2009). Fragmented Social Mirrors (FSM) (Bergstrom, Harris et al. 2011) is a tool that was investigated as a public backchannel in classrooms. Students can post messages during the lecture; they can also indicate whether the message is a question, or if they simply want the instructor to slow down. The message is projected on a separate screen in the classroom. The system was tested in 6 class sessions (3 of them used FSM and the other 3 did not use FSM) and found that FSM encouraged students’ initiatives in classrooms. The Harvard Live Question Tool allows students to submit answers to questions that are raised by the teacher; the answers are displayed publicly in the class. No formal evaluations have been conducted to study the impact of this tool, although it has been recommended by Educause as an effective way to encourage students’ participation and students-teacher interaction (EDUCAUSE 2011).

The studies cited above have evaluated the effects of classroom backchannels, but only for a limited period of time (usually 1-2 class periods), leaving longer-term impacts unknown. Second, it is not yet clear what factors may influence students’ willingness to adopt such tools in their classes. Thirdly, although researchers have discussed the advantages of using public backchannels in classrooms, less attention has been paid to the potential problems with such technology. The study summarized in this chapter aimed to address these research questions, drawing from a long-term implementation and deployment of a classroom public backchannel tool in two classes. The study addressed several exploratory research questions:

RQ1: What are the factors that influence students’ adoption of this kind of tool?
RQ2: What is its long-term impact on students’ sense of community?
RQ3: From both teachers’ and the students’ perspectives, what are the benefits and drawbacks of tools of this kind in classrooms?

The Field Study

The Classes: Project Management & HCI

ClassCommons was used in two classes for 15 weeks in the fall 2011 semester, from Aug. 29th to Dec. 9th, in College of Information Sciences & Technology at Penn State University. One class was about project management (IST302) and had 67 students, with 16 females and 51 males. IST302 met twice a week on Mondays and Wednesdays for 75 minutes each time. The teacher for IST302 was a senior instructor teaching this course for the third time.

The second class was about human computer interaction (IST331) and had 50 students, with 7 females and 43 males. IST331 met three times a week on Mondays, Wednesdays and Fridays for 50 minutes each time. The instructor of this course was a junior instructor teaching IST331 for the first time.

Students in both classes were juniors and seniors, and 4 males and 1 female were enrolled in both classes. Both classes are required for all students in the undergraduate major program. At the start of the semester, students were offered up to two extra credit points for participating in the study; as in the earlier study, this offer was made at the time that they were invited to complete a background survey. The amount of extra credit they received was determined by their level of participation (the number of messages posted), and this incentive was communicated at the start of the project. Points awarded was determined after the end of the study, based on the distribution of participation. Students who posted at least 10 messages received 2 points. Those who posted between 5 and 10 messages received 1.5 points. The rest of the students received 1
point. Students were not required to participate in the research study to gain access to ClassCommons, but the analyses reported here are based on the activities of only those who did volunteer to participate.

We chose these two courses as testbeds for ClassCommons for two reasons. One is that like IST110, both courses are mid- to large-size classes where “feelings of disconnectedness are common among students” (Sanders, Basham et al. 2006). Thus we again hoped that by building a sense of community among students we could improve the quality of their educational experience. The second reason was more pragmatic – these two courses were taught in classrooms where every student had a laptop or workstation to use during the class, making it possible for every student to interact with ClassCommons if/when desired.

Figure 6-3 shows the setup of ClassCommons in the two classes. The larger public display on the left in each case was used by the teacher to project lecture slides; the second smaller public display on the right contains the content posted through ClassCommons. The public display was 5’ (width) x 6’ (height); the actual “display” was created by projecting a video output from the experimenter’s laptop to a video projector system that was aimed at a portable screen. As a result the resolution of the display was less than a standard display output system, so
we used pilot testing in the two classrooms to ensure legibility of the font from all seat locations in the rooms.

The instructors chose to use different policies regarding the use of ClassCommons in their classes. Before ClassCommons was used in the two classes, it was made clear to the instructors that ClassCommons was designed as an option to facilitate classroom communication and it is up to the instructors to decide when they want to use it and how they want to use it. The instructors welcomed the use of ClassCommons in their classes and let their teaching assistants (TAs) monitor the system and respond to the questions during the class. They also said that they would look at the messages posted on ClassCommons during the class. However, the IST302 instructor allowed no posting of entertaining messages or any message unrelated to class content because he was concerned that messages of that sort might distract students from the lecture. He announced this the first day ClassCommons was used in IST302. In contrast the IST331 instructor had no constraints and welcomed any content. He did this because he wanted more students to participate and wanted them to participate freely. This difference in usage protocol had consequences for how students used ClassCommons during the semester and we will report this in the result section.

Data Collection

We used multiple methods for data collection, including a pre-survey (before using ClassCommons), a mid-survey (about half way through the semester) and a post-survey (at the end of the semester). We also archived the ClassCommons usage logs, conducted a small set of interviews and recorded informal observations.

One of the focuses of this study was to investigate how students’ sense of community was influenced by using ClassCommons, so students’ sense of community was measured. For this
construct, instead of using the SOC scales in the video commenting study, we adapted an existing scale of seventeen items (Rovai 2002; Peterson, Speer et al. 2008). Peterson, Speer and McMillan’s scale was developed to measure people’s sense of community in their neighborhood (Peterson, Speer et al. 2008) and consequently the context of their SOC scale differs from the context I am investigating, especially on the sub element of need fulfillment. In their SOC scale, the questions on need fulfillment is very general (for examples, questions are like 1) I can get what I need in this class; 2) This class helps me fulfill my needs). It is argued that to precisely assess students’ SOC it is necessary to ask questions more directly relevant to the classroom context. For example, in classes students’ main needs would be their need for learning. On the other hand, there are no existing SOC scales that are for measuring students’ classroom SOC. The most relevant learning related SOC is Rovai’s SOC which was developed to measure students’ SOC in distance learning courses where students were distributed all over the world. But Rovai’s scale provided some good measurement of students’ feeling of need fulfillment. Based on these thoughts, we adapted Peterson, Speer and McMillan’s and Rovai’s SOC scale.

The SOC scale we developed has 17 questions. Example items were: “I feel that I am encouraged to ask questions in this class”; “I feel that I belong when I am in this class”; “I have a say about what goes on in this class”; and “I feel connected to the class”, covering the four dimensions of sense of community, namely fulfillment of learning need, membership, influence and shared emotional connection (Peterson, Speer et al. 2008). We assessed scale reliability with Cronbach’s alpha coefficient, which was 0.88 for the PreSOC data. According to (Nunnally 1978), a value of over 0.5 is acceptable for a scale intended to measure a single psychological construct.

Since in this study another focus was to research into the factors that influence students’ adoption of ClassCommons, we added some new questions which were not asked in the video commenting study. It includes a set of background characteristics for participating students. We used the subsequent surveys to assess potential changes in sense of community as well as to
examine students’ perceptions about the system and about their course efficacy as individuals and as a class. We now describe the measures in more detail; refer to Appendix C, D and E for the survey items.

Pre-survey

Before ClassCommons was introduced, students were invited to complete a background survey. They were offered extra credit at this point for agreeing to serve as research participants (all students were able to use ClassCommons regardless of their participation in the evaluation process). We gathered information about participants’ interests in interacting with the instructor and other students and their experiences with using social media tools like Facebook, Twitter and online discussion forums were gathered. We used 7-point Likert scales from prior research to measure personal variables, including Extroversion, classroom anxiety (CAnxiety) and public speaking apprehension (PApprehension) (Bendig 1962; Wrench, Richmond et al. 2001; Rovai 2002).

Because we were particularly interested in how ClassCommons might affect students’ feelings of connectedness with one another, we measured sense of community at multiple points including prior to ClassCommons use (PreSOC).

Mid-survey

At the beginning of the seventh week, students were invited to complete another survey, where we again measured sense of community (MidSOC). We included other measures in this survey as well but because of the considerable variability that seemed to be due more to the
course differences than to the overall usage patterns, we did not include those measures in this analysis.

Post-survey

At the end of the fifteenth week, students were invited to complete another online survey. Once more we assessed sense of community (PostSOC).

We probed reactions to the messages that had been posted: the relevance of the content (Content Relevance); the extent to which the student feels s/he can learn something new from the messages (Learn New Information); and general interest (Interest). These three judgments were made on a 7-point scale from 1: not at all to 7: very much. We also asked students to which degree they felt that ClassCommons was a distraction in the classroom (Distraction). This judgment was made on a 5-point scale from 1: Not distracting at all, to 5: very distracting. Finally, we used two open-ended questions to probe students’ general feelings about ClassCommons, namely what they liked most about and least about it.

The post-survey also asked students to report how much attention they felt their instructor had paid to the messages posted on ClassCommons during the semester (Teacher Attention; from 1: none to 5: very much). At this point, we also gathered self-reports about Use of ClassCommons. We did this with three 5-point Likert scale items (Cronbach’s alpha= 0.74). The questions were “How often did you glance at the public display for ClassCommons in the class?”; “How often did you check the ClassCommons system on your own workstation in the class?” (1: Never, 5: Very often) and “How many messages did you read?” (1: I did not read any of them, 5: I read every comment).

To investigate relationships between ClassCommons and class performance we assessed students’ feelings of efficacy in the class, both for themselves and as a collective. Self-efficacy is
the belief that one is capable of performing in a certain manner to attain a certain set of goals (Bandura 1977); it is a strong predictor of people’s actual performance (Bandura 1977). In this case we developed four 7-point Likert scales to assess self-efficacy in the context of the classes the students were taking (Cronbach’s alpha= 0.73). Example items were: “I can have an impact on class discussions, even though I am only one member in a relatively large group of students.”; “Even though I may have trouble at first, I can master the concepts that come up in this course”.

Collective-efficacy is similar to self-efficacy but refers to beliefs about joint endeavors and joint outcomes (Goddard, Hoy et al. 2004). It was measured using six 7-point Likert scales that we designed for this study (Cronbach’s alpha= 0.90). Example items were: “OUR CLASS can ensure that all members’ ideas are considered, even if one idea does not seem to fit”; “OUR CLASS can ensure that everybody gets a chance to contribute to discussions, even though we are not all comfortable speaking up”.

Finally, we included a measure of Social support to investigate how students’ class-specific social networks might relate to the other variables being assessed. Social support is defined as feeling that one is cared for by and has assistance available from other people and that one is part of a supportive social network. Students’ feeling of social support was measured using six 7-point Likert scales developed for this purpose (Cronbach’s alpha= 0.81). Example items were: “If I wanted to do some extra studying for a quiz, I would have a hard time finding someone to study with me”; “If I wanted to form a small reading group to study for this class, I could easily find others to join me”.

Log data

All the messages students posted to the public display were logged on the server. Each message logged included the author, the time the message was posted, the message text and any
image or video attached. We also logged the “Likes” submitted by students regarding other messages, as this can be considered as a lightweight and generic anonymous posting.

**Interviews**

At the end of the semester, 10 semi-structured interviews were conducted to understand students’ and teachers’ (the instructors and the TAs) feelings about using ClassCommons. Six students, two instructors and two TAs were interviewed. The interviews lasted from 20 to 30 minutes. Five of the students were in both classes; one was enrolled in IST331 only.

We selected the dual-enrolled students because they could provide us a rich understanding of possible differences between the two classes, including whether and how such differences might have influenced their use of ClassCommons. In addition, these 5 students used ClassCommons to different extents. Some posted more than 50 messages while others posted fewer than 10. The sixth student was selected from IST331 because he used the system frequently and in many different ways.

During the student interviews, we asked about motivations for using ClassCommons, perceptions of benefits and drawbacks of ClassCommons, and the differences if any that they perceived between IST302 and IST331 (except for the sixth student); we also asked for suggestions about how to improve ClassCommons. In the interviews with the instructors and TAs, we asked about perceived benefits and drawbacks of ClassCommons.

**In-class observation**

Observations were carried out during the class. One researcher was in the classroom observing students’ use of this system during the whole semester and some informal notes that
aimed to connect messages posted in ClassCommons with things happened in the class. This was used to provide context information for researchers when analyzing the messages later.

**Results from the Long-term Study**

We gathered a variety of data, much of it obtained through the pre- and post-class surveys. In some cases we repeated scales from one survey to the next. In presenting our findings, we first give an overview of measures from two surveys that form the basis of the multivariate analysis reported later; we also summarize the ClassCommons usage data. We then provide a more detailed discussion of differences between the PM and HCI class, exploratory regression analyses of ClassCommons use, and a content analysis of the messages contributed by students.

**Overview**

ClassCommons was used in both classes for 15 weeks. Before the class starts, I set the ClassCommons system up on a second public display. During the class, the TA kept monitoring the messages posted on ClassCommons and the instructor looked at the messages posted on ClassCommons from time to time. One of the researchers was in the classroom observing and taking notes. ClassCommons was first introduced on Aug. 29th, 2011. I demoed the ClassCommons system on that day in both classes, showed them how to use the system and answered their questions. The first class session was used for familiarization with ClassCommons, so messages posted on that day are not included.
**Background measures**

Students rated their use of social network sites like Facebook, micro-blogging like Twitter and online forums (1: never use, 2: few times a year, 3: few times a month, 4: few times a week, 5: everyday, 6: several times a day). Most students used social network sites (SNS) like Facebook often, with 76.3% of the students in PM class and 88.5% of the students in HCI class reporting that they use Facebook at least once a day. In contrast, micro-blogging is not as popular, with only about 20% of the students using a tool like Twitter every day (PM: 20.4%, HCI: 22.9%). Reported use of online forums was even more rare.

Table 6-1 summarizes variables measured in the pre-survey that were used in the analysis reported in Section 6.3. As the means suggest, students reported being moderately interested in having interactions with the teacher and other students (a bit higher than the neutral point of 3.0 on a 5 point scale). With respect to the personal variables, the mean values suggest that these students are somewhat extroverted (just above the mid-point of the 7-point scale), not particularly anxious about being in the classroom, and a bit apprehensive about public speaking. The two classes do not differ on these variables.

Table 6-1. Analysis variables measured in pre-survey

<table>
<thead>
<tr>
<th>Variables</th>
<th>Class</th>
<th>Mean(S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest interacting with teachers</td>
<td>PM</td>
<td>3.69(0.73)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>3.77(0.65)</td>
</tr>
<tr>
<td>Interest interacting with students</td>
<td>PM</td>
<td>3.75(0.65)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>3.89(0.68)</td>
</tr>
<tr>
<td>Extroversion (index of 7 items)</td>
<td>PM</td>
<td>4.72 (0.44)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>4.68 (0.49)</td>
</tr>
<tr>
<td>Class anxiety (index of 20 items)</td>
<td>PM</td>
<td>3.26 (0.43)</td>
</tr>
</tbody>
</table>
Public speaking apprehension (index of 6 items)  

<table>
<thead>
<tr>
<th></th>
<th>PM</th>
<th>HCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=59 for PM; N=49 for HCI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The first two variables were assessed on a 5-point scale, the final three on a 7-point scale

End-of-semester measures

Table 6-2 summarizes the students’ self-report of ClassCommons use that were gathered at the end of the semester in the post-survey. The first three items in the table refer to students’ ratings of the content they had been viewing on the public display over the semester (i.e., did they like using it, was the content relevant, and did they learn new things from the posts). In general these ratings were in the positive direction (collapsing across classes, each rating is significantly greater than the neutral value of 4.0, p<.001). At the same time, we can begin to see some possible differences between the two classes, with the HCI class reporting a higher value for Interest in ClassCommons than the PM class (t(92)=2.06, p<.05). A similar difference emerges in the judgments concerning how much attention the instructor paid to the system (t(91)=4.0, p<.001). Although we have no other measures of teacher involvement in ClassCommons, it seems that at least from the student perspective there is a difference in how the system was experienced across the two classes. The informal observations noted by the researcher while in class were consistent with this impression.

Table 6-2. ClassCommons use measures from post-survey

<table>
<thead>
<tr>
<th>Variables</th>
<th>Class</th>
<th>Mean(S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>HCI</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Interest</strong>*</td>
<td>4.89 (1.16)</td>
<td>5.38 (1.10)</td>
</tr>
<tr>
<td><strong>Content Relevance</strong></td>
<td>4.66 (1.14)</td>
<td>4.48 (1.24)</td>
</tr>
<tr>
<td><strong>Learn New Information</strong></td>
<td>4.98 (1.09)</td>
<td>5.10 (1.21)</td>
</tr>
<tr>
<td><strong>Distraction</strong></td>
<td>2.13 (0.76)</td>
<td>2.34 (0.98)</td>
</tr>
<tr>
<td><strong>Teacher Attention</strong></td>
<td>2.94 (1.0)</td>
<td>3.75 (0.9)</td>
</tr>
<tr>
<td><strong>Use of ClassCommons</strong></td>
<td>3.16 (0.63)</td>
<td>3.42 (0.83)</td>
</tr>
</tbody>
</table>

*N=53 for PM; N=41 for HCI. The first three variables were assessed on a 7-point scale, while distraction, teacher attention and system use were on a 5-point scale

* difference between classes is significant, *p* < .05

** difference between classes is significant, *p* < .01

Students did not find the presence of the ClassCommons in the classroom to be distracting (collapsing across classes, the rating is significantly less than the mid-point value of 3.0, *t*(92)= -8.87, *p* < .001).

We also asked more directly about use of ClassCommons. As explained earlier, the index in the table combines students’ estimated frequency (on a 5-point scale) of glancing at the public display, checking in on the system using their own computer, and reading the displayed messages. The average value is greater than the mid-point of 3.0 (*t*(92)=3.6, *p* < .001). While there is a trend for the self-reported frequencies to be higher for the HCI class than the PM class, this difference falls sort of significance (*t*(91)=1.67, *p* < .10). Nonetheless, in combination with the contrasts of
liking and teacher attention, these data suggest that system use and acceptance varied across the
two classes. We will return to this point later.

Table 6-3 summarizes the psychological variables measured in the end-of-semester
survey, all measured on 7-point rating scales. A scan of the means suggests that perceptions of
social support from other students, and both self- and collective-efficacy are moderately high but
that they do not vary across classes.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Class</th>
<th>Mean(S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Support (index of 6 items)</td>
<td>PM</td>
<td>5.41 (1.08)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>5.23 (0.72)</td>
</tr>
<tr>
<td>Self-efficacy (index of 4 items)</td>
<td>PM</td>
<td>5.57 (0.75)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>5.56 (0.82)</td>
</tr>
<tr>
<td>Collective-efficacy (index of 6 items)</td>
<td>PM</td>
<td>5.48 (0.86)</td>
</tr>
<tr>
<td></td>
<td>HCI</td>
<td>5.45 (0.96)</td>
</tr>
</tbody>
</table>

*The social support and efficacy scales were assessed using a 7-point scale.*

**Usage logs**

ClassCommons usage logs confirmed the good levels of participation, though again this
appears to vary across classes. In PM, less than half of the students (32 of 67 or 47.8%) posted
messages in the system at least once, while the majority of students (42 out of 50 or 84%) in HCI
did so; a chi square test of these frequencies confirms that this pattern is a significant departure of
what one would expect by chance ($\chi^2(1,N=117) = 16.18$, p<.001).
In total 641 messages were posted and 254 Likes were voted. Table 4 shows the detailed use of ClassCommons, broken down by the two classes. Because the graduate teaching assistant (TA) in both classes contributed messages throughout the semester, generally in response to questions, we have tabulated these separately from those of the students. Again the classes differed in this, with the TA contributing almost 20% of the messages for PM but just over 5% for HCI. As we will discuss later, our informal observations suggested that this was due to the differing nature of messages posted in the two classes, with those in PM often aimed at gaining clarification about course assignments or other class logistics.

Table 6-4. The use of ClassCommons in PM and HCI

<table>
<thead>
<tr>
<th>Class</th>
<th>Participation</th>
<th>Messages (Students/TA)</th>
<th>Likes</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>47.8%</td>
<td>84 (65/16)</td>
<td>95</td>
<td>179</td>
</tr>
<tr>
<td>HCI</td>
<td>84.0%</td>
<td>557 (527/30)</td>
<td>159</td>
<td>716</td>
</tr>
</tbody>
</table>

Recall that ClassCommons supports posting of photos and videos in addition to text. Across both classes, 76 images were posted, but video content was not common in students’ postings; only five video clips were posted, and all of these were in messages posted in the HCI class. Table 6-5 details the distribution of these more complex multi-media posts.

Table 6-5. Photos and videos posted in ClassCommons

<table>
<thead>
<tr>
<th>Class</th>
<th>Photos</th>
<th>Videos</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HCI</td>
<td>75</td>
<td>5</td>
<td>80</td>
</tr>
</tbody>
</table>

Students in both classes made heavy use of the PAPA option (using an anonymous handle when posting), but use of this feature was more common in HCI than PM. In the HCI class, 77.9% of the messages were posted under an alias, whereas in the PM class, only 60.7% of the
messages were posted under an alias ($\chi^2(1, N=592) = 10.00, p<.05$; note that only messages posted by students were included in this analysis). That is, students in HCI class tended to post using an alias more often than students in PM. Again, this seems likely to be due to the differences in message content that we discuss later – when one is posting a question about an assignment for clarification, there is no need to “hide” behind an anonymous handle and in fact one might expect credit or thanks from other students for asking such questions.

In general, students enjoyed using ClassCommons and a large majority of students in both classes reported that they would like to use ClassCommons in other classes. In the post-survey, we asked whether they would like to use ClassCommons in future classes. 88.68% of the respondents (47 out of 53) in PM and 92.68% of the respondents (38 out of 41) in HCI indicated that they would like to do so.

**Message content**

To understand how students’ have used ClassCommons, we analyzed the messages posted in each class. We used a card-sorting technique to categorize the messages. Each message was read, and assigned a descriptive label. The messages were then clustered into similar groups. We clustered the messages into nine types: social, questions, TA response, report problems, logistics, comments, share info, counter spam and random messages. Examples of each category can be found in Table 6-6.

*Social* messages refer to the small talk that usually happened at the beginning or end of class. For example, students might post a message to greet one another, or to talk about the sports and news going on campus or around the world. *Questions* are messages that contain questions about the course. *TA responses* are the messages posted by the TAs, answering students’
questions or making announcements. **Report problems** are messages posted to report the problems that students found in the class.

**Table 6-6. Examples of the messages by type**

<table>
<thead>
<tr>
<th>Message Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>“Hi folks.”; “Class is starting! IM SO EXCITED”; “have a great weekend folks!!! Stay dry, and GO STATE!!!”; “Predictions for the score on Saturday? I say 45-7.”</td>
</tr>
<tr>
<td>Questions</td>
<td>“Anybody here able to access their u drive?”; “Unjustified claims are bad, mmmkay?”; “anyone know if we are choosing something, or making something entirely new?”</td>
</tr>
<tr>
<td>TA Response</td>
<td>“We suggest you find problems that apply to broader audiences.”; “You can use whatever presentation technology you choose.” “Grades for 4 and 5 are up (unless we didn't get your assignment).” “Both options are acceptable. Designing something completely new, or improving an existing system.”</td>
</tr>
<tr>
<td>Report Problems</td>
<td>“One of the problems did not match up with what was discussed in class”; “Team 3 seems to be a combination of team 8 and 9... typo?”; “it's frustrating, I can't open any documents from my desktop or drives.”</td>
</tr>
<tr>
<td>Logistics</td>
<td>“GROUP #16 WHEN YOU'RE DONE MEET IN BACK CORNER NEAR THE CLOCK”; “Currently looking for fourth member. Must be qualified, and like puppies. Inquire within.”</td>
</tr>
<tr>
<td>Comments</td>
<td>“awesome presentations today!”; “This design is against man law.(commenting on a design discussed in the class)” &quot;Can't see the stock on the left machine (commenting on 2 vending machine designs)”</td>
</tr>
<tr>
<td>Share Info</td>
<td>“Here's the video which goes along with the Microsoft team's blog post about...”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Counter Spam</th>
<th>“Can you guys stop posting weird videos and pics?”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random</td>
<td>“derk-a-derrr”; “it’s a tarp”</td>
</tr>
</tbody>
</table>

**Logistics** are messages to deal with logistical issues in the class, for example locating team members. **Comments** are the messages posted by students during the lecture, commenting on the things that the teacher just talked about. **Share info** message are ones that were posted by students who meant to share information to the whole class. Messages of this kind usually contain a URL link to some webpage from the Internet. **Counter spam** messages were ones that were intended to stop other students from posting random messages. **Random** messages are ones that were posted during the lecture, and have nothing to do with the class. The differences between comments and share info messages are that share info messages are ones that have new information, while the comments are just messages posted by students in response to the lecture, without obvious new information inside.
Figure 6-4. Content Analysis of the Messages Posted

Given the other differences between the two classes, it was not surprising to see differences in the types of messages posted; this can be seen in Figure 6-4. Students in IST302 made more focused use of the tool than students in IST331; they tended to use it to ask questions, report problems or for class logistics. And because students posted such questions, the TA posted more (responses) in IST302 than in IST331. Students in IST331 often used the tool to make comments, and share information. There were also more random messages in IST331 than in IST302.

Compared to the messages posted in the video commenting study, messages posted in this study were more diversified. While most of the messages posted in the video viewing study were messages commenting on the video, it was found that in this study students used ClassCommons for more than just commenting what was going on in the class. They also use it to socialize with other students, to ask questions, to share information with other students and report
problems. The diversity of the messages indicates that ClassCommons can not only serve utilitarian purposes in the class, but also enrich the course content and enable students to interact with other students and the teachers.

**Contrasting the Two Classes**

One pervasive result concerning ClassCommons use is its differential impact on the two different classes: students in the HCI class used the system more and used it in more ways; they also reported that they liked it more and that their instructor paid more attention to the messages being displayed. To better understand why these differences may have emerged, we interviewed students, teachers and TAs for opinions about these differences. The fact that five of our interviewees had been in both classes was particularly useful in probing for explanations. In reviewing their comments, three themes emerged: the nature of the course topic, the amount of attention the teacher paid to the content posted on ClassCommons, and the instructors’ teaching style.

**The Nature of the Course Subject**

The richness of the course material and the difficulty of the subject played an important role. Compared to the PM class, students in the HCI class found the course material to be more interesting and therefore more likely to evoke backchannel comments. For example, S1 (Student1) said: “I think PM, the subject is pretty dry. It is not interesting, and then human computer interaction (HCI) is a lot more interesting, a lot more fun. There is a lot more human touch to that class.” The TA for PM commented: “It might be the material of PM is pretty straightforward. You just store the knowledge and learn. Maybe if you have a math class or
something, where you have to apply what you learn to solve problems, students might use it more (to ask questions).”

**Teacher Attention**

A second factor was the attention the teacher paid to the messages on ClassCommons. We reported earlier the survey finding that students in HCI reported that their instructor paid greater attention to the backchannel than those in PM. In the interviews, students noted that their instructor’s acknowledgement of ClassCommons messages encouraged them to use it more. S5 mentioned: “I think it (the message) is more acknowledged in HCI. The professor kind of actually looked up at the public display. The questions are usually acknowledged, read and answered....(In PM class), he did not really look up at the display much”. S4 said: “The fact that the professor acknowledges the display encourages student to use the display. They acknowledge the posts on ClassCommons, they address the questions on ClassCommons, and it makes it more useful, more popular”. This combination of survey and interview data emphasizes the critical role of teacher attention in adoption and use of technologies like ClassCommons.

**Teacher’s Style**

Finally, students are more likely to use ClassCommons in classes where the instructor adopts a more personal approach to teaching. For example, S2 said: “(instructor of HCI) is very personal the way he teaches it. Whereas PM is much more of a big class, I found that it was more impersonal.” S4 commented: “In PM, the instructor seems stricter.” The PM teacher was quite senior relative to the HCI teacher and this may have influenced their teaching style and students’ subsequent reaction to and motivation to engage with them via the backchannel. In general,
though, the backchannel is intended for relatively informal exchange, so it would make sense that professors who exhibit a more informal teaching style might encourage more participation.

**Predictors and Impacts of ClassCommons**

To gain insights into how ClassCommons affected students’ classroom experiences, we carried out a series of exploratory multiple regression procedures, similar to but more extensive than the ones conducted as part of the video commenting study. Given the scarcity of prior related research studies, our goal in this was not to formulate and test hypotheses but rather to build conceptual models of inter-related factors that might be used to guide our own and others’ future research. To increase the power of our analysis, we used the combined data from the two classes in all regressions. Because many of the predictor variables are correlated, we used stepwise regression in all analyses; in this approach multiple dependent variables are used to predict a single outcome variable, and are added to the model only when they account for variance not already accounted for by other variables (Pedhazur 1997).

**ClassCommons Usage Model**

Several student characteristics were assessed and regressed on students’ starting Sense of Community (PreSOC). For example we expected that students’ Classroom Anxiety might negatively impact their starting Sense of Community, whereas Extroversion would show a positive relation. As expected, the regression model for PreSOC revealed a significant positive relation of Extroversion (p<.05) and a negative relation of Class Anxiety (p<.01); no other student background variables provided explanatory power in the model, which accounted for 39.5% of the variance.
A number of variables might influence students’ use of ClassCommons. In Section Contrasting the Two Classes, we discussed some of the differences between classes that seemed to play a role in this, but we also wanted to explore student variables, both in terms of their personal characteristics and their beliefs about the usefulness of or interest in the ClassCommons system. For instance one would expect that students who believe ClassCommons provides relevant content would find themselves using it more. To investigate this we regressed the variables from the first model (PreSOC, Extroversion, and Class Anxiety) and the four system ratings (Interest, Content Relevance, Learn New Information, Distraction, see Table 6-2) on the ClassCommons use index (PostUse). The resulting model accounted for 36.5% of the variance and included positive relations of Interest (p<.01), Content Relevance (p<.05) and PreSoc (p<.05).

The third regression model considered the possible impact of ClassCommons use on SOC. The system was designed to enhance students’ feelings of community, so we expected a positive relation between usage and felt community. To examine this possibility, we regressed the variables from the previous model (Interest, Content Relevance, PreSOC and PostUse) on PostSOC (in this model PreSOC can be conceptualized as a covariate measure, i.e., it is included to control for individual tendencies in SOC). The resulting model accounted for 28.4% of the variance in PostSOC and included positive effects for PreSOC (p<.001) and PostUse (p<.05).
Figure 6-5. Path diagram relating ClassCommons use to SOC

Figure 6-4 combines the results of the three regression analyses in a path diagram. In the
diagram the arrows show which measures were found to be independent predictors in each model;
the numbers on the arcs report the standardized beta or regression coefficient for each predictor.
The model summarizes the three overlapping models: 1) the students’ feelings of classroom
anxiety and extroversion predict PreSOC; and 2) PreSOC, content relevance, and interest in
ClassCommons predict use of the system. However, personal variables like extroversion,
classroom anxiety or public speaking apprehension do not predict students’ use of
ClassCommons; these individual differences may have an influence but if so it is present
indirectly through their relationship with PreSOC.

Finally, 3) PostSOC is predicted by students’ PreSOC and their reported use of
ClassCommons. Recall that the PostUse measure is based on students’ self-report of use and
includes both reading and posting activities. While we acknowledge that these models are based
on correlations only, this pattern of results is consistent with our expectation that use of use of
ClassCommons can help students feel more sense of community.
Broader Impacts of Sense of Community

As a secondary analysis, we also wanted to explore the broader impacts that are associated with the feelings of community that students report. In particular, we were interested in whether and how SOC is related to students’ self-efficacy, social support and collective efficacy in the classroom. In general, we expected that a high sense of community will be positively related to students’ self-efficacy, social support and collective efficacy in the classroom.

Our analysis confirmed this. We found that PostSOC is significantly correlated with self-efficacy ($r=0.58$, $p<.001$), collective-efficacy ($r=0.60$, $p<.001$) and social support ($r=0.60$, $p<.001$). As above, we cannot argue for a causal interpretation. Given the large degree of collinearity in our data, further studies will be needed to tease apart these overlapping constructs.

Asymptotic Growth Trajectory of Sense of Community

Students’ sense of community changed differently in the two classes. Table 6 reports students’ sense of community in both classes along the semester. A one-way within subjects ANOVA was conducted to compare the effect of time on students’ sense of community in each class. In PM, there is a significant effect of period ($F(2,46) = 24.55$, $p < .001$). Bonferroni post hoc tests revealed significant differences in the scores for PreSOC and MidSOC ($p<.001$) and for PreSOC and PostSOC ($p<.001$). However there was no increase from MidSOC and PreSOC: Students’ sense of community increased in the first seven weeks, but stayed at the same level until the end of the semester.

For the HCI class, there was no significant effect of time at all ($F(2, 23) = 2.69$, $p = .089$). Relative to the PM class, students’ sense of community started out at a high value and stayed at about the same level. One possible contributing factor for the higher initial SOC is that the size of
the HCI class was somewhat smaller than PM (HCI had 50 students while PM had 67); perhaps the smaller size helped students to feel more interconnected and coherent as a group from the beginning. Of course the differences may also be due to other factors that distinguish the two classes, for example the two different instructors, a greater starting familiarity among the students; the content under study, or even the physical characteristics of the room.

Table 6-7. Sense of Community across classes and time

<table>
<thead>
<tr>
<th>Class</th>
<th>PreSOC</th>
<th>MidSOC</th>
<th>PostSOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>4.41(0.61)</td>
<td>4.86(0.68)</td>
<td>5.0(0.75)</td>
</tr>
<tr>
<td>HCI</td>
<td>4.82(0.70)</td>
<td>5.00(0.72)</td>
<td>4.79(0.75)</td>
</tr>
</tbody>
</table>

Regardless of the source of differences, these patterns lead us to speculate that sense of community may have an asymptotic growth trajectory in university courses. More specifically, we propose that a value of around 5.0 (on a 7-point scale) may represent an asymptotic value for the SOC construct in this context; that is when the community in question is a group of students who happen to be taking a course together. Note that in Table 6-6, the initial SOC value for the PM class is the only one that is not close to this value of 5.0. While individual students may experience more or less SOC in a classroom, it may be that few of them would ever feel SOC intensely enough to assign scale values of 6 or 7. This does not mean that the construct is not valuable for assessing feelings of “connectedness”, but it may be useful to explore an alternative to the conventional SOC scale, perhaps one that is customized for the learning communities one could expect to emerge in a 15-week class.

**ClassCommons Benefits and Drawbacks**

To understand the tradeoffs associated with the use of ClassCommons in a university setting, we asked students what they liked the most and the least about ClassCommons in the mid
and post surveys. We also asked students and the teachers and the TAs similar questions during the interviews. These qualitative data helped us gain deeper insights into the benefits and drawbacks with using ClassCommons, from both the students’ perspective and the teachers’.

Looking across the comments, we found several themes in the “likes” reported:

**a) They can easily ask questions and get quick responses from the TA.** For example, student comments included: “What I liked best is that at any time I can post a question and get a timely response from a TA”; “It makes asking questions in lectures feasible without disrupting the flow of class. Often times I will not want to interrupt the professor, and hold off on asking my question, only to later forget what my question at the time was”; “I like the fact that I'm able to interact with others and the instructor without yelling across the room.”

**b) They can interact with other students, provide peer support and learn new information from each other.** For example, students said that “It's a great way to interact with other students during class times without being disruptive to the teacher. You can ask quick questions to other people and get a timely response”; “I like the ability to post a question and have it answered immediately by my peers who have the extremely unique perspective of being in the exact same position in the course”; “The technology and idea of it is pretty cool. I do learn things about the class from looking at the message board”;

**c) It makes the class experience fun.** “It was interesting to see what the other students were thinking”; “It is a fun and more forward approach to learning”.

Students’ only perceived downside with using ClassCommons is that the alias feature encourages people to post irrelevant content which is distracting to the class. “The first few weeks, the messages almost always consisted of distracting and/or vulgar content, probably because submissions were anonymous. If real names were used, ClassCommons might work better in classes”; “Alias encourage distracting comments” and “People like to be anonymous in order to post stupid comments and things that don't matter, this can get annoying.”
From the teacher’s perspective, the instructors felt that ClassCommons provides a social media service that is more relevant to the class than Facebook. The instructor of HCI commented: “During the class, many students spend a lot of time on Facebook, which is irrelevant to the class. I would rather like students to spend that time on ClassCommons, which is more relevant to the class than Facebook. We can use ClassCommons to replace Facebook in classes.” The instructor of PM felt that the public display seems to make the class more coherent: “I think this class as a whole, seems to be somehow more coherent than before. It made a community of interest around that system and that community of interest might help them. It gave them all a common thing to focus on.”

The concerns the teacher had with ClassCommons were the anonymity issue and the possibility of causing embarrassment for other students. For the anonymity issue, the teachers voiced a concern similar to the students. For the embarrassment issue, the HCI instructor mentioned that “Sometimes I will ask students to make presentations about their group project in the class. I remembered that one time when a student was presenting, he made some mistakes and some students pointed that out directly on ClassCommons. I felt that this could embarrass the student who is presenting”.

Summary

The 15 week field study provided us an opportunity to investigate the long-term impact of public backchannel tools on students’ sense of community in classrooms. It is encouraging that 90% of students were interested in using it in future classes. Based on the survey data, we modeled the ClassCommons usage pattern and found that content quality and students’ interests were important factors that influence students’ use of ClassCommons. Further, the use of ClassCommons is positively related to students’ sense of community. The content analysis
revealed how students have used the tool during the semester and the qualitative interview and students’ answers to the open-ended questions enriched our understandings about the benefits and drawback of using public backchannel in classrooms.
Chapter 7

Public Backchannel Communication Patterns

The research activities in Chapters 5 and 6 have focused on evaluating whether the use of ClassCommons could increase students’ participation in class and potentially their feelings of community with one another. In the analysis presented here, we sought to expand our understanding of a digital backchannel in a classroom from a communication perspective, with a focus on analyzing the communication patterns that emerged in ClassCommons interactions, and consider how students would use public digital backchannels. We have shown thus far that students’ participation was high in the class activities we studied; how we did not yet characterized in any detail what the participation might be like when a digital backchannel is available and in use for an extended period of time. We have learned how ClassCommons influenced students’ sense of community. However it is not clear what the communication dynamics is like in ClassCommons. In this chapter I seek to address these gaps in the literature by answering the following research questions:

RQ1: How do students appropriate public digital backchannel tools in classrooms?
RQ2: What communication patterns are typical in classroom digital public backchannels?
RQ3: How if at all does students’ participation in the digital public backchannels evolve over an extended period of time?
RQ4: What are the characteristics of the messages that get more responses from other students?
Analysis Methods

The ClassCommons messages posted in the IST331 were collected and analyzed deeply to answer these research questions. Only the messages from IST331 were included in this analysis because compared to the messages posted in IST302, a) more messages in IST331 were posted. As reported in Chapter 6, only 84 messages were posted in IST302 versus 557 in IST302, and b) the messages posted in IST302 were mostly directed towards the teacher or the TA, while there were more interactions among the students in IST331.

To answer the question about how students appropriated public digital backchannels, we conducted a qualitative analysis of the messages posted. One researcher read each message and grouped the messages that were in the same thread as a conversation. The researcher decided whether messages belonged to a conversation by determining whether they were about the same topic and whether those messages were replies to each other. The researcher used notes taken during the observation to help him understand the contexts in which the messages were posted and help him group the conversations. If a message was posted but it did not get any responses, it was counted as a conversation with length of 1. Since this is an exploratory study, only one researcher was involved in this process.

The 557 individual messages were clustered into 265 conversations. We focused on conversations as the unit of the analysis instead of individual messages because a) conversations can provide more context information about each individual message, based on which the qualitative analysis would be more accurate; and b) communication patterns, which is the focus of analysis in this chapter, are embedded in conversations rather than individual messages.
Conversations Overview

For each conversation, its length (the number of messages in that conversation), the number of participants involved in that conversation, and the average number of messages posted by each participant in a conversation were calculated. Table 7-1 shows the details of the statistics of these variables.

Table 7-1. Statistics of conversation length, # of participants and contributions per participant

<table>
<thead>
<tr>
<th>Variable</th>
<th>Statistics (mean, s.d)</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversation Length</td>
<td>1.95(1.90)</td>
<td>17</td>
</tr>
<tr>
<td>Participants</td>
<td>1.72(1.33)</td>
<td>9</td>
</tr>
<tr>
<td># of Messages /participant</td>
<td>1.08(0.24)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

The communication pattern emerged was that most of the grouped messages were not conversation as all: (60.4%) had only 1 message. For the groupings of size larger than 1, about 20.4% of the conversations had 2 messages and 19.2% had 3 or greater than 3 messages. The distribution of the number of participants in each conversation showed similar patterns. Most of the conversations had only 1 participant (63.4%), 19.4% of the conversations had 2 participants and 16.98% of conversations had greater than 3 participants. See Table 7-2.

Table 7-2. Distribution of # of messages and # of participants in a conversation

<table>
<thead>
<tr>
<th># of msgs in a conversation</th>
<th>%</th>
<th># of participants in a conversation</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60.38</td>
<td>1</td>
<td>63.4</td>
</tr>
<tr>
<td>2</td>
<td>20.38</td>
<td>2</td>
<td>19.6</td>
</tr>
<tr>
<td>3</td>
<td>8.3</td>
<td>3</td>
<td>8.68</td>
</tr>
<tr>
<td>&gt;3</td>
<td>10.94</td>
<td>&gt;3</td>
<td>8.3</td>
</tr>
</tbody>
</table>
Trends in Conversation Characteristics

In other related work public digital backchannels tools were used extensively in classroom settings, but in general they have been tested for only short periods of time (e.g., 1-2 class sessions). As a result we know little if anything about how students would use such a service over an extended period of time. The semester-long data collection in this study provides the perfect opportunity to examine participation trends over several months of use.

We began this analysis by grouping the conversations according to their length (length =1, length =2 and length >=3). We did this because our preliminary summary analysis (Table 7-2) had revealed that very few conversations had more than three posts, but there was a reasonable number of length two, which would be a core conversational form (e.g., question-answer or comment-reaction). After grouping them thusly, we examined the number falling into each conversation length over the 15 week period. Figure 7-1 shows these data.

Figure 7-1. The number of conversations of different length over the 15 weeks
Overall, conversations in ClassCommons were more frequent in the earlier part of the semester; participation declined gradually over time. The one exception to this general trend is the individual messages posted during week 15; this shift in pattern may have been due to students who were posting to increase their contribution count and thus the amount of extra credit they would be awarded.

Of note for the current analysis, conversations of different length showed similar patterns. The initial high usage could be attributed to the novelty effect. When it was first introduced, students were more curious about it and would like to try it. Later on students’ participation stabilized after the initial momentum.

Note that there were two peaks in ClassCommons conversation activity along the semester – weeks 3 and 15 (Figure 7-1). In Week 3, the number of conversations is much higher than the other weeks. In Week 15, the number of non-conversations (i.e., those of length 1) jumped relative to earlier weeks. Review of class observation notes revealed that those two weeks corresponded to periods when the students gave presentations about their group projects. In the HCI class, students were divided into 10 teams and each team’s term project was to design a new system. Week 3 was the week that they presented their ideas and week 15 was the week that they presented their prototype systems. This team presentation activity seemed to be particularly evocative with respect to commenting, and is reminiscent of the high level of posting we observed during the video viewing sessions in IST 110. The relatively high levels of participation during these weeks than weeks when the teacher was lecturing may indicate that students feel more comfortable commenting on their peers but not on the instructor. Unfortunately we did not recognize these peaks until after the data were analyzed so the interview questions were not designed to shed light on this possibility.
Conversations in ClassCommons

After we had grouped students’ posts into conversations, we examined the main topic of each one. We used a card-sorting technique to categorize the conversations: each conversation was read, its topic was assessed, and it was assigned a descriptive label. The conversations were then clustered into similar groups. In the end, we clustered the conversations into seven types: comments, suggestions, information sharing conversations, discussion conversations, question conversations, social and random conversations. Figure 7-2 shows the distribution of different kinds of conversations. Comments and random messages were the most common conversations, followed by questions, information sharing, social conversations, suggestions and discussions. We now consider in more detail the nature of each of these categories.

![Figure 7-2. The distribution of different types of conversations in ClassCommons in IST331](image)

---

Conversation Type:
- Comment: 18.87%
- Suggestions: 26.79%
- Share Info: 7.92%
- Discussion: 2.64%
- Miscellaneous: 12.63%
- Social: 2.20%
- Question: 28.69%
Comments

In many conversations, the students simply posted messages to make comments about things or activities ongoing in the classroom. In this sense the ClassCommons backchannel can be seen as a sort of “digital utterance” in their current class experience. Various kinds of comments were made, including reactions to the lecture, the quiz or other students’ presentations. Most comments were of length 1, which is they were an individual student’s thought about some topic or issue. Table 7-3 contains several examples of the comments in ClassCommons.

As we reported earlier, team presentations were most heavily commented. In fact 75.4% of the comments (49/65) were in response to other students’ presentations; many of these had a kidding or sarcastic aspect to them (see, e.g., the last comment in Table 7-3). Students were less likely to comment on the instructor’s lecture. Again, we speculate that this is due to students’ greater comfort teasing other students, rather than the instructor.

Table 7-3. Examples of Comments

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Anonymous 36</td>
<td>“confused about question”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(The student was confused by the teacher’s question.)</td>
</tr>
<tr>
<td>#1</td>
<td>Jack</td>
<td>“depth inception. Depth within depth!”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(The teacher was talking about “inception” in the class.)</td>
</tr>
<tr>
<td>#3</td>
<td>Anonymous 132</td>
<td>“The lecture is good! I like that usually the professor involves the students during the lectures using games and discussions.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Comment on the lecture.)</td>
</tr>
<tr>
<td>#4</td>
<td>GoStateBeatBama</td>
<td>“look at the audience, not your slides”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Comment on other students’ presentation.)</td>
</tr>
</tbody>
</table>
#5 BigLuigi  “don’t overclock your system if you don’t know what you’re doing, you can do some serious damage to system :/.”  
(Comment on one team’s project idea)

#6 BigLuigi  (Comment on another’s team’s presentation slides.)

Questions

Students used ClassCommons to ask questions. Most of these questions addressed issues with assignments, quizzes and grades. A few of them were questions about a topic currently under discussion (#1 in Table 7-4). All of these questions were answered, either by the instructor (who at times addressed ClassCommons question in the class orally), by the TA or by other students who answered by posting in the system. Table 7-4 shows examples of the question-based conversations.

Table 7-4. Examples of the question conversations

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Mr. Mackey</td>
<td>“Unjustified claims are bad, mmmkay?”</td>
</tr>
<tr>
<td></td>
<td>TA</td>
<td>“Right. The challenge is how to justify the claims. Any thoughts?”</td>
</tr>
<tr>
<td></td>
<td>Mr. Mackey</td>
<td>“Research. Could be surveys, studies of other products and their sales, features, etc.”</td>
</tr>
<tr>
<td>#2</td>
<td>Jason</td>
<td>“Anybody here able to access their u drive?”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Jack</td>
<td>“NOPE”</td>
<td></td>
</tr>
<tr>
<td>TA</td>
<td>“@Jason: I have access.”</td>
<td></td>
</tr>
<tr>
<td>Jason</td>
<td>“it’s frustrating, i can’t open any documents from my desktop or drives.”</td>
<td></td>
</tr>
<tr>
<td>Blaine</td>
<td>“@ Jason: Go to my computer, then the U drive, then the folder with your first initial, then the folder with your middle initial. You should be able to get to your documents there”</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>BigLuigi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“soooooooo. anyone know if we are choosing something, or making something entirely new? ”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anonymous28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Do we create something or use something that already exists?”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BigLuigi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“ahhhh, ok. so, we choose something that is already there, and just propose a way to enhance or add to it... i think”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Both options are acceptable. Designing something completely new, or improving an existing system.”</td>
<td></td>
</tr>
</tbody>
</table>

One benefit of using ClassCommons is that students can easily ask question in the class and get timely responses, either from the instructor, TA or other students. In the course exit survey, in response to the question about what they liked about ClassCommons, students commented that “You can ask quick questions to other people and get a timely response”; “I like the ability to post a question and have it answered immediately by my peers who have the extremely unique perspective of being in the exact same position in the course”.

Share Information

Another use of ClassCommons was the sharing of information among peers. This usually happened when the teacher was talking about something in the class, and the students posted additional information that was related to what was being talked about. Messages of this kind usually contained an image or a link to an external webpage. These postings enriched the course content and made the course subject more vivid. See Table 7-5 for examples.

This type of usage emphasizes that teachers are no longer a “sage on the stage”. In traditional classrooms, it is just the teacher who does the talking during the class and students rarely have opportunities to speak up, even when what the teacher says is controversial. ClassCommons gave students another channel for speaking up. See example #4 in Table 7-5: prior to this post, the teacher was talking about the tongue map, showing large regional differences in sensitivity across the human tongue, which was commonly produced in textbooks and often cited. In parallel to the lecture, the student found an article showing that this traditional view of tongue sensitivity is in error, according to latest research; the student shared this article with the whole class. The instructor noticed that particular post in ClassCommons and acknowledged its relevance. He said that he would look into this later after class.

Table 7-5. Examples of Sharing Information Conversations

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Greg</td>
<td>“mr sketch”</td>
</tr>
</tbody>
</table>

(In response to the instructor’s question about whether there is any design example that integrates scent.)
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| #2 | BigLuigi | “You know what's really interrupting? When I'm playing a video game,  
and I cannot pause it, and my mom or significant other calls.”  
(When the teacher was talking interruption in the class.) |
| #3 | Ben | “Piano stairs! Persuasive technology!  
http://www.youtube.com/watch?v=2lXh2n0aPyw”  
(Share an example of persuasive technology) |
| #4 | trollface | http://www.scientificamerican.com/article.cfm?id=the-taste-map-all-wrong  
sorry, that picture was false  
(The teacher was talking about the tongue map, a student found an article  
that showed that that map was wrong) |

**Discussions**

Although students used ClassCommons primarily to make spontaneous digital comments and ask questions as reported above, at times they used it to discuss class-related topics. In one example, the instructor was talking about the pros and cons of two designs of the vending machine in the class. He put the pictures of the vending machines on his power point slides (Figure 7-3) and asked for students’ opinions. Students started posting their thoughts in ClassCommons (#1 in Table 7-6). Some of the messages were quite insightful; others were intended to be humorous. After all, ClassCommons makes it possible for students to further discuss topics of interests and the “*unique perspectives*” offered by students amplify the course
material and enrich the course content. In the #2 example in Table 7-6, students were discussing color and how it is related to words, and one student shared with the whole class a Wikipedia article that explains it.

Figure 7-3. The two vending machines discussed in class

Table 7-6. Examples of Discussion Conversations

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>David</td>
<td>“Can't see the stock on the left machine”</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
<td>“You’re able to roundhouse the left machine more efficiently.”</td>
</tr>
<tr>
<td></td>
<td>Chuck Norris</td>
<td>“I fully endorse the machine on the left.”</td>
</tr>
<tr>
<td></td>
<td>David</td>
<td>“Also the left one leaves a small margin for error. One mis-step and you’re getting a diet soda instead of a delicious normal one”</td>
</tr>
<tr>
<td></td>
<td>David</td>
<td>“....I meant the right.”</td>
</tr>
<tr>
<td></td>
<td>BigLuigi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HeHateMe</td>
<td>“@bigluigi...well said”</td>
</tr>
<tr>
<td>#2</td>
<td>Ben</td>
<td>“some people think certain words have certain colors”</td>
</tr>
</tbody>
</table>
Discussion conversations only account for about 2.26% of all the conversations in ClassCommons. In our interviews with students, we asked students why there were relatively few discussions taking place in ClassCommons. Students told us that a) “not all students were scholars who have the best attentions in discussing course subjects”, and “students are motivated by grades. If they are not being graded on something, probably they won’t spend much time on it” and b) to encourage students to be involved in more course related discussions, the instructor should provide some form of scaffolding. For examples, “having the professor pose questions, and having people like post answers on it would be effective in having more students participate in the discussion”.

Suggestions

A few of the conversations (2.64%) contained suggestions. For example, students posted messages to make suggestions about improving the design of a system being used in the class. Another interesting observation was that in one case students used it to suggest something that might be challenging to voice in a normal fashion, for instance, submitting a suggestion that the quiz should be open notes. See Table 7-7.

Table 7-7. Examples of Suggestion Conversations
<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Jim</td>
<td>“Looks like strip_tags() needs to be applied to aliases as well.”</td>
</tr>
<tr>
<td></td>
<td>TA</td>
<td>“You are right. Thanks!”</td>
</tr>
<tr>
<td></td>
<td>Tom</td>
<td>“Jim is awesome!”</td>
</tr>
<tr>
<td>#2</td>
<td>VIP Lounge</td>
<td>“This quiz should be open note - WAY too much material.”</td>
</tr>
<tr>
<td></td>
<td>Sidthekid</td>
<td>“Agree with VIP..open note team quiz”</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>After seeing this on the public display, the instructor agreed to make</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the quiz open note.</td>
</tr>
<tr>
<td></td>
<td>Trollface</td>
<td>“I LOVE xxx (instructor’s name), not trollin”.</td>
</tr>
<tr>
<td></td>
<td>VIP Lounge</td>
<td>“This professor is my hero”.</td>
</tr>
<tr>
<td>#3</td>
<td>Trollface</td>
<td>“wow this looks a lot harder, partners should be allowed”</td>
</tr>
</tbody>
</table>

Although suggestions were not very common in ClassCommons, the appearance of such postings can still be seen to have important implications. Simply speaking, ClassCommons empowers students. It opens another channel for students to negotiate with the instructor regarding class logistics and organization; this is less likely to happen in traditional classrooms and typically would happen in private if the student goes to the professor during office hours or has a brief conversation after class. ClassCommons makes it easier for students to speak up about things that they might be shy about raising in person; the fact that students can post messages under an alias ameliorates concerns about asking something that is otherwise difficult to broach. At the same time, it makes the suggestion public, so if it has broad consequences (e.g., the request for open notes on the quiz), all students can appreciate and benefit from the post. Interestingly, the instructor may be more likely to accommodate requests that are made in public forum like ClassCommons – it is easy enough to deny or postpone a private request from a single student, but a suggestion that is viewed and implicitly “seconded” by many others who are also in the room would be harder to ignore.
Social Purpose Conversations

Conversations happening at the beginning of the class (5 minutes or less after class begins) function as ice-breaking messages (#3, #4 in Table 7-8); conversely, conversations at the end of the class (5 minutes or less before class ends) are to say Goodbye to the class (#2 in Table 7-8). These postings were coded as social purpose conversations and this category accounts for about 7.92% of all the conversations in ClassCommons.

Table 7-8. Examples of Social Purpose Conversations

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Anonymous100</td>
<td>“Nice haircut”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(The instructor had a haircut)</td>
</tr>
<tr>
<td>#2</td>
<td>BigLuigi</td>
<td>“Have a great weekend folks!!! stay dry, and GO STATE!!!”</td>
</tr>
<tr>
<td>#3</td>
<td>trollface</td>
<td>“Good Morning Minions”</td>
</tr>
<tr>
<td>#4</td>
<td>d-(^_^)z</td>
<td>“Class is starting! IM SO EXCITED”</td>
</tr>
<tr>
<td></td>
<td>trollin</td>
<td>“we so excited”</td>
</tr>
<tr>
<td>#5</td>
<td>Dr. Toboggan</td>
<td>“Happy birthday ^_^”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(It was the instructor’s birthday.)</td>
</tr>
</tbody>
</table>

Miscellaneous

Miscellaneous conversations were messages posted during the class and that had nothing to do with class content or activities. Such posting were relatively common, with 28.68% of the conversations being of this sort. The category included students’ chat messages, messages that shared funny things and that talked about sports, etc. (Table7- 9). Within this category, internet memes were the most common (#2, #3 in Table 7-9). The benefits of this type of posting are
simple – they were intended to entertain the class. However, it is less clear whether there were negative impacts, for example distraction away from class topics or teasing that made a student or group feels bad.

Table 7-9. Examples of Miscellaneous Conversations

<table>
<thead>
<tr>
<th>No.</th>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>BigBen</td>
<td>“In other news the Steelers will go 15-1 this year.”</td>
</tr>
<tr>
<td></td>
<td>Anonymous69</td>
<td>“Doubtful”</td>
</tr>
<tr>
<td>#2</td>
<td>GotSWAG</td>
<td>(funny picture)</td>
</tr>
<tr>
<td>#3</td>
<td>BigLuigi</td>
<td>“You did so well, here is one schrute buck :D”</td>
</tr>
<tr>
<td>#4</td>
<td>Kid in the Red Polo</td>
<td>“I am the coolest cat in class”</td>
</tr>
<tr>
<td></td>
<td>Zoidberg</td>
<td>“Why not Zoidberg?”</td>
</tr>
<tr>
<td></td>
<td>kid in the pink polo</td>
<td>“I’m even cooler than kid in the red shirt, I also go by vip lounge. I like to pretend im anonymous, but I sit in the back corner”</td>
</tr>
</tbody>
</table>

Characteristics of Long Conversations

One goal of the public backchannel was to involve more students in class discussion. However, the majority of “conversations” in ClassCommons had length ≤ 2. Essentially, one
person would post something and one other person would react, often in a very simplistic way. To explore the characteristic of the conversations that have more participants and a longer length, we collected all the conversations that have a length of more than three and analyzed their characteristics.

We found that 29 conversations had a length that is greater than 3, with a maximum of 17 messages and a minimum of 4 messages. A researcher read through all of these conversations,considering carefully how each of the conversations was initiated and developed over time and different participants. We found three general patterns: a) questions that are open ended and no one is able to provide a definitive answer; b) some topics are simply controversial; and c) at times something interesting is posed that invites further expansion. We now consider each of these in turn.

**Open Ended Questions**

In ClassCommons, questions that were open ended were likely to attract more students to the issue. For instance, in the #1 example in Table 7-6, the teacher asked students to discuss the pros and cons of two different vending machines. 6 students participated in the discussion with 7 messages posted. Another example is that a student was trying to ask whether other students are currently able to access a specific resource (their u-drive) on their computer. No one had a definitive answer, so different students posted related information trying to help that student solve the problem. Table 7-10 shows all the messages that were posted by students on this topic.

Table 7-10. Students offering information to help a student with a problem

<table>
<thead>
<tr>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom</td>
<td>“anybody here able to access their u drive?”</td>
</tr>
</tbody>
</table>
Jansen | “NOPE”
---|---
TA | “@Thomas: I have access.”
TA | “I don't know if undergrad students have different restrictions.”
wharrgarbl | “@Thomas i can access mine too”
Tom | “it's frustrating, i can't open any documents from my desktop or drives.”
MICHAEL | “@Tom: Go to my computer, then the U drive, then the folder with your first initial, then the folder with your middle initial. You should be able to get to your documents there.”
HeHateMe | “@Tom my computer is the same way...have of these computers don't work.”

### Controversial Topics

Not surprisingly, controversial topics attract more students to a discussion. Conversations of this kind usually start with one student posting a message in ClassCommons. In that message, something is mentioned or some point is made. If other people hold different opinions, they will start posting messages debating and arguing. In this way, conversations are developed.

Table 7-11. An example of student debating on a controversial topic

<table>
<thead>
<tr>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIP Lounge</td>
<td>“we already have assignments out and pending. why are you assigning more?????”</td>
</tr>
<tr>
<td>Mike</td>
<td>“Wayyy too many assignments at once.”</td>
</tr>
<tr>
<td>Dr. Toboggan</td>
<td>“It's called work. They tend to assign it in classes. Get over it.”</td>
</tr>
<tr>
<td>VIP Lounge</td>
<td>“it's called senioritis. just because you like being a prude doesn't mean i want to stay away from the bars.”</td>
</tr>
</tbody>
</table>
Table 7-11 shows a conversation in which students began debating the topic of demanding class assignments versus social life. Initially the student with the alias “VIP Lounge” complained that there were too many assignments. Then “Dr. Toboggan” (another student)
suggested that “VIP Lounge” should “get over it”. A debate then ensued, including some personally demeaning commentary, but with several other students also contributing to the debate occasionally.

**Something Interesting to Expand**

Another situation where conversations might be developed is when something is posted that is of particular interest to another student, who then chooses to expand on the topic. Table 7-12 shows an example of this kind: Trollface posted a message in reaction to an illusion that was being discussed about in class. He mentioned “eye exam” in that message. Further, James posted a message that mimicks how an eye doctor does the exam, but also conveying his feelings, which gives the post a funny angle. Then a third student posted another funny image related to this. In conversations of this kind, other students were building the conversation using some vivid examples to amplify content raised in previous messages. To a great extent, conversations of this kind were developed opportunistically, depending on whether there is more that can be said, and particularly whether any student has more to say.

**Table 7-12. Students expand a conversation based on the term “eye exam”**

<table>
<thead>
<tr>
<th>Poster</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>trollface</td>
<td>“Some people should go get an eye exam”</td>
</tr>
<tr>
<td>James</td>
<td>“Eye doctor: Better one, or two? Me: Uhh...one?”</td>
</tr>
<tr>
<td>BigLuigi</td>
<td>“To people with bad vision”</td>
</tr>
<tr>
<td>Anonymous36</td>
<td>“Ok, thank you”</td>
</tr>
</tbody>
</table>
Chapter 8

Discussions

Generally speaking, the idea of using public backchannels to support classroom community and to facilitate community building in classrooms was well accepted by students. There was a high level of commenting in the video viewing study, and although the amount of commenting was less in the longer term study, there was uniformly positive response and desire to continue using a tool like this in the future. In this chapter, issues that came up during the studies are discussed.

Distraction

One of the biggest concerns that teachers and students express when they consider using ClassCommons in their classes is that it may be a distractive activity in the class. Some teachers were afraid that students would be distracted by messages posted by other students, and were concerned that they might lose control of the class.

However, students’ self-report data indicated that the level of distraction is modest as reported in Table 6-2 in Chapter 6.

Nonetheless, scholars have argued that in modern day of pervasive Internet access and use of wireless devices, especially smart phones operating within a ubiquitous computing context, distractions are always present (Phalen 2003). In today’s classrooms students are often browsing the Internet, checking Facebook updates, and texting to their friends. This phenomenon has been termed “continuous partial inattention” (McCarthy and boyd 2005). The role of ClassCommons
is to leverage what is already underway, that is to operate within the context of students’ continuous partial attention. In this sense, ClassCommons can be seen as a service that a student would consider using when s/he is inattentive, and using ClassCommons will in turn be more helpful to students than other activities totally unrelated to the class (for example Facebook).

Further, based on our deployment experiences thus far, we believe that teachers may also play an important role in making ClassCommons less of a distraction so that they can achieve the maximum benefits of ClassCommons. We will elaborate on this theme in the following section.

The Importance of Teacher’s Involvement

In this thesis research, the teacher’s involvement in the public backchannel discussion was minimal; all of the classes studied had TAs whose job it was to monitor the content in ClassCommons. In the video viewing study, the teacher left the use of ClassCommons system totally up to the students, so as to see whether and how they would choose to use it. In the longer term study, the teachers took similar approaches. While they were giving the lecture, they paid little attention to things going on in the public display, but on occasion they might notice a particular comment and react to it. In general they expected that their TAs would monitor the messages posted on ClassCommons, answer questions that came up and so on.

However, the students who participated in the interviews in the long-term study conveyed that they would like their teachers to pay more attention to the contribution on ClassCommons. Students wanted to have their contributions acknowledged by the teacher so that they would feel more encouraged; otherwise they would feel as if they were being ignored. Further, students believe that any answers that they get from the teacher would be more authoritative; the TA might not be able to answer all of the questions or might not be able to make a decision about a suggestion made via the backchannel.
The theory of social construction of technology (SCOT) proposes that technology does not determine human action, but rather that human action shapes technology (Bijker, Hughes et al. 1987). Given this perspective, we argue that teacher’s involvement in the public backchannel discussions is part of the human action that can shape the technology of ClassCommons. If so, finding ways to include teachers more frequently in the discussion might be critical in realizing the maximum benefits of integrating public digital backchannels in classrooms.

Pedagogical changes may be needed to enable teachers to become more involved in a public backchannel discussion. One common way of lecturing in classrooms is for a teacher to give a lecture and take questions at the end of the class. Consider what might happen if instead the teacher lectured for 15 or 30 minutes and then shifted to ClassCommons, reviewing and reacting to the content posted, as well as encouraging students to ask more questions. If class took place this way, students might feel that their ClassCommons contributions are actually being taken seriously by the teacher and might feel more motivated to use it as a result. Further, more students can ask questions and communicate with the teacher by posting on ClassCommons.

Another change the teacher might explore is to take a more proactive role in the use of ClassCommons for commenting and making suggestions. Vygotsky’s view of the Zone of Proximal Development (ZPD) refers to the potential knowledge and skill space students can reach when they are properly engaged and guided by the teacher or in collaboration with other more capable peers. If the teacher stopped on occasion and contributed his or her own question or comment to the backchannel, students might react specifically to that comment and lead themselves in further discussion while the teacher returns to the ongoing lecture. In this way, a teacher might help students achieve the ZPD by providing scaffolding in the form of brief messages or prompts for reflection.

What might the instructor contribute to provide this scaffolding? One possibility would be to post questions in ClassCommons and ask students to respond. Following our analysis of the
longer conversations, the teacher should prefer open-ended questions, as this may attract more students to participate in the discussion. Or, the teacher might raise a point or topic that s/he believes will be controversial and encourage students to freely express their opinions, as reported in chapter 7. The instructor can then review students’ answers and give feedback to students and keep the use of ClassCommons more focused.

Content Quality

In this long-term study of ClassCommons, the percentage of random conversations that had nothing to do with the class was around 25% - 30%. In the video viewing study, the corresponding percent was 19%. Informally, we observed that random conversations distracted students from the class lecture and had negative impacts on students’ classroom experience. Furthermore, in the final survey for students in IST331 and IST302, students complained about irrelevant content. For example, students mentioned that “Sometimes people posted irrelevant pictures or had irrelevant conversations”; ”Sometime, people posted things that were not relevant to the course on the display, which in some cases were a distraction.”

There are at least two techniques that teachers might use to decrease the tendency for random postings. One of these would be to encourage contributors to use their real names. In the course exit survey, students mentioned that “A lot of anonymous posts were off-topic.” Further, “having an alias didn't allow other to get to know names in class” which is not helpful in facilitating community building in classrooms. Second, teachers have an opportunity to set the norm and expectations when introducing the tool into the class. In this study, when introducing ClassCommons, the instructor did not specify the expectations. Instead students were simply encouraged to participate and post messages freely; any content was welcomed. If an instructor
knows in advance what kind of content s/he wishes to see, appropriate norms and expectations can be set in advance, possibly reducing the amount of random conversations.

**Improvements**

Finally, drawing on comments made in the end-of-semester survey in IST302 and IST331 classes, and from the interviews with students, teachers and TAs, we can propose several ways to improve ClassCommons. Students’ feedback focused on two aspects: they wanted the instructors to improve how they use ClassCommons; and they had some detailed suggestions about improving the system. Among these two, students felt that addressing the first aspect is more urgent than the system enhancements.

Students commented that they wanted the instructor to improve the way that they used the system. More specifically, they suggested that the instructor should pay more attention to the messages posted on ClassCommons, instead of just leaving it for students to interact with other students. For example, S1 said that “The only thing I would say is to pay attention to it more... and answer the question more quickly or like pause every 30 minutes to look at it”. S5 commented that: “I think if they can look at it, acknowledge the comments and answer any questions that is up there would help. Mostly, just acknowledging is the important part.” S6 also suggested that “Teacher could ask questions, students respond and the teacher acknowledge them. That would be something that would be beneficial. I think it is a good way to promote engagement and excitement”.

As to more detailed system level improvements, it is suggested that a) there should a discrete way to notify the professor when new messages are posted. S4 suggested that “Maybe there was a discrete way that the professor could be notified that something has been posted. Most of the time, the professor is lecturing, walking around the classroom, not really paying
attention to the classroom display, until the end.” b) it would be useful if users can highlight important questions on the display. For example, the instructor of PM suggested: “Please highlight the important questions on the display so that I can easily identify them and address them accordingly”.

These comments reinforce our earlier discussion of the important role that teachers can play in encouraging students’ use of the system. Students wanted the instructor to know their concerns and wanted to get the instructor’s attention.

A Call for a Classroom Sense of Community (SOC) Scale

In this thesis research we observed that a value of around 5.0 (on a 7-point scale) may be an asymptotic value for SOC in this educational settings; that is, when the community in question is a group of students who happen to be taking a course together. This is not surprising when one considers the relative looseness of the ties that bind students together over a semester. Indeed, in the classes we studied, SOC might be higher than in other moderate to large courses, simply because the students do spend significant time working in teams and sharing the corresponding team concepts with other students in the class. For a more traditional lecture-style class, we speculate that SOC would asymptote at an even lower level. However, this does not mean that feelings of community are irrelevant to the students who comprise a semester-long class. It may simply mean that we need a more custom tool for assessing and tracking these feelings. Thus to advance research in this field, we suggest that a Classroom Sense of Community scale is needed. Sense of Community is an important concept in community psychology and social psychology, however, in the current literature there is no inventory that has been specifically designed for classroom communities. In this research, we adopted a) McMillan & Chavis’s sense of community scale which has four elements: membership, influence, integration and fulfillment of
needs, and shared emotional connections (Peterson, Speer et al. 2008), and b) Rovai’s classroom sense of community scale which has 2 elements, namely connectedness and learning (Rovai 2002). Yet, neither of these scales is totally appropriate for our context: McMillan’s scale was developed for measuring SOC in neighborhood communities and Rovai’s was intended to measure SOC in distance learning classrooms. Thus, we see a need for research aimed at developing classroom SOC scale, in other words assessing feelings of classroom community where all students are collocated.

Building a classroom specific SOC scale could start from reviewing the sense of community literature, identifying the various SOC scales and the sub elements within the scales, and extract the sub elements that might be relevant and could be applied in classroom settings. In this thesis research, we adapt the McMillan’s four element SOC scale (need fulfillment, emotional connection, influence and membership), and integrate with Rovai’s 2-element (social community and learning community) distance class SOC scale. Other possible elements that might go into SOC scale could be respect, trust, caring, cohesiveness (Kettering 1987), homogeneity, interdependence and shared responsibility (Glynn 1981). The choosing of the sub elements should be based on existing community psychology theories. Starting from these sub elements and adapting the inventory from previous scales, a classroom SOC scale could be refined through confirmatory maximum likelihood factor analysis by sampling the scales with a large number of students (300- 400 students).

**Generalizing ClassCommons**

In this dissertation, the experiences of using public digital backchannels in three undergraduate classes have been reported and it demonstrated the great potential of public digital backchannels in classrooms to support student-teacher and student-student communication. The
increased interaction among students and the teacher have positive impact on students learning experiences, as reported in earlier parts of the dissertation. These three classes use PowerPoint as a medium to deliver lecture content and they are all information sciences & technology classes. However, in universities there are many more courses, which are lectured in different formats (teacher lectures using the blackboard) and on different subjects (social sciences, art classes, mathematics and engineering class). A more challenging question is whether the success achieved in this dissertation could be achieved to in other classes and what the challenges would be. In this section, how lecturing styles and course subject would influence students’ and the teachers’ use of ClassCommons is discussed.

Teachers’ lecturing style is likely to influence the adoption, and the use of public digital backchannel in classrooms. Lecturing styles like lecturing using PowerPoint and lecturing on blackboards, using chalks are the two most common ways of lecturing in classrooms. The teachers in this study all used PowerPoints to deliver lecture content and the results demonstrated positive impact of public digital backchannels in this kind of classes. For classes whose teacher mainly lectures on the blackboard using chalks, it is expected that the teacher would not be able to pay as much attention to the public digital channel as the teachers who mainly use PowerPoints because the teacher tends to focus a lot more on writing the lecture content, mathematics formulas, going through the proofs on the blackboard. In this kind of classes, keeping the public digital backchannel running all the time might not be a good way to engage the students and the teacher. In classes of this kind, it is suggested that the teacher can lecture first and then leave 10-15 minutes towards the end of the class to use public digital backchannels, soliciting questions and feedback from the students and then the teacher can address those questions accordingly.

Course subject is another factor that would influence the use of public digital backchannels. In this study, we found that most of the questions were “housekeeping” questions on the due days of assignments, where to find the presentation slides etc. However, in our
informal communications with instructors from mathematics, physics departments, it was found that students taking those classes tend to have more questions on the course subject. For examples, more questions on the course content are asked and more students come to the office hours to ask the instructor/TA questions. The possible reasons for this are that math and sciences courses are hard. Students need to learn about abstractions and apply abstractions to solve problems. According to (Campbell 2011), it is not “natural to the way the brain generally works”, so it is not surprised to find that students tend to have more questions in these kinds of courses. It is expected that public backchannel would be used more in courses of this kind. Further, in this kind of classes, minimal distraction is desired. So it is also suggested that the teacher can lecture first and then leave 10-15 minutes towards the end of the class to use public digital backchannels, soliciting questions and feedback from the students and then the teacher can address those questions accordingly.

To sum up, the idea of public digital backchannel is applicable to all kinds of classes. Depending on the nature of the course subject and the instructor’s lecturing style, it could be used differently in different classes.
Chapter 9

Future Research Plans

In this thesis research I have studied the possibilities and the impacts of integrating public digital backchannels in classrooms, both for offering students an opportunity to speak up more easily and freely, and for helping to build feelings of community. The positive feedback from the participants suggests that there is significant potential for public digital backchannels to contribute to classroom education.

The work reported here lays the groundwork for a number of new research opportunities. One important area worth pursuing is whether and how educators can steer students towards using public digital backchannels for discussions that involves higher order thinking and reflection, rather than a preponderance of “housekeeping” questions. Earlier we emphasized the importance of the teachers’ role in providing scaffolding. This leads to questions about what kind of scaffolding would be most effective? How should the teacher embed the scaffolding into the system or into his or her other activities? On a design level, what kind of designs could best support the teachers’ guiding contributions?

Another important direction for future research would be to explore mechanisms for notifying the teacher when new content is posted that needs the teacher’s attention. Currently, the teacher must stop the lecture and refer to the public display to review the content. We reported an emerging requirement from the students to get timely feedback from the teacher, but teachers’ current practices cannot meet this need. Designing effective notification technologies with minimal distraction would be an important topic to investigate for HCI researchers in education research.

More broadly, it is worth investigating the possibility of integrating public digital backchannels with existing classroom technologies, for example the persuasive PowerPoint
technology to further advance the adoption of public digital backchannel and reduce the overhead of setting up an additional public display in the classroom. Other possible direction could be integrating it within the Blackboard education system.

Finally, public digital backchannels also have great potential to support distance learning and online education. With today’s proliferation of Internet technologies, distance learning could be made more widely available for people around the world. Using public digital backchannels to support distance learning and online education would be another important field to investigate. Of course many questions arise regarding the differences between co-located and distance classes. Even when distance students “meet” in a synchronous fashion, it is by no means clear that they would feel engaged enough to use ClassCommons for sharing. Unless design enhancements were added to better convey audience, a tool like this might be experienced as simply another channel for talking “to” the instructor rather than each other.

Education is an equalizer. It can help children who are born into deprived economic and social conditions to succeed, and by so doing raise their aspirations. Education is a driver. Human knowledge is passed from generation to generation through education. Educators have the responsibilities and the obligations to ensure that students’ needs are well met in classes, that timely feedback is given, constructive suggestions are made and a welcoming education atmosphere is built. Education technologies have the great potential to help educators in achieving these goals and ClassCommons provides one set of opportunities worthy of continued exploration and evaluation.
Appendix A

Pre Survey in the Short Term Video Viewing Study

Background information questions:

1. What is your gender?
   Male, Female

2. What is your age?
   18-21, 22-25, 26-30, >30

3. What is your year at the university?
   Freshman, Sophomore, Junior, Senior

4. What is your major?
   IST, SRA, Some Combination of IST and SRA, Other

5. To ensure that you earn extra credit, please provide your PSU email account (e.g., hzd106).

7-point Likert Scale Questions

From Strongly Disagree (1), to Strongly Agree(7)

1. I can get what I need in this class.

2. This class helps me fulfill my needs.

3. I feel like a member of this class.

4. I belong in this class.

5. I have a say about what goes on in my class.

6. People in this class become better at influencing each other.

7. I feel connected to this class.

8. I have a good bond with others in this class.
Appendix B

Post Survey in the Short Term Video Viewing Study

1. First, to ensure that you earn extra credit, please again provide your PSU email account (e.g., hzd106).

2. From what devices did you access the system and post the comments? (Please check all that apply)
   Desktops b) Laptops c) iPhones d) iTouches e) BlackBerries f) other, please specify

7-point Likert Scale Questions

From Strongly Disagree (1), to Strongly Agree (7)

1. I can get what I need in this class.
2. This class helps me fulfill my needs.
3. The use of this Video Commenting System makes me feel like a member of this class.
4. The use of this Video Commenting System makes me feel more like I belong in this class.
5. The use of this Video Commenting System helps me have a say about what goes on in my class.
6. The use of this Video Commenting System help people in this class become better at influencing each other.
7. The use of Video Commenting System makes me feel more connected to this class.
8. The use of this Video Commenting System makes me have a better bond with others in this class.
9. Being able to share my comments via the public display real time helps me better interact with my classmates.
10. I would like to see the system used for more classes.
11. I only need to watch the videos, I don't want to see other people's comments
12. I only need to watch the videos, I don't want to post my own comments.

13. I think the Video Commenting System...

is desirable b) is favorable c) holds my interests d) is valuable e) is helpful f) improves class participation.

14. My interactions with Video Commenting System are clear and understandable.

15. I find it is flexible to interact with the Video Commenting System.

16. It is easy for me to become skillful at using Video Commenting System

17. I think the comments posted to the system are ...

Very Interesting… Moderately Interesting… Not Interesting at all

While I was watching the videos, I found the comments to be...

Very Distracting… Moderately Distracting… Not Distracting at all

18. How much attention did you pay to the comments?

A great deal, much, somewhat, little, not any

19. How many comments did you read?

I read every comment, I read most of them, I read some of them, I read only a few of them, I did not read any of them

**Open Ended Questions**

1. How would you describe your goal(s) when you were using the system to post comments? Did you achieve this goal? Please explain.

2. Describe one comment posted in the system where you learned something new about or gained a different insight into the videos or the course. Please explain.

3. How did you feel as you were using the Video Commenting System?

4. Do you have any suggestions as to how to improve this Video Commenting System?
Appendix C

Pre Survey Items in the Long-term ClassCommons Study

1: Strongly Disagree 2:Disagree 3:Neutral 4:Agree 5:Strongly Agree

Q1. Please indicate to which degree you agree or disagree with the following statements:

I am interested in interacting more with my professor in this class.
I am interested in interacting more with other students in this class.
I am interested in having more say over the class during the semester.

1: never use it 2: few times a year 3:few times a month 4:few times a week 5:every day
6:several times a day

Q2. How often do you use the following tools on average?

Facebook, MySpace, etc.
Instant Messaging (AIM, MSN Live Messenger etc.)
Twitter or other micro blogging tools
Online discussion forum

1: Strongly Disagree 2:Disagree 3:Neutral 4:Agree 5:Strongly Agree

Q3. Please indicate the extent to which you agree or disagree with each statement about your feeling in this class.

I feel apprehensive in this class.
I feel disturbed in this class.
I am peaceful in this class.
I feel relaxed in this class.
I feel uneasy in this class.

I feel self-assured in this class. I feel fearful in this class.

I feel ruffled in this class.

I am jumpy in this class.

I feel composed in this class.

I am insecure in this class.

I feel satisfied in this class.

I feel safe in this class.

I feel flustered in this class. I feel cheerful in this class. I feel happy in this class.

I feel dejected in this class. I feel pleased in this class.

I feel good in this class.

I feel unhappy in this class.

1:Strongly Disagree 2:Disagree 3:Slightly Disagree 4:Neutral 5:Slightly Agree 6:Agree 7:Strongly Agree

Feelings of connection to others in the class

I feel that I am encouraged to ask questions in this class.

I feel that it is hard to get help when I have a question in this class.

I feel that I receive timely feedback in this class.

During the semester, I have come to rely on several people in this class to keep up with work.

I can recognize most of the people in this class if I saw them in the street.

I feel at home in this class.

Very few of my classmates know me.

I feel that I belong when I am in this class.

I care about what my classmates think of my behavior.
If there is a problem in this class, students here can get it solved.
I have a say about what goes on in this class.
I can have an impact on discussions in this class.
I feel connected to this class.
I feel that students in this course care about each other.
I trust others in this course.
I don’t feel a spirit of community in this class.
I feel isolated in this class.

1: Strongly Disagree 2: Disagree 3:Neutral 4:Agree 5:Strongly Agree

Q4. Extroversion

Please indicate the extent to which you agree or disagree with each statement about you.

I usually try to make new friends.
Other people say I am an outgoing person.
I usually say what I feel like saying at the moment. I enjoy parties just to be with people.
I feel alone at school.
I feel left out of things at school.
I am lonely at school.

1: Strongly Disagree 2: Disagree 3:Neutral 4:Agree 5:Strongly Agree

Your feelings about giving speeches in public

I have no fear of giving a speech.
Certain parts of my body feel very tense and rigid while I am giving a speech.
I feel relaxed while giving a speech.
My thoughts become confused and jumbled when I am giving a speech.
I face the prospect of giving a speech with confidence.

While giving a speech, I get so nervous I forget facts I really know.

1: Strongly Disagree 2:Disagree 3:Neutral 4:Agree 5:Strongly Agree

Q5. Teacher Apprehension

Please indicate the extent to which you agree or disagree with each statement about your feeling about the teacher.

5.1 Feelings about the teacher for this course

5.2 I feel uncomfortable receiving communication from my teacher.

5.3 I feel disturbed when my teacher communicates with me.

5.4 I have no fear when my teacher communicates with me.

5.5 I am comfortable when my teacher communicates with me.

5.6 I feel uneasy when my teacher talks to me.

5.7 I feel relaxed when listening to my teacher.

5.8 I feel fearful when my teacher talks.

5.9 I feel ruffled when my teacher talks to me.

5.10 I feel happy when he or she is talking to us.

5.11 I feel composed when listening to my teacher. I am bothered when my teacher talks.

5.12 I feel satisfied when my teacher is talking and teaching.

5.13 I feel safe when my teacher communicates.

5.14 I feel nervous when listening to my teacher. I am cheerful when my teacher is talking.

5.15 I feel happy when my teacher is communicating ideas to the class.

5.16 I feel dejected or hurt when my teacher is communicating.

5.17 I feel pleasure when my teacher talks to me.

5.18 I feel good when my instructor is teaching a lesson to us.
5.19 I feel happy when he or she is talking to us.
Appendix D

Mid Survey in the Long-term ClassCommons Study

Q1: Which would you prefer to see in the ClassCommons system when you are reading messages posted?

[ ] Real name
[ ] Nick name
[ ] I do not have preferences

Q2: Which would you prefer to use when you are posting a message in ClassCommons?

[ ] Real name
[ ] Nick name
[ ] I do not have preferences


Q3. Sense of Community

Please indicate the extent to which you agree or disagree with each statement about your feeling in this class.

3.1 I feel that I am encouraged to ask questions in this class.
3.2 I feel that it is hard to get help when I have a question in this class.
3.3 I feel that I receive timely feedback in this class.
3.4 During the semester, I have come to reply on several people in this class to keep up with work.
3.5 I can recognize most of the people in this class if I saw them in the street.
3.6 I feel at home in this class.
3.7 Very few of my classmates know me.
3.8 I feel that I belong when I am in this class.
3.9 I care about what my classmates think of my behavior.
3.10 If there is a problem in this class, students here can get it solved.
3.11 I have a say about what goes on in this class.
3.12 I can have an impact on discussions in this class.
3.13 I feel connected to this class.
3.14 I feel that students in this course care about each other.
3.15 I trust others in this course.
3.16 I don't feel a spirit of community in this class.
3.17 I feel isolated in this class.

Q4. How often did you glance at the public display for ClassCommons in the class?
1: very often 2: often 3: sometimes 4: rarely 5: never

Q5. How often did you check the ClassCommons system on your own workstation in the class?
1: very often 2: often 3: sometimes 4: rarely 5: never

Q6. How many messages did you read?
1: I read every comment 2: I read most of them 3: I read some of them 4: I read only a few of them 5: I did not read any of them.


Q7. Please indicate the extent to which you agree or disagree with each statement.
7.1 The public display of students’ messages encourages better interaction in the classroom.
7.2 Being able to share messages via the public display real time helps me better interact with my classmates.

7.3 Being able to share messages via the public display real time helps me better interact with my instructor.

**Q8. Please indicate the extent to which you agree or disagree with each statement.**

8.1 I think the comments posted to the system are interesting.

8.2 I learned new information from the messages posted by other students.

8.3 The messages posted in Classcommons are relevant to the class.

8.4 I like using this system in this class.

8.5 I would like to see the system used for more classes in the future.

**Q9. While I was in the class, I found the comments to be...**

1:very distracting 2:distracting 3:moderately distracting 4:of little distraction 5:not distracting at all

**Q10. What are the things that you like the best about ClassCommons?**

**Q11. What are the things that you like the worst about ClassCommons?**

**Q12. To ensure that you earn extra credit, please provide your PSU email account (e.g., hzd106)
Appendix E

Post Survey in the Long-term ClassCommons Study

Q1. Social Support

Please indicate the extent to which you agree or disagree with each statement about your feeling in this class.


1.1 If I wanted to do some extra studying for a quiz, I would have a hard time finding someone to study with me.

1.2 I feel that there is no one in this class I can share my most private worries and fears about the course with.

1.3 If I realize one afternoon that I need help with a particular usability engineering concept, I could easily find someone in the class to help me.

1.4 If I wanted to form a small reading group to study for this class, I could easily find others to join me.

1.5 If I really do not understand something, there is someone in the class I ask to help me

1.6 If I needed to get some serious issues about this course off my chest, I would have a hard time finding someone to listen to me.

Q2. Self Efficacy

The statements below describe situations that commonly arise in this class. For each situation please rate how certain you are that you can manage them effectively. Please indicate the extent to which you agree or disagree with each statement.
2.1 I can have an impact on class discussions, even though I am only one member in a relatively large group of students.

2.2 Even though I may have trouble at first, I can master the concepts that come up in this course.

2.3 I can do well on quizzes in this course, even if the instructor includes a few tricky questions.

2.4 I can solve most problems in this class if I invest the necessary effort.

Q3. Collective Efficacy

The statements below describe situations that commonly arise in this class. For each situation please rate how certain you are that your class, working together as a whole, can manage them effectively. Please indicate the extent to which you agree or disagree with each statement.

3.1 OUR CLASS can ensure that all members' ideas are considered, even if one idea does not seem to "fit".

3.2 OUR CLASS can critically address important issues, even if they are inherently controversial. OUR CLASS can ensure that everybody gets a chance to contribute to discussions, even though we are not all comfortable speaking up.

3.3 OUR CLASS can take responsibility for the quality of discussions, even though the instructor chooses the topics.

3.4 OUR CLASS can build on ideas suggested by a wide variety of class members, even when the ideas lead discussion in many different directions

3.5 OUR Class can negotiate with the instructor about course related stuff, even though the instructor makes the final decision.

Q4. Sense of Community

Please indicate the extent to which you agree or disagree with each statement about your feeling in this class.
4.1 I feel that I am encouraged to ask questions in this class.

4.2 I feel that it is hard to get help when I have a question in this class.

4.3 I feel that I receive timely feedback in this class.

4.4 During the semester, I have come to rely on several people in this class to keep up with work.

4.5 I can recognize most of the people in this class if I saw them in the street.

4.6 I feel at home in this class.

4.7 Very few of my classmates know me.

4.8 I feel that I belong when I am in this class.

4.9 I care about what my classmates think of my behavior.

4.10 If there is a problem in this class, students here can get it solved.

4.11 I have a say about what goes on in this class.

4.12 I can have an impact on discussions in this class.

4.13 I feel connected to this class.

4.14 I feel that students in this course care about each other.

4.15 I trust others in this course.

4.16 I don’t feel a spirit of community in this class.

4.17 I feel isolated in this class.

1: very much 2: much 3: some 4: a little 5: none

Q5. How much do you think the instructor has paid attention to things discussed in the ClassCommons system?

Q6. How much do you think the TA has paid attention to things discussed in the ClassCommons system?
References


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The Pennsylvania State University, University Park, PA (August 2007 – Present)
Ph.D Candidate, Human Computer Interaction

Renmin University of China, Beijing (September 2002 – June 2006)
Bachelor of Science, Management Information System

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Dissertation Project, HCI lab at Pennsylvania State University (2007 – present)
Research Intern, Palo Alto, CA, Palo Alto Research Center (May 2011 – Present)
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Awards & Honors

- Peer Bonus Award at Google
- Penn State University Graduate Student Fellowship, September 2007
- University Level Three Good Student Honor, Renmin University of China, June 2006
- First Prize Scholarship Award, Renmin University of China, May 2006
- Second Prize Scholarship Award, Renmin University of China, May 2005
- Excellent Social Work Award, Renmin University of China, May 2004
- Second Prize Scholarship Award, Renmin University of China, May 2003