The Pennsylvania State University

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"I FELT LIKE A CONTRIBUTING MEMBER OF THE CLASS": INCREASING CLASS PARTICIPATION WITH CLASSCOMMONS

A Thesis in

Information Sciences and Technology

by

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ABSTRACT

Public displays have become pervasive in everyday life. Recent technological development has decreased the cost of such displays and they have been adopted increasingly in places where people meet each other, e.g., town centers, cafés, classrooms, libraries, offices. Currently, most public displays are non-interactive, serving a broadcast function (TV news, ads, etc). Our informal observations around public displays in our own building indicate that people pay little attention to the displays. In fact, it is generally accepted that most large public displays are under-utilized. However, given their strategic spatial positioning such displays might easily be used to attract the attention of people who are working or relaxing in the area. The work reported here explores the question of whether social interaction through a public display can also promote a sense of community amongst the participants. The design and first deployment experiences of a platform-independent, interactive video commenting system, ClassCommons, using a large public display in two sections of a large-enrollment university class, is described here. The preliminary evaluation suggests that students enjoyed the activity of commenting, that they participated a great deal, and that their sense of community was greater after using the system. Further analysis revealed that reading the comments and posting relevant comments are associated with increases in community members' sense of community. Finally, lessons learned from this initial experience and further work using this and similar interactive activities will be discussed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Chapter 1

INTRODUCTION

Public displays have become pervasive in everyday life. Recent technological development has decreased the cost of such displays and they have been adopted increasingly in places where people meet each other, e.g., town centers, cafés, classrooms, libraries, offices.

Currently, most public displays are non-interactive (Churchill, Denoue et al. 2004), serving a broadcast function (TV news, ads, etc). Our informal observations around public displays in our own building indicate that people pay little attention to the displays. In fact, it is generally accepted that most large public displays are under-utilized. However, given their strategic spatial positioning such displays might easily be used to attract the attention of people who are working or relaxing in the area; if the displays also accept input from these individuals, they can enable social interaction and networking (Churchill, Denoue et al. 2004). The work reported here explores the question of whether social interaction through a public display can also promote a sense of community amongst the participants.

Feelings of community within a group of individuals can have important consequences for their behavior. The phrase *sense of community* 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). In neighborhoods, a sense of

community 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 who have a sense of community 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, studies have found that for schools with a strong sense of community, the number of students who feel lost is reduced, students' feeling of anxiety, depression and loneliness is ameliorated, and personal growth, motivation and retention rate are improved (Lounsbury and DeNeui 1996; Bailey, Bauman et al. 1998; Cartland, Ruch-Ross et al. 2003).

However, simply working or living in the same place does not guarantee a 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).

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). The ClassCommons tool reported here offers university students a lightweight mechanism for interaction, namely commenting together on large public display. Thus our research question is whether the interactions that result will build or enhance students' feelings of community.

In this thesis, I first review related work on interactive public displays. After this I describe ClassCommons, the public video commenting system I developed (*commons* refers to shared property in a community, and is often used as a metaphor for social capital). Next, the early deployment experiences in a university classroom setting are described. Although classes are only semi-public, the lessons we have learned from this experience can be used to guide future work with interactive displays in public places. Currently, the ClassCommons system is being used in IST413 class. One of its variations, namely CafeCommons, is being used in a campus cafe. The thesis is concluded with some initial result about the use of these systems in these two settings.

Chapter 2

Literature Review

2.1 Public Display as Collaborative Workspace

Most research on public displays falls into two categories. One is the use of large public displays as a collaborative workspace to support group activity awareness (Greenberg and Rounding 2001; Huang and Mynatt 2003), and to aid group memories (Fass, Forlizzi et al. 2002). After analyzing many of the existing and past projects that utilize public display as collaborative work space and drawing on ideas from (Huang and Mynatt 2003), it is found that those projects could be meaningfully subdivided along two dimension. First, collaborative public display spaces could be categorized by the size of group they are intended to support. Some of them only targeted at supporting groups of small sizes. For example, Notification Collage (Greenberg and Rounding 2001) is a groupware system utilizing a share public display to support group awareness within a small community, where people can post media elements onto a read time collaborative surface that all members can see. Community members indicate their presence to others by posting live videos (Figure 1). MessayBoard is another example of use of public display as collaborative work space to aid memories of small groups (Fass, Forlizzi et al. 2002). In the MessyBoard study, it is found that MessyBoard is especially useful for scheduling, and supporting factual as well as emotional communications among group members (Figure 2).

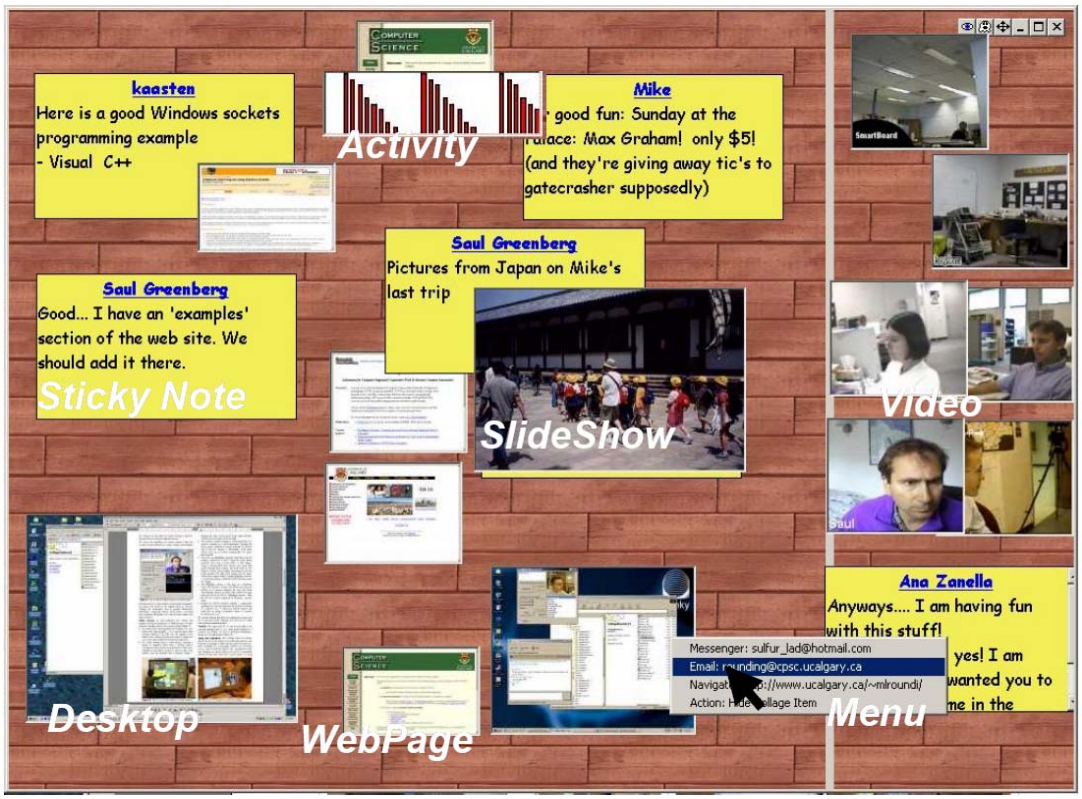
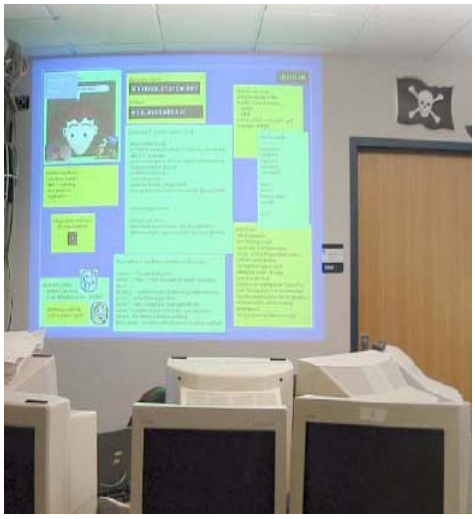


Figure 1: Screenshot of Notification Collage (Greenberg and Rounding 2001)



Rescheduling next week's teleconference (Tuesday, 16 October)
When are you available?

	<12	1:30-3:30
Andrew	no	ok
cedar	ok	all day
J9	ok	ok
Denny	ok	ok
Adam	ok	ok
Phantom	no	>2
tom	no	maybe....well, ok
Randy	ok	no

randy has a class 1:30-3:30, and 3 people can't come in the morning, sooo....
how about someone make an exec. decision about who needs to be there? We vote tuesday at 2:30 (cedar & J9), since that seems to be the maximal participation (if everyone is counted equally, that is)

I (Adam) agree.

Figure 2: MessyBoard for Schueduling (Fass, Forlizzi et al. 2002)

In addition to supporting small communities, public displays have also been used to aid memories and activity awareness in large groups, like a company of a hundred. A fundamental difference between supporting small community and aiding large group is that, when aimed at supporting large group awareness, in addition to a central public display, some simple client applications are also required to be installed on distributed group members' computers. For example, in the Elvin projects, people need to install a TickerTape (Figure4) client on their computers. The TickerTape cycles through all the information individual members contribute and thus provide group activity awareness among members. When people go to the kitchen for a coffee break, they can click on a CoffeeBiff (Figure3) icon to indicate their intention to colleagues. This information is then sent to everyone who has installed TickerTape (Fitzpatrick, Kaplan et al. 2002). Similar studies of using public display to support large groups could also be found in FishTank (Farrell 2001), GroupCast (McCarthy, Costa et al. 2001) and synthetic group photo (Hudson and Smith 1996).

Figure 3: Coffee Biff (Fitzpatrick, Kaplan et al. 2002)

Figure 4: TickerTape (Fitzpatrick, Kaplan et al. 2002)

When group size changes, the level of information shared on the display also changes. Previous studies have found that for large groups, instead of sharing detailed personal activity information, providing low level of general awareness information, such as indicating the presence or absence of group members, has been most successful (Farrell 2001; Jancke, Venolia et al. 2001). It could be explained by the fact that people have more privacy concerns about sharing detailed information to a large number of people.

In addition, collaborative public display spaces could also be categorized by the environment in which such displays are placed and viewed by group members. Some displays are placed in semi-public places such as labs, classrooms or offices. Some are placed in more public places such as kitchen or lounge area of a building. The above mentioned two applications which primarily support small groups; the Notification Collage and Messy Board, are all placed in semi-public spaces. Applications aimed at supporting large groups are usually placed in public places within buildings.

To sum up, in this line of research of designing public display as collaborative work space, public displays are tools that deliver information to loosely collocated group members to support group awareness and aid group memories.

2.2 Public Display Interaction Techniques and Applications

2.2.1 Public Display Interaction using Multi–touch Techniques

A second stream of research on public displays is aimed at exploring interactive techniques and applications that would integrate public displays into social contexts, not for working purposes, but mostly for entertaining and relaxing. In terms of interaction techniques, both multi-touch and personal device-based interaction techniques have been studied.

Multi-touch denotes a set of interaction techniques which allow users to control graphical applications on the public display with few fingers. As opposed to standard touch screens, like ATM, which only recognizes several touch points on the screen, multi-touch recognizes multiple simultaneous touch points. Multi-touch has been widely used in personal devices like iphones, ipods as well as MacBook and MacBook Pro. In the meantime, researchers are exploring the possibility of using multi-touch techniques to support multiple-users collaboration over large public displays. Some prototypes have been developed, like DiamondTouch(Figure 5, (Dietz and Leigh 2001; Esenther, Forlines et al. 2002)) and Mircosoft Surface (Microsoft 2009). Both share the same ideas but with different techniques to achieve the goal of multi-touch, multi-user interaction.

Figure 5: DiamondTouch supporting multi-user, multi-touch interaction (Esenther, Forlines et al. 2002)

Multi-touch interaction is device-independent, yet it suffers from the drawback that only a limited number of users can interact with the display at one time and they must be physically close to the display.

The CityWall is a multi-touch interactive display installed in an urban setting. It is a novel application and has attracted much attention from the pedestrians. Yet, just as its title says “It’s Mine, Don’t Touch!” (Peltonen, Kurvinen et al. 2008), it can support only a few users at one time. The same problem is also found in DiamondTouch. As has been illustrated in Figure 5, when multi-users are interacting with DiamondTouch at the same time, it is necessary to differentiate different users’ fingers. However, the current solution to this problem is very cumbersome. To differentiate different users’ fingers, the system requires users to sit on a special chair which is connected to the system. Only people sitting in the chair can interact with the display.

Similar problems were realized in (Vogel and Balakrishnan 2004), and the ideas of subtle interaction and implicit interaction for people not being able to interact with the display directly are proposed to ameliorate the problem (Figure7). In this framework, it is suggested that the public display can interact with people standing in the subtle interaction phase or implicit interaction by automatically detecting users' body position and orientation and use this information to infer their openness to receiving information and display the information somewhere on the display where users can see , Yet, still only a limited number of users can interact simultaneously and the level of interaction participants can get from the public display are not equally the same

Figure 6: City Wall in use, only a few people can interact with it at one time (Peltonen, Kurvinen et al. 2008)

Another issue with multi-touch interaction is that it usually requires users to enact their behaviors *in front of* the public display, with other co-present (and curious) people watching. This put users at an awkward viewing perspective (Ballagas, Rohs et al. 2004). According to (Agamanolis 2003), *"half the battle in designing an interactive situated or public display is designing how the display will invite that interaction"*. In the multi-touch interaction situation, the social embarrassment caused by the performance

requirement has been identified as a key factor for people's reluctance to participate in the interaction activities (Rogers and Brignull 2002).

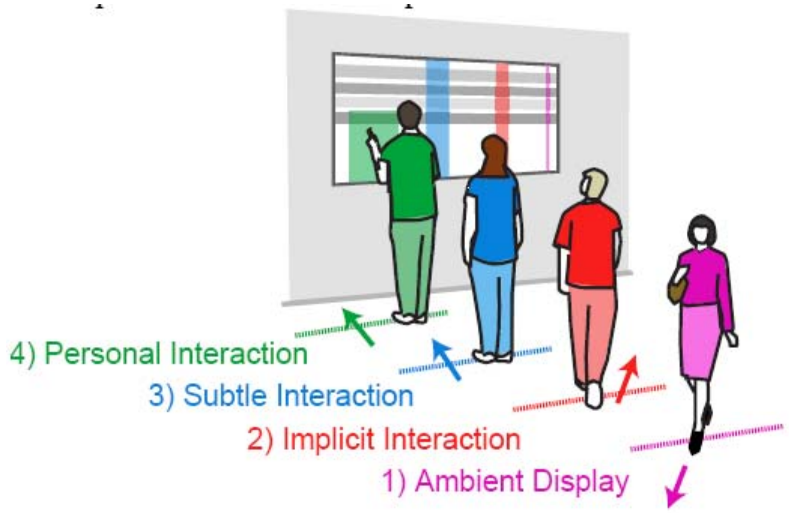


Figure 7: Subtle Interaction and Implicit Interaction in front of public display (Vogel and Balakrishnan 2004)

The characteristics of multi-touch interaction technique make multi-touch interaction suitable for situations where the number of potential interacting users is small and where users are familiar with each, like in offices and labs. To support multi-user interaction with public display in large scales and to reduce the social embarrassment, personal device based interaction seems to be more promising, which will be introduced in the following part.

2.2.2 Personal Devices based Public Display Interaction

"Your mobile phone is the first truly pervasive computer."

(Ballagas, Borchers et al. 2006)

In the whole world, nearly 60.6% of the whole populations have their own mobile phones. As of March of 2008, about 85.7% of Americans have mobile phones. In European Union, the number reaches even higher to 93.7% (CIA 2009). With the increasing number of mobile phones, the computing capability of these mobile devices is also increasing dramatically over the past few years. With the faith that mobile devices could be "ubiquitous input devices (Ballagas, Borchers et al. 2006)", researchers have invested much interest in designing mobile phone based public display interaction techniques and have achieved some success.

In designing personal device based public display interactions, users' personal devices (mainly mobile phones) are used as client tools to input information to the public display. The information (text messages, photos, video or audio) could be displayed on the display directly. If the information is commanding information, the mobile phones could also be used to control objects on the public display. In the following part, mobile device based interaction techniques of these two general types will be reviewed respectively.

2.2.2.1 Interacting with Public Display with Network Connections

Submitting content from mobile devices to public displays could be achieved through several different ways, such as text-messaging, Bluetooth, mobile network (eg. GSM, GPRS, HSCSD, or UMTS) or Free WiFi.

Table 1 presents a comparison among different information sharing mechanism. Text-messaging involves little cost on the users' end and has the advantage that users are familiar with text messaging. However, the issue with text-messaging is that it has limited capability in supporting submitting multi-media content to the display. Although Multimedia messaging has been developed and commercialized, it has achieve little success so far.

	Text-messaging	**Bluetooth**	**Mobile Network**	**Free WiFi**
Types of Information	Plain text messages	Multi-media content	Multi-media content	Multi-media content
Cost	Little	Free	Data Fees	Free
Distance to the display	No distance limit	At most 10 meters from the service	No distance limit	No distance limit
# of Connection	No limit	7 connections at one time	No limit	No limit

Table 1: Comparison among different mobile device input methods

By using Bluetooth, users can have the capability to interact with public displays without incurring personal financial connectivity cost (Cheverst, Dix et al. 2005). However, the fact that Bluetooth only support 7 connections simultaneously and requires users to be within 10 meters around the Bluetooth server limits its use to a great extent (Scheible and Ojala 2005).

Mobile network and Free WiFi connection are basically the same along all the dimensions compared here, expect for the fact the when using mobile network, users have to pay additional connectivity fees to mobile network providers. Both of them support multi-media sharing, unlimited number of connections and have no distance limit.

Of the four mechanisms, Free WiFi is the most desirable in that it involves no cost on users' side and it could support all media types without any limitations. Although currently most places still do not have free WiFi services, it is expected that it will become pervasive and available as community develops and technology advances, as envisioned in (Carroll and Rosson 2008).

2.2.2.2 Gesture based Objects Control through Mobile Phones

A second stream of research on mobile based public display interaction is aimed at exploring techniques that can let users control objects on the display from a distance. Mobile devices are used as pointing terminals. Various methods have been used to achieve this. For example, it could be achieved through continuous indirect translation with a track pad, continuous indirect translation with velocity-controlled joysticks, continuous indirect translation with accelerometers, continuous indirect translation with directional step keys, continuous direct translation with camera tracking, continuous

indirect translation with camera tracking, discrete translation using camera image, and various other ways (Ballagas, Borchers et al. 2006).[1]

Figure 8: Continuous Indirect Tracking with Camera Tracking
(Ballagas, Borchers et al. 2006)

Figure 9: Discrete direct translation using a camera image
(Ballagas, Rohs et al. 2005)

[1] The technical details are not within the scope of this thesis. Please refer to Ballagas, R., J. Borchers, et al. (2006). "The smart phone: a ubiquitous input device." IEEE Pervasive Computing **5**(1): 70-77, for more details

These gesture based mobile and public display interaction technique are novel and have not been widely adopted yet. It requires high computing capabilities on the mobile device in order to reduce latency and increase the precision of pointing. Users also must be close to the display (usually within 1 meters from the display) (Ballagas, Rohs et al. 2005).

In general, interaction with public displays using personal devices through mobile network seems to be more promising because of the ubiquity of mobile devices, users' familiarity with their own devices (Ballagas, Rohs et al. 2004; Sas and Dix 2008), the capability of supporting a large numbers of users at the same time (Scheible and Ojala 2005; Maunder, Marsden et al. 2008; Scheible, Ojala et al. 2008) and availability of mobile networks. ClassCommons adopts a device-based mobile network interaction approach.

2.2.3 Public Display Interactive Applications

Using interaction techniques reviewed above, various public display interaction applications have developed and studies. Previous researchers have explored applications of two general types. One is gaming (Tuulos, Scheible et al. 2007; Finke, Tang et al. 2008); the other is information sharing (Churchill, Denoue et al. 2004; Peltonen, Salovaara et al. 2007; Peltonen, Kurvinen et al. 2008).

2.2.3.1 Interactive Game on Public Displays

The biggest success amongst the recent game console release has been the launch of the Nintendo Wii (Vajk, Bamford et al. 2008). A distinguishing feature of the console is its wireless controller, the Wii Remote, which can be used as a handheld pointing device and detect movement in three dimensions. Interactive public display games share basically the same idea as Wii. It aims at utilizing the ubiquitous mobile phones as remote consoles to control the game on the public display.

Polar defense (Finke, Tang et al. 2008) and the Poppet (Vajk, Bamford et al. 2008) systems are two examples of such interactive games on public displays. In the Polar defense system, users can control the objects on the display using SMS. In Poppet, sensors are added to users' mobile phones so as to control the game. The games on public displays are usually simple but entertaining games, like racing (Vajk, Bamford et al. 2008) , placing towers on a virtual world to defend the field from oncoming enemies (Finke, Tang et al. 2008) and collaborative story telling (Tuulos, Scheible et al. 2007).

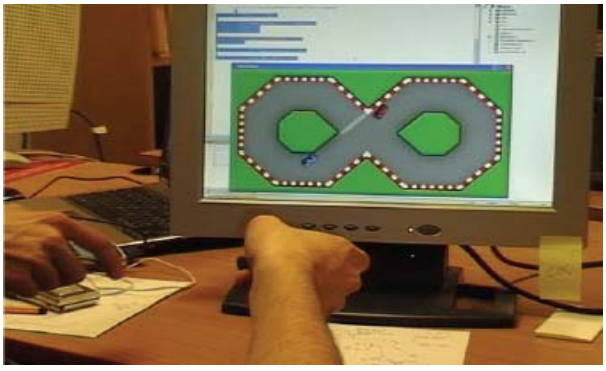


Figure 10: Racing using Mobile phones as console
(Vajk, Bamford et al. 2008)

Figure 11: Polar Defense, placing towers to defend enemies
(Finke, Tang et al. 2008)

2.2.3.2 Information Sharing on Public Displays

In the early years of the Internet, websites' major mission is to publish information for people to read. Users are passive information receivers. As Internet develops, the idea of "web 2.0" (Web2.0 2009)emerges and users can contribute their knowledge and information and share it with other people. This further brings diversity and novelty and injects new energy to the Internet.

The development of interactive public display applications follows exactly the same path. Large public displays were firstly used to replace the community boards on streets and in work places (Figure 12). Administrators manage the content to be displayed on the screen, waiting for opportunities when users can get this information either through *peripheral noticing* or *active reading (Churchill, Nelson et al. 2003)*. Actually, currently most public displays are still only serving the mono-function of broadcasting. Having realized the potential of these public displays in receiving inputs from individuals,

researchers have devoted much effort in designing interactive public displays for content sharing, from plain text messages to multi-media content (photos, audio and video, etc)

Figure 12: Community Boards (Churchill and Les Nelson 2003)

The idea behind the various information sharing applications is that users can post their content to the display and share it with all the other people, who may be also watching the display at that time or who may watch it later. The Plasma Poster (Churchill, Nelson et al. 2003) is an example of this kind. Users can post multi-media content to the display through emails or web clients. A variation of Plasma Poster, called eyeCanvas (Churchill 2007), can let users scribble on the surface of the display and then the scribble could be saved on the display and viewed by other people later. Similar designs could be found in Notification Collage (Greenberg and Rounding 2001), , Dynamo (Izadi, Brignull et al. 2003), Manhattan Story Mashup (Tuulos, Scheible et al. 2007), MobiToss (Scheible, Ojala et al. 2008), CoCollage (Farnham, McCarthy et al. 2009)(Figure 3) and various other projects (Huang and Mynatt 2003; Cheverst, Dix et al. 2005; Peltonen, Kurvinen et al. 2008).

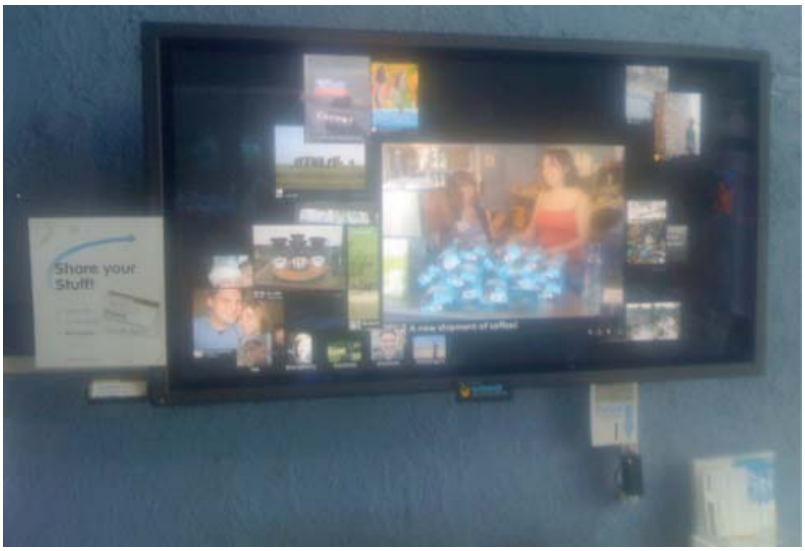


Figure 13: CoCollage displays user-submitted photos, an example of information sharing on public display
(Farnham, McCarthy et al. 2009)

So far, information sharing on public display have achieved some success, as evident by the presence of such applications in some third places (Oldenburg 1989), like Cafés (Farnham, McCarthy et al. 2009) and bars (Churchill 2007).

Looking back at all these various projects, it is found that most of these applications rely on multi-media contents, and it indeed achieved the goal of human-public display interaction. However, few studies have examined whether such kind of interaction could become *ice-breakers* (Rogers and Brignull 2002)for people to start real conversation with each other, especially in third places.

Figure 14: MobiLenin, users can vote their favorite music track using mobile phones(Scheible and Ojala 2005)

Inspired by the idea of designing public display as “tickets to talk” (Moerman 1990) in public spaces, a public video commenting system is designed in this study. The video commenting system described in this thesis falls into general classification of information sharing, but it adds a real-time evaluative component. A related system is MobiLenin (Scheible and Ojala 2005), which lets an audience vote for music tracks with mobile phones. However, MobiLenin interaction between audience and display is limited. Our ClassCommons system extends the voting concept by empowering audience members to speak out freely; the resulting comments are shared on the public display in close to real time, thus viewable to all other audience members.

Our work with ClassCommons is more than an exploratory design for public display interaction. We are particularly interested in the effects that public commenting may have for class members’ feelings of connection to one another. A deficit of previous work is that although instilling sense of community is often offered as a motivation for

use of public displays, few studies have used quantitative methods to evaluate whether or not this goal has been achieved. The current study explicitly addresses this question in a large-scale trial, using a mix of quantitative and with qualitative methods for richer understanding.

Chapter 3

System Architecture of ClassCommons

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 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.

The requirements for ClassCommons were relatively 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 15, The ClassCommons system accomplishes this with three basic components; there is 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.

3.1 Client Side of ClassCommons

Any device with access to the Internet can be a client. To send comments, users log in to a posting website. Figure 16 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 16 (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 16(c))

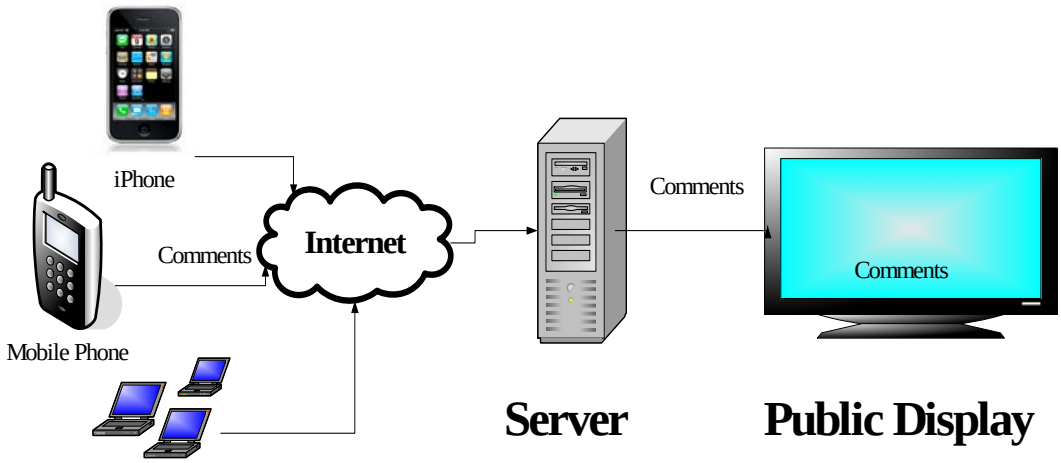


Figure 15: ClassCommons System Architecture

Figure 16: Client Interface on iPhone: (a) login page (b) post comments (c) a comment is posted (d) top commenter list

3.2 Server Side of ClassCommons

The server is implemented using JSP and MySQL database. All comments are sent to the server, which schedules the sequence and timing for presenting messages on the public display. The server also takes care of functions such as logging the comments in the database, 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 comments are displayed on the public display in a “First In First Out” (FIFO) fashion, namely comments posted earlier will be displayed first.

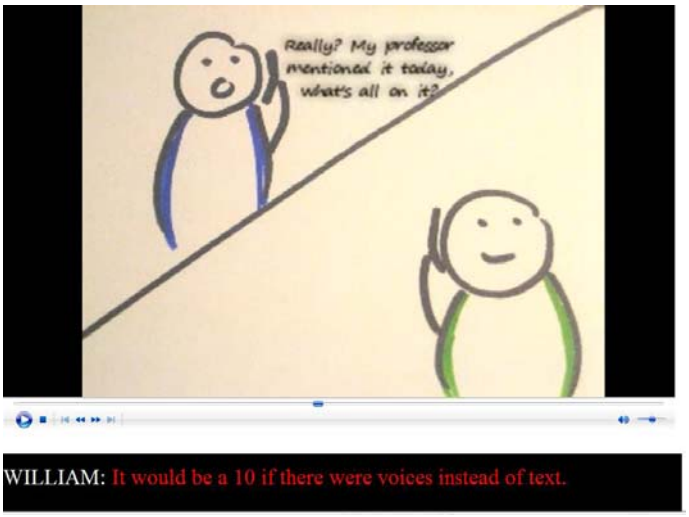


Figure 17: Public Display view, video in the upper part, and comment in the bottom

3.3 The Public Display in ClassCommons

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 17 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. AJAX allows us to update the ticker without reloading the page, so that new comments appear in a seamless and non-interruptive fashion.

The whole system is implemented using JSP, AJAX and MySQL database. As a web application, it is platform independent and gives us the scalability and flexibility and can be quickly deployed in any public display setting.

Chapter 4

Filed Trial in IST110

4.1 Reasons for Choosing this Venue

The video commenting system is used by students in an introductory class, IST110, which was mainly for first semester students, at College of Information Sciences and Technology at Penn State University, University Park. We used two sections of the same course taught by a single instructor. Section 1 has 120 students and Section 2 has 134 students. The class meets 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 18). The students are organized into teams of 6-7 students who sit together and spend considerable time working as a group. Both sections meet on Mondays and Wednesdays, one in the morning and the other in the afternoon.

Figure 18: 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 trying out the activity 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"*. Building sense of community within students in large classes can improve the quality of the educational experience a lot.

A second reason is the tradition in this course for teams to produce a 5-minute video as part of their final project; the last week of class is used to share these videos. In the past, students just sat and watched the videos; we wanted to support a more active viewing experience.

4.2 Procedure

We deployed the system in the final week of class (during the first week of December 2008; Figure18). Each section viewed their own and peers' videos on two different days for periods lasting about 45-60 minutes. Section 1 used this system in the mornings and section 2 in the afternoons. Across the two viewing days, there were 19 team videos from the first section and 21 from the second.

Every student was given a login account. 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 etc) to the 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. As the video were played at the front of the classroom, students could post comments. In a few seconds, each comment would be displayed in order of submission. The students' names were appended to the comment to increase their sense of accountability for what they said.

Chapter 5

Data Collection Methods

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 videos were shown. In the email, the ClassCommons project was summarized and students were invited to complete an online background survey; they were 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). We drew upon existing survey instruments(Peterson, Speer et al. 2008) for these measures. The background survey was closed the night before the video sessions began.

Post-usage survey. After the video viewing and commenting sessions were over, students were invited to complete a second survey. In this one, their sense of community *after* using the system (PostSOC) was measured. 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.

Log data. All the comments students posted to the public display were logged on the server. Log data include the comments, the video currently in play when a comment was submitted, and the time a comment was posted.

On-site observation. Observations were carried out during the class. Two researchers were in the classroom observing students' use of this system. One researcher was in the front of the classroom and the other in the middle of the classroom.

Chapter 6

Data Analysis and Result

Our initial field trial of ClassCommons was successful. Students participated at a high level: the two sections posted a total of 3115 comments across the four video review sessions (about 250 minutes). This means that approximately every five seconds a new comment was posted. Combined attendance for the two sections was 192. The log data reveals that 129(67.2%) students posted comments, with an average of 24 comments each. One factor preventing some students from posting comments was the limited number of workstations in the classroom (6-7 students share two computers). Although students were encouraged to bring their own laptops or web-enabled mobile phones, but not all did 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.

The distribution of the comments per student revealed a familiar exponential distribution (Figure 19): 20% of the most active participants contributed 80% of the comments and the remaining 80% contributed 20%.

Most of the comments were short; the average length was 4.97 words and Internet shorthand was common. For example, FTW(for the win), FTL(for the loss), ROFL(roll on the floor laughing), PWNED(previously owned), lol(laugh out loud), and similar acronyms were often used in the comments. Also, many emoticons, like :(, >_<, (sad), and i<3(I love you) appeared in the comments.

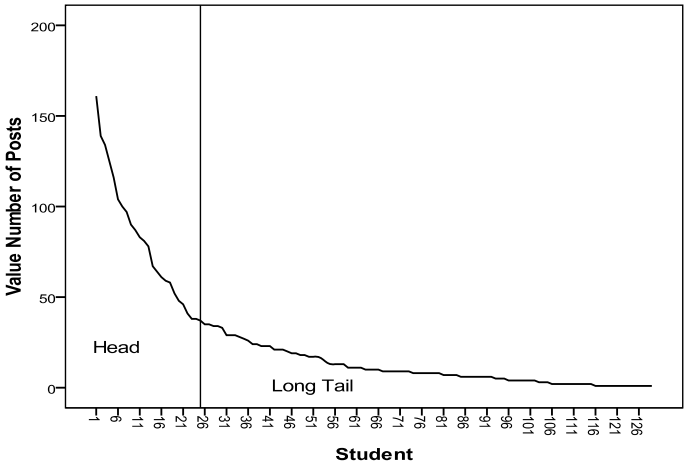


Figure 19: The per-student distribution of comments

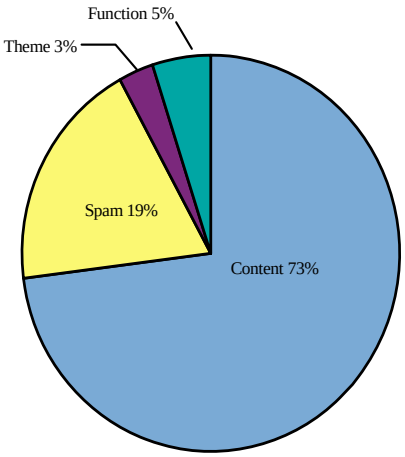


Figure 20: Content Types

In a preliminary analysis, we classified the comments into four types: content comments, theme comments, functional comments and spam. Content comments refer to messages reacting to parts of the video, e.g., raising questions or criticizing what they are seeing. 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 reflect on the video. For instance, in a video on 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 are requests 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 are irrelevant and 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"*.

As seen in Figure 20, the majority of messages were content comments (73%). Our informal observations indicated that a typical behavior was for a student to make a brief extemporaneous comment as he or she saw something specific in the video. Theme content comments were less frequent, perhaps because the videos were played non-stop, and more reflective comments were quickly overwhelmed by content reactions to the video underway.

The fact that there are so many spam comments even in a classroom setting was surprising to us. We noted that spamming occurred most often when students thought the current video was boring. They used spam messages to vote against those videos, and some spam message tended to provoke others. Some were even quite offensive.

6.1 Effects of System Usage on 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 (sense of community, and participants' reaction toward the system). Specifically, we investigate the extent to which the usage of ClassCommons might increase students' sense of community.

Our survey data comes from the 90 students who filled both the background survey and the post-usage survey. Two outliers were identified and deleted, so we ended up with a dataset of 88 participants.

We gathered several demographic variables: gender, age, year at the university and major. The survey result revealed that 72.7 % (64) of our participants are male and 27.3% (24) are female. Most of them (92%) are 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) are freshmen; 28.7% (25) are sophomore; 17% (15) are junior and 2.3% (2) are senior. In terms of major, 52.8% (46) are majors in our department. 47.7% (42) are majoring in other programs, typically either business or liberal arts (e.g., business management, marketing, health policy and administration, finance and Spanish).

The psychological variables we investigated were students' pre-usage Sense of Community (PreSOC), their post-usage Sense of Community (PostSOC), and their reaction toward this system. Subjects identified themselves in agreement or disagreement with statements in the survey on 7-point Likert Scales (1: Strongly Disagree, 4: Neutral and 7: Strongly Agree).

Both PreSOC and PostSOC were measured using eight items adopted from (Peterson, Speer et al. 2008). Example items for PreSOC were: “I can get what I need in this class”; “I feel like a member of this class”; “I have a say about what goes on in my class”; and “I feel connected to the class”. 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.

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”. 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.

Students’ reactions to the system were measured using six items adopted from (Block 2005). Some sample items for this scale were: “I think the video commenting system is desirable”; “I think the video commenting system holds interests” and “I think the video commenting system is favorable”. The Cronbach’s alpha coefficient was 0.93. The mean score of the six items were computed for each subject and assigned a user reaction score (URT).

Three system usage variables were measured. One is the extent to which subjects read the comments (reading). It was measured through self-report on a 5-point likert scale (1: not any, 3: some of them, 5: every comment). The second usage variable was whether

the student ever posted comments (0: did not post comments, 1: did post at least one comment). The third was the percent of *relevant* comments a student posted. One researcher read through all the comments posted by each participant and decided whether a comment was relevant or not. Basically if the comments fell into the content comment, theme content or function comment categories as have defined above, it was counted as a relevant comment. Otherwise, it was counted as irrelevant. Further the percent of *relevant* comments a student posted was calculated (e.g., 0.6 means 60% percent of the comments were relevant to the videos or relevant to the class). It was measured exclusively for students who posted comments.

6.1.1 Increase in SOC

We use a paired-sample t-test to compare students' PreSOC and PostSOC. The test revealed that students' sense of community did increase significantly after using the ClassCommons system (mean PreSOC: 4.79, mean PostSOC: 5.08; $t(89)=-2.96$, $p<.01$; see Table 2).

Table 2: Comparison between PreSOC and PostSOC

	N	PreSOC	PostSOC	t-test	p-value
All	88	4.79	5.08	-2.96	<.01
Non-Posting	39	4.7	5.0	-1.79	0.08
Posting Group	49	4.86	5.15	-2.38	0.02

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. Separate t-tests revealed that the sense of community increased only marginally for the non-posting group ($t(38) = -1.79$, $p = .08$) but showed a significant difference for the posting group ($t(48) = -2.38$, $p = .02$). Not surprisingly, this suggests that the participants who were more active in commenting behavior may have been more influenced by the process.

6.1.2 Increasing SOC through Reading the Comments

In addition to simply asking whether the video commenting process increased overall sense of community, we wanted to determine more systematically whether students' usage patterns were related to this outcome. 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 expect that students with higher PreSOC will have a higher PostSOC after using this

system given the interactions afforded by this system; in this model PreSOC is used as a control variable to account for initial differences in SOC among students. The regression analysis supports our hypotheses as shown in Figure 21, suggesting that even after controlling for initial variation in PreSOC, the extent to which students paid attention to the comments was predictive of their PostSOC.

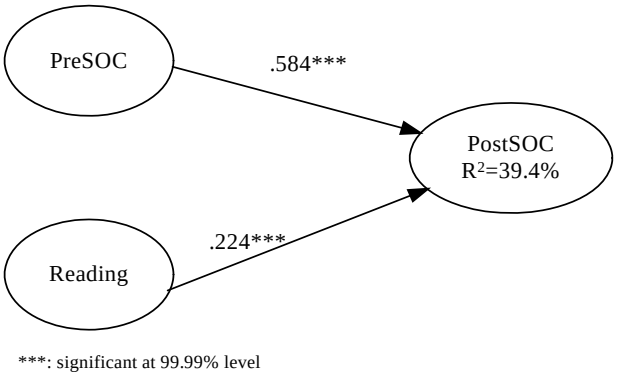


Figure 21: For All Students, PreSOC and Reading on PostSOC

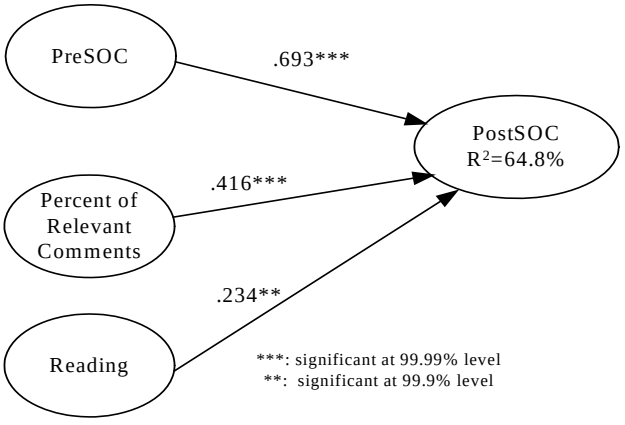


Figure 22: Students who Posted Comments PreSOC, and Reading on PostSOC

6.1.3 Increasing SOC through Posting the Comments

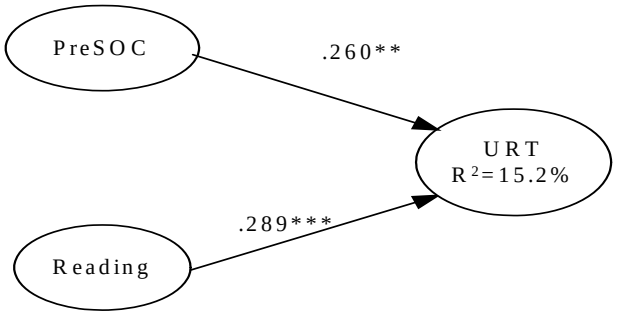
An additional analysis was used to examine the patterns of reading and posting for *just* the 39 students who did post comments. In this case, we included a third predictor variable, the percent of relevant comments posted (relevance is determined by whether the comment has some relation with the video or not as defined above). As shown in Figure 22, 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 higher PostSOC. This suggests that community members may increase their sense of community through contributions of meaningful comments.

6.1.4 Reactions to the ClassCommons System

In the Post-usage survey, students indicated high level of satisfaction with the system. Before we deployed this system, we worried that the stream of comments might be distracting. However, this was not the case. Most students (66.7%) reported that the comments were not distracting, and expressed a strong interest in using this system (85.6%); 79 (87.8%) found video commenting to be interesting; 83(83.7%) would like the system to be used more in future classes; and 75 (67.2%) reported that they read most of the comments that were posted.

We conducted a related set of stepwise regressions to analyze the relationship among PreSOC, reading and user reactions (URT) as an outcome variable. The results were isomorphic to the findings for PostSOC: students with higher PreSOC reported

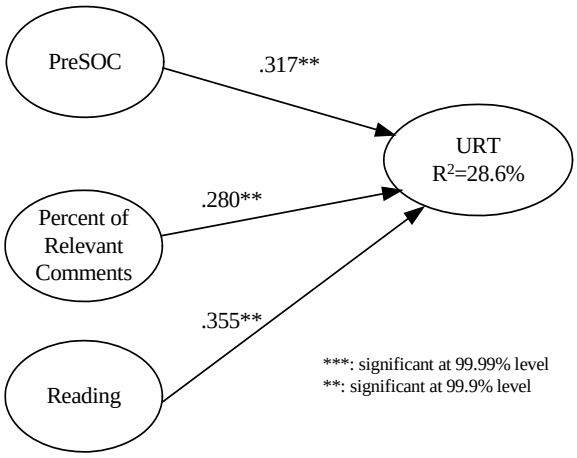
more positive attitude toward the system and students who read more of the comments also will have more positive attitude (Figure 23). For the students who posted comments (Figure 24), the more relevant comments are posted, the more positive attitude they held toward the system.



a. For All Students, N=88

***: significant at 99.99% level
**: significant at 99.9% level

Figure 23: Reaction to ClassCommons for All Students



b. For Students who Posted, N=49

Figure 24: Reaction to ClassCommons for Students who Posted Comments

6.2 User Experience

We have described some of our initial findings 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 correlation models presented above.

6.2.1 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 2003). The reasons for this are various. The usability of the system, whether the application is novel or not, whether there is encouragement or not, and whether there is demonstrations or not all play some roles (Churchill and Les Nelson 2003). However, we argue that the fact that people are not enticed to participate in the interaction may be due to people's *selective* thought that they have no reason or goals that would lead them to do so(Becklen and Cervone 1983; Carter, Mankoff et al. 2002).

In our case, most of the students told us that they had specific goals when posting. Most said that they posted comments in order to discuss the quality of the videos, so as to provide feedback. 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 6).

From these responses, we argue that by specifying to people clearly what the goals are, people will be more likely to be enticed to participate in public display interactions.

6.2.2 Increased 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"*.

6.2.3 Students Felt More Empowered

According to McMillan, to build 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 to 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."*

6.2.4 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".

6.2.5 Self-organized Counter-Spam Actions

As reported earlier, 19% of the comments were spam messages. Not only we are surprised at this, 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 delighted to see that students took the initiative to fight against the spam messages. During the video reviewing sessions, if many 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 comment 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 that *"My goal was to antagonize other commentators because they were simply wasting space on the screen/time".*

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 usage, especially in pubic places, some external spamming controlling mechanisms (e.g., automatic filtering, moderation) are needed.

Chapter 7

Discussion

7.1 Distinct Features of this Context

Our study of ClassCommons has achieved a certain level of success, given the high participation rate and vast amount of text comments students posted. In retrospect, we feel that this success is at least partly due to the distinct features of this classroom context. One of these is the audience. In our case, the audience is comprised of young college students, who are active, characterized by being energetic, curious about new technology and would like to try new things.

Another distinct feature is that we were viewing a number of high quality videos (and some not of such high quality!) that had been produced by students themselves; this community-genereated content may provide a reason to attract people's *selective* attention. In the literature, how to produce engaging and interesting content has always been a challenge for pubic display application designs. We are fortunate that this content issue was not a barrier here.

The contribution of this research lies in the new chain of thoughts that it inspires, namely the real time public display commenting idea that was implemented and tested. Our quantitative and qualitative analysis suggests that community members' sense of community increased as a result of both reading and posting the comments.

One design implication of this research is that a public commenting system might add value to other shared content, i.e., not just classroom videos. In this sense, it means that commenting implementation could be an independent module separated from content design, but it can be a great complement to the content.

7.2 The Tragedy of the ClassCommons

The Commons have inevitable tragedy(Hardin 1968), so does the ClassCommons. As we reported above, about 19% of the comments were classified as spam messages. This behavior was distressing, given the classroom environment in which the system was used, and the university norm of respect for one another in classroom settings. Further analysis revealed that most spam messages emerged when the current video was boring or of low quality, which indicated that students may have been using spam to "vote against" low quality content.

Given that even in a semi-public classroom environment we observed so many spam messages, we expect that there might be even more spam threat in fully-public places. In this regard, we were glad to see the self-organized anti-spam actions to protect our ClassCommons. We also realize that spam is simply easy to create and can be economically or emotionally advantageous for those who send it, but at the cost of the harmony of the whole community. Thus in the future we intend to include more spam filtering mechanisms in our public display experiments.

7.3 Reducing the Cost of Participation

From a cost-benefit perspective, we suggest that people can be enticed to participate in public display interaction by either increasing the potential benefit they get in from the activity or by reducing their cost of participation. Producing engaging content and providing constant encouragement are approaches to increasing benefits. Yet, the potential social embarrassment or awkwardness is still high in cost for participants. So to entice people to participate in public places, we must find ways to reduce the participation cost.

Compared to the multi-touch public displays, which require the user to actually perform on the display, the personal device based interaction method is less demanding on the users in terms of social cost. Yet, this method does involve other economic costs for users. In this study, the cost is the mobile Internet cost. For people who used their mobile network to post their comments, they had to pay Internet fees (this may not be a problem for people who already subscribed the monthly mobile Internet service, but for people who have not, it is an issue worth considering). Fortunately, it is expected that in the future with the increasing availability of Free Wi-Fi services in public places and the reducing cost of mobile Internet services, the cost would decrease.

Some other studies have used text-messaging(Finke, Tang et al. 2008) or Bluetooth as an input mechanism. Text-messaging has similar problems with the use of mobile Internet in that people has to pay text-messaging fees in order to post their messages. The advantage of text-messaging is that most people are familiar with it and that the mobile network is much more pervasive than the Wi-Fi network currently in most

places. Bluetooth methods are cost-free for users, but currently Bluetooth channels can only accept at most seven client connections simultaneously; these channels also restrict the users to be within a ten meter radius from the service point (Scheible and Ojala 2005).

We have analyzed the cost of participation at the individual level. Another kind of cost noteworthy at the group level is the *production blocking* (Kraut 2003) dilemma. In the current design, the comments are displayed in an FIFO fashion. As a result, comments submitted later can not be displayed until all the early posted messages in the queue have been displayed. The lag between submitting and displaying may limit the ability of students in the class to contribute at all. As some students have required in the post survey that for future improvement it should have "*less lag and possibly show more comments at once*". It is expected that future research on addressing the *production blocking* problem can further increase the use of the public display.

7.4 Offline Interaction Affordance

In the survey comments we found that students felt an opportunities to interact more with their classmates by chatting and sharing thoughts through the ClassCommons system. We realized that in the future it would be interesting to investigate whether the online interaction formed through the ClassCommons system could afford offline interaction in the real world.

We have conducted some onsite observations in the classroom where the system was deployed. Because every team was assigned their own sitting area in the class, it was not surprising that we did not observe students who stood up and walked to some one and

had conversations. However, it is believed that such offline interaction can happen as reported in a content sharing public display study in (Izadi, Brignull et al. 2003).

We suggest that to enrich future study in this line of research, we need to investigate whether and the online public display interaction can afford and shape the offline interaction. This implies that a more longitudinal evaluation framework, perhaps using diary methods to track users' engagement and longer term impacts from use of a public display. Using such a paradigm, we might determine whether it has a substantial effect on community building and accumulation of social capital within the community.

Chapter 8

On–going work with ClassCommons and CafeCommons

8.1 ClassCommons in IST413 and CafeCommons

As has been introduced in early part of this thesis, the platform independent nature and flexibility of the system make it have the potential to be quickly deployed in other settings. Currently two variations of the ClassCommons system are being used in two other settings. One is used in IST413 from Jan, 2009, and will be used through the whole Spring semester until the beginning of May, 2009. Another one called CafeCommons, was launched in the beginning of April, 2009 and will be used continuously all around the year in Reese's Cafe in the atrium of IST building. Compared to the system used in IST110, where students are commenting while watching videos, in IST413 and Reese's cafe, on the display there is only an area that display users' comments, and there is no video playing.

We are interested in these two setting for several reasons. First, we want to investigate people's reactions to the public commenting system in different settings. In IST110 class, the display was students' main focus during the two video viewing sessions. While in IST413, the display is peripheral. Students spent most of their time working on team-projects. The system is intended to function as an add-on component for them to raise questions, make comments and make it viewable to the whole class. The rationale behind this is that we hope students who are too shy to raise their hands can benefit from

this system. In Reese's cafe, it is a public space and although the video wall is in a salient position on the wall, still it is only a peripheral display and whether people would pay attention to it and how people's attention could be attracted by it is still a challenging question to be solved.

Secondly, while in IST110 experiment, we are interested in how the use of the system would impact students' sense of community, in IST413 and Reese's Cafe, we are also investigating the social support users can gain from this system. In class, it is common to find that a question raised by one student, is also a questions that many other students all have. We hope that this system could be an add-on platform on which students can discuss their questions, concerns and get some support from their peers. In Reese's cafe, the social support users can get from using the system could be recommendations on various issues (suggestions on good restaurants in downtown State College, tips on how to find an internships, etc).

Third, for CafeCommons in Reese's, we are especially interested in whether the use of this system could facilitate off-line interaction among patrons of *Third Places*. According to Oldenburg(Oldenburg 1989), one's "first place" is the home and those that one lives with. The "second place" is the workplace - where people may actually spend most of their time. Third places, are "anchors" of community life and facilitate and foster broader, more creative interaction. The typical third places are cafés, coffee shops, bookstores and other hangouts at the heart of the community, where people enjoy each other's company, can gain new insights from the informal communications with each other. This is people's "home away from home" where the sense of community is built.

The answers to the question of how technology will shape the interaction between people have been controversial. In the mass media, it is touted that technology development has made our world a global village, especially with the current development in Internet. However, in everyday life, while we are being increasingly connected to people on the other end of the world, we are also increasingly being disconnected from people in our local community. In his very influential paper, *Bowling Alone: America's Declining Social Capital(Putnam 2000)*, Dr. Putnam articulated that the technological development is individualizing our leisure time via television, Internet and eventually virtual reality helmets such that people spend less time with their community members and disengage from civic involvement.

Right now, mobile technology seems to be exacerbating the “Bowling alone” phenomenon in the third places. Although people still go to cafés as usual, it is common to find that cafés are full of people with headphones on, speaking on their mobile phones or laptops and hacking away at their keyboards, more engaged with their e-mail inbox than with the people touching their elbows. So, I am interested in whether this public commenting system could promote more interactions among people in the third places to build our own community and use Reese’s as a venue to test this.

8.2 Some Initial Results from IST413 ClassCommons and CafeCommons

8.2.1 Initial Results from IST413 ClassCommons

IST413 is a senior course on usability engineering. Students and teacher meet every week twice on Mondays and Wednesdays, except for holidays and spring break. Each time lasts 75 minutes. Before class starts, every student in the class completed a background survey, in which students' personal psychological variable- extroversion, and personal self-construal (independent vs. interdependent) were measured. It is expected that students who are more extroverted are more likely to use this system, and student who are more interdependent of each other might be more likely to use this system. Other variables like age, gender etc. are also collected in that entry survey.

As of April.29, a total of 179 messages were posted, averaging about 6.6 messages per class. Messages posted to the display covers a lot of topics, ranging from querying about other students' score on quizzes, like "*Who else got 50% on the quiz?*", to suggestions on how to name their teams, "*I believe we should be teams named after the legendary teams on Legends of the Hidden Temple instead of just boring colors.*", to expressing their opinions on how to improve the class *"Also, in terms of future classes here is a list of things to avoid: 1.) xxx 2.)xxx"*.

Another interesting thing from IST413 usage experience is that students have mix feeling about putting their name on the display together with their comments. In mid March, a focus group was run to collect students' feedback on the ClassCommons system. 8 students participated in the focus group. Some of them are active users of the system

and some are modest users and 2 students have never posted anything. In the focus group, students express strong opinion about displaying their name on the display together with their comments. However, they also wanted the teacher to know who post what. In response to this request, a new feature, allowing students to choose an alias for themselves, was added. Then instead of their real name, their alias together with their comment is displayed on the display and the teacher can link the alias to the name of the student. It turns out that students like this change and the average number of messages posted per class rises to 13.5, as opposed to 4.6 before the change.

At the end of the semester, students will fill out an exit survey. We will collect students' responses and attitudes towards this system and more systematic analysis will be carried out.

Figure 25: CafeCommons in Reese's Cafe, the red rectangle is the area in which users' comments with their name will be displayed

8.2.2 Initial Results from CafeCommons

The CafeCommons system was officially launched on April.14, 2009, in Reese's Cafe in IST building. Emails were sent to IST and CSE faculty, staff, graduate students and undergraduate student email lists, announcing the launch of this system. To increase the accountability of the comments posted, users need to login using their Penn State user account. After a message is posted, the content of the message together with the name of the people who posts that message will be displayed on the display. Each new message will stay on the display for 30 seconds. When there have not been new posts for 1.5 minutes, the system will switch to *history mode*, displaying history messages and prompt messages, motivating people to post comments to react to campus or world issues, advocate football strategies or curricular innovations, find a job and apply for a bailout. When a new message is posted, the system will immediately switch to *normal mode*, displaying the new message instead of history and prompt messages.

As of April 25, 2009, a total of 185 messages were posted in 11 days, averaging about 16.9 messages per day. 227 users have logged in the system and 62 of them have posted comments. Preliminary analysis on the comments people posted revealed that the comments are mostly replying the prompt messages. For example, messages like *"There is nothing wrong with smaller companies. You might actually get a better experience doing "real" work"," Be active on compass!!!!"*(compass is a recruiting website for IST undergraduate students) were posted in response to the prompt message of "Have tips on internships?". Some warm-hearted students used this system to warn community members a security risk in a public computer lab, like "*Anyone who has used USB drives*

in 202 IST should back up the data and format your drives. Be wary of AutoPlay". Some one also used this system to advertise their events, or websites. For example, messages like "*Come to the Counter-Terrorism Panel!*", "*eat more, exercise less, and lose up to 30lbs in 6 weeks! Visit http://www.bit.ly/LoseWeightPSU*", "*Tour Old Main Tomorrow With The Lion Ambassadors!!!!*" all fall into this category of advertising messages. Further information about users' attitudes toward this system and how the system might impact Reeses' Cafe users' sense of community and their perceived social support will be collected through a post-usage survey to be published in the first week of May.

We also learned some lessons from the 15 days' use of CafeCommons. Users have provided many feedbacks as to how to improve the system. Suggestions include making each message displayed on the screen for a longer period of time instead of 30 seconds, color coding parent messages and child messages with small legend to differentiate the conversation threads. Having realized the shortcomings of current design of CafeCommons, we will take an iterative design approach to perfect it and expect that CafeCommons would be a beautiful landscape on the west end of University Park campus.

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9 APPENDIX

9.1 Appendix 1: Email invitation to IST110 Students before Class

Dear Class,

Next week we will have a lot of fun in class. Video showing is a traditional activity in IST110 class. This year we will bring some new things to it and make the video show even more interesting.

We have developed a Video Commenting System which can let you post your comments to the public display while you are watching the videos. Your comments together with your first name will display on the big screen in the front of the classroom in a real time manner.

Everyone in this class can use this system and post comments. Every one has a login account and password. Your login account is your PSU ID (e.g., mur13) and, your password is the combination of your last name and PSU ID. For example, in my case, my name is Honglu Du, and PSU ID is hzd106. Then my Login account to this system is hzd106, and password is duhzd106. Dr. Rosson's login would be mur13 and her password is rossonmur13.

Due to the limited number of workstations in the class, this system is also designed to support mobile devices. So if you have you have a laptop or a web-enabled mobile device (iphones, ipod-touches, or other mobile phones), please bring it with you to the class to enjoy the fun.

Also I am writing to seek research volunteers to participate in a research project entitled Building Sense of Community through Interactive Public Displays. This research has been approved by Penn State Office for Research Protections (ORP). This research will investigate how an Interactive Public Display Commenting System could enhance the interaction between people and build a sense of community.

As a research participant, all you need to do is to fill in two short questionnaires, one before class begins on Dec. 8, and one after watching all the videos. Each survey takes about 5-8 minutes. If you participate and complete this study, you can get one credit of extra course. Your decision to be in this research is voluntary. You can stop at any time. Your decision about whether or not to participate in this research project will have no effect on your grade in this class. If you agree to participate in the research, you can

click this URL to read a consent form and take the first survey at(please fill in it before class starts on Monday): Click here to start the survey. (http://www.surveymonkey.com/s.aspx?sm=bPw2sIXjtYw8H0ZL0ccpBg_3d_3d)

If you prefer not to participate in this study but would like an alternative to gain extra credits, you may write a short commentary for a paper on community informatics. In this commentary (2 pages, single-spaced with 12-point font), you should address community issues pertaining to the wireless revolution. I will provide access to the paper if you choose this option.

To sum up, everyone in this class is invited to use the Video Commenting system in class. If you also would like to be a research participant, you will need only to fill in two surveys. One is here(please fill in it before class starts on Monday): Click here to start the survey. (http://www.surveymonkey.com/s.aspx?sm=bPw2sIXjtYw8H0ZL0ccpBg_3d_3d) As compensation, you can earn one extra course credit.

I appreciate your help very much!
Very sincerely yours,
Honglu Du

9.2 APPENDIX 2: Email invitation to IST110 Students after Class

Dear Class,

It was a great time spending with you enjoying your videos and your intelligent and interesting comments.

I am inviting you to fill the second survey to get some feedbacks from you. Here is the link to the second survey:Click Here to take survey

If you can not see the link, copy and past this url to the web browser: http://www.surveymonkey.com/s.aspx?sm=r_2bhr5s4kq_2b2y7fGzrJm_2fsQ_3d_3d

Your feedbacks will be of great importance to this research and to the improvement of this system.I appreciate your time and efforts very much!

Just a reminder: you need to fill in this survey together with the survey I sent last week so as to get the extra credit.

Thank again!

Very sincerely yours,

Honglu

9.3 APPENDIX 3: Pre Survey for IST110 Class

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?
Freshemen, 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 Strong Strongly(0), Disagree 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 this 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. I often find that I can remain cool in spite of people around me being excited.

10. I enjoy the way I am rather than the way other people would like me to be.

11. To become an adult means to become myself and to be distinct from others.

12. I feel more comfortable having someone to rely on rather than dealing with my problems alone.

13. I will stick to my own opinions if I think I am right, even if I might lose popularity with others.

14. I have my own privacy, which I would never share with even my closest family members or partner.

15. There should be a clear boundary between me and others, even with my parents, spouse, and closest friends.

16. I would like to solve my personal problems by myself, even if someone else can help me.

17. Most of the time, I do not get involved in other people’s personal problems.

9.4 APPENDIX 4: Post Survey for IST110 Class

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)
   a) Desktops b) Laptops c) iPhones d) iTouches e) BlackBerries f)other, please specify

7-point Likert Scale Questions
from Strong Strongly(0), Disagree to Strongly Agree(7)

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

19. This class helps me fulfill my needs.

20. The use of this Video Commenting System makes me feel like a member of this class.

21. The use of this Video Commenting System makes me feel more like I belong in this class.

22. The use of this Video Commenting System helps me have a say about what goes on in my class.

23. The use of this Video Commenting System help people in this class become better at influencing each other.

24. The use of this Video Commenting System makes me feel more connected to this class.

25. The use of this Video Commenting System makes me have a better bond with others in this class.

26. Being able to share my comments via the public display real time helps me better interact with my classmates.

27. I would like to see the system used for more classes.

28. I only need to watch the videos, I don't want to see other people's comments

29. I only need to watch the videos, I don't want to post my own comments.
30. I think the Video Commenting System...
    b) is desirable b) is favorable c) holds my interests d) is valuable e) is helpful f) improves class participation

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

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

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

34. I think the comments posted to the system are ...
Very Interesting… Moderately Interesting… Not Interesting at all

35. While I was watching the videos, I found the comments to be...
Very Distracting… Moderately Distracting… Not Distracting at all

36. How much attention did you pay to the comments?
A great deal, much, somewhat, little, not any

37. 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?

9.5 APPENDIX 5: Approved IRB for this study

Implied Informed Consent Form for Social Science Research

The Pennsylvania State University

Title of Project: Building Sense of Community through Interactive Public Displays

Principal Investigator: Honglu Du, Graduate Student
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1. **Purpose of the Study:** The purpose of this study is to gain in-depth understanding of how class size will influence the quality of education, explore how to make use of the public displays to enhance the interactions among people.

2. **Procedures to be followed:** You will be asked to register in a website setup by the researchers, take a survey immediately after you register. Then you can use the system to publish your comments on other teams' video project. Your comments will be displayed on the public display in the front of the classroom and they are viewable to every one in the classroom. You will use this system for two classes and at then end of the study, you will take another survey. Your decision to be in this research is voluntary. You can stop at any time.

3. **Duration/Time:** You will use the system in the final two classes of IST 110, fall 2008, which lasts 2.5 hours in total, with 1 hour and 15 minutes for each class. The survey will take you about 10 minutes on the average. You can choose not to answer certain questions.
4. **Statement of Confidentiality:** Besides your responses made to the questionnaire, your comments in this study will be logged and used in the data analysis. The comments you posted through the mobile public display interactive system together with your first name will be displayed on the public display in the front of the classroom. All your responses to this study (including your comments and browsing history) will be archived only for data analysis purpose and reported only as compiled, aggregated results. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared. Your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties. All data will be accessible only to the researchers and the research advisor.

5. **Voluntary Participation:** Your decision to be in this research is voluntary. You can withdraw at any time without penalty. You can choose not to answer any questions you do not want to answer. We have internal policies to ensure that your decision to not participate in this research project will have no effect on your grade in this class. Prof. Rosson will not know whether any individual student has participated in this research or not, because when the comments and participants' information are stored in the database, all names will be mapped to internal codes using a coding algorithm. Prof. Rosson will only be able to see an aggregated report of how many comments are posted.

6. **Payment for Participation:** One extra course credit will be offer to students who participate in this study. If they prefer not to participate in this study but expect an alternative to gain extra credits, they can write a short commentary for a short paper on community informatics. In this commentary (2 pages, single-spaced with 12-point font), they should address community issues pertaining to the wireless revolution. This articile is available in the course's angel site.

7. **Right to Ask Questions:** Please contact Honglu Du at (814) 865-9838 with questions, complaints or concerns about this research.

You must be 18 years of age or older to consent to take part in this research study.

Completion and return of the survey implies your consent to participate in this research.

Please print a copy of this form for your records.