Encouraging Initiative in the Classroom with a Fragmented Social Mirror

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ABSTRACT
Inspiring and maintaining student participation in large classes can be a difficult task. Students benefit from an active experience as it helps them better understand the course material. However, it's easy to stay silent. There are few opportunities for students to speak and evaluation anxiety often discourages them. The Fragmented Social Mirror (FSM) provides students with the ability to anonymously initiate classroom dialog with the lecturer. The system encourages participation by enabling anonymous expressive feedback to reduce evaluation anxiety. The FSM further catalyzes participation by allowing for many simultaneous participants. In this paper, we introduce the FSM as a classroom device, discuss its design, and describe a pilot test of the interface. Initial results indicate a promising direction for future feedback systems.

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Audience Response Systems, classroom, education, social mirror

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Students learn more when they actively engage in the classroom [14]. However the structure of many classes ensures that the lecturer speaks for at least 80% of the time. Though some students participate, it's expected that 5 students out of 40 will dominate any classroom discussion.

The lecturer's awareness of class comprehension is skewed by the students' many social pressures and the few speaking opportunities. Students try to present a positive image of themselves to their peers. They often avoid volunteering information due to evaluation anxiety, a fear of being judged by others for making a mistake, or being the focus of attention [14]. It's easy to remain silent. Those students who do speak are generally self confident or understand the material. However, there is a reluctance to appear too engaged in the classroom. Those who raise the expectations on a group may be ostracized by their peers [11].

In this paper, we present an interface prototype designed to encourage student engagement and improve the lecturer's awareness in the classroom. The prototype, entitled Fragmented Social Mirror (FSM), aims to create a new communication channel of anonymous dialog between the instructor and the class. Unlike many previous Audience Response Systems [5, 13], FSM allows for expressive feedback via text and is accessible at any time during the lecture. In our short pilot observation, students in a large class began to initiate interaction with the professor, whereas previously they had only mumbled answers in response to posed questions. In this note, we describe the design of the FSM in the context of other Audience Response Systems. We also discuss promising initial observations from a classroom pilot study of the FSM.

FEEDBACK IN CONVERSATION

FSM is designed to extend the benefit of backchannel communication. Familiar face-to-face backchannels include "yeahs," "uh huhs," and head nods that show attention to the speaker. Similarly, facial expressions reveal feelings while gestures provide emphasis [9]. From the listener's perspective, these signals show the speaker that the audience is listening and is interested. In a large audience, these visual signals can be lost in the crowd which necessitates speaking up, rumbling voices, and applause. Furthermore, the audience also moves into private side-conversations as the audience grows. Large classrooms have addressed this issue by using Audience Response Systems for multiple choice and true/false questions. The interfaces in [5, 13] provide a small number of pre-selected responses of A/B/C/D, and a True/False response. These interfaces are most often used when the lecturer explicitly asks a multiple question of the audience. To be effective, the lecturer has the difficult task of anticipating key moments to query the audience and must specifically structure a lecture to accommodate this new question-answer format. Though each system varies, many include specialized hardware which are either purchased by or provided for each student [8, 13]. In the worst cases, when a lecturer does not incorporate interesting interaction into the lecture,

the Audience Response Systems become automated attendance and quiz systems, which students grow to resent [8].

Other feedback modalities such as text based systems provide opportunities for students to engage with each other [10, 15]. Studies of dedicated course chatrooms show students will chat about the lecture's content to help explain concepts to confused classmates [15]. In addition to making help available, this style of active learning helps students communicate concepts to peers for a deeper understanding of the material. However, the chat rooms also encourage unrelated discussions, and potentially draw students away from the lecture. Outside of the classroom, text based systems similarly open public dialog into shared events through IRC, instant messaging, Twitter, and Facebook [4, 10, 12]. Though all of these side-channels can contribute to audience discussion, they often leave the speaker out of the loop during the event.

Writing systems, such as Classroom Presenter, benefit from writing as input while still including the instructor in the interaction [1]. A tablet PC system, it allows students to mark directly on the current slide with a stylus, which can then be viewed and shared by students and the instructor. Instructors can set up slides that encourage students to answer questions that can be discussed and reviewed as a group. This method enables a broad sampling of student understanding and encourages active participation with the material.

Related work such as backchan.nl and Conversation Votes create a new feedback channel that integrates approval feedback into group dialog [3, 6]. With backchan.nl audience members organize their collective questions for the speaker in a conference or after a talk. A moderator filters the most appropriate questions from the top rated questions. With Conversation Votes, participants annotated an abstract visualization of conversation with positive and negative votes to highlight agreement during conversation. In small groups, this anonymous feedback increased the vocal participation from those less satisfied with previous conversations.

Viewed on an axis of expressivity, distinct categories of low expressivity and high expressivity emerge. Low expressivity systems as in [3, 5, 13] limit what a student can communicate, but ensure the feedback can be quickly interpreted. High expressivity systems like [1, 6] and chatrooms allow students vast communication capabilities, but can require more focused attention for both the lecturer and students.

Our work takes a middle path. FSM provides a meaningful, but constrained, set of signals to be observed alongside the lecture like low expressivity systems, but it allows expressive text to convey personal ideas like a high expressivity system. As an always available interface, the FSM captures the fleeting moments of confusion and conveys this information to the lecturer while it can be addressed in context.

THE FRAGMENTED SOCIAL MIRROR

The Fragmented Social Mirror (FSM) provides feedback based on principles borrowed from social mirrors [7]; however, the classroom setting necessitates a break from the standard social mirror design. A social mirror is a real-time depiction of interaction meant to augment natural face-to-face interaction. It captures ephemeral moments in conversation and brings them into the public view through visualization. In previous work, social mirrors displayed abstract visualizations of each individual's participation in conversation. The resulting display of conversational dominance, non-participation, and turn taking encouraged more balanced conversation [3]. In these social mirrors, ***one*** shared visualization of conversation was projected centrally for all participants to see. On a classroom or large lecture scale, this form does not function as well. There are many more participants involved, and the architecture of the space is different from the spatial layout of small group interaction around one shared table. Furthermore, there is a natural asymmetry in participation due to the lecturer-audience dynamic. This results in less interaction between the lecturer and the audience not suited to the traditional social mirror visualizations.

The term "fragmented" in FSM refers to the use of individual interfaces for each participant as opposed to one shared visualization and the shortened time component as opposed to the full history present in previous social mirrors. In our setup, each participant accesses a Java applet from their computer or mobile device, while a large public display is presented to everyone. Furthermore, while a traditional social mirror maintains a persistent history of interaction, FSM highlights questions and comments that are pressing at the specific moment.

FSM Design Choices

The FSM design focuses on capturing and reflecting the unheard and unvoiced dialog in the classroom. We informed our initial design by observing an active and engaged classroom of 100+ students to see how much and what students say in class. After refining numerous sketched prototypes, we settled on a simple interface students could use while still paying attention in class. As mentioned earlier, the traditional social mirror displayed persistent interaction. The lecture audience setting necessi-

Figure 1: The input device is small and simple for classroom use. The two left icons for information and questions allow for typing phrases to send along with the icon message.

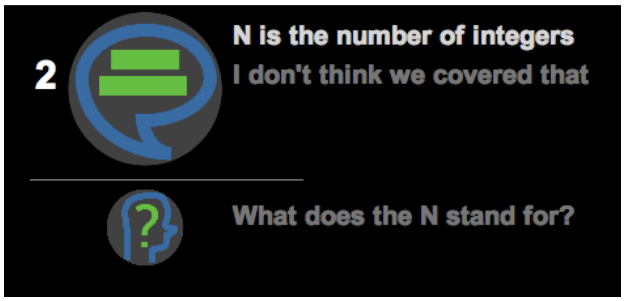

Figure 2: The public display groups by icon and highlights the most recent feedback from the class.

tated a change to this design. In past studies, a social mirror was primarily viewed by the listeners (and not the speaker) in conversation because they had more free attention [2]; however, a lecturer's attention is often focused on teaching. In this design, the captured feedback of conversation is significantly pared down, so that the lecturer can receive the benefits from the social mirror with minimal attention. Therefore, current comments/questions are displayed so as not to overwhelm the viewers.

There are two FSM interfaces — the student input interface for a computer or handheld device (Figure 1) and a larger public screen for the lecturer and audience (Figure 2). The public display is situated in the front of the room, though the lecturer sees the public display on a personal screen. Four different pre-selected icons were designed to categorize student responses in the student interface. The icons represent: Information, Questions, yes/agree, no/disagree. We selected these four categories based on our initial classroom observation of common student interaction. We designed 5-11 sketches for each of the four categories. A survey completed by 56 undergraduates was used to select the most representative icon for each category and to provide feedback for the selection. Of the four categories or signals, the Information and Question signals can be augmented by a 40 character message. The short messages allow students to clarify their questions or possible answers when there is no opportunity to speak while the yes/no buttons allows students to answer simple questions quickly.

Students use the input interface in Figure 1 to send their message to the public display shown in Figure 2. All messages on the public display are sorted by their associated icon to increase legibility for the speaker. The speaker can look up and see many questions that need to be addressed or they can glance over answers that students provided via the display. The icon with the most messages moves to the top of the screen with a larger icon. The most recent message of this icon appears at the top of that icon in white text set against the black background. As a message ages, it fades to grey before finally disappearing after a pre-set time. For icons with multiple messages, a count is displayed to the left of the icon.

Messages on the public display are limited to messages in the most recent minute. The rationale for the simplicity of the design was two fold: (1) we did not want the lecturers to be confused or overwhelmed by reading old questions from a prior part of the lecture and (2) if a question goes unanswered and disappears, this removal may encourage a student to verbalize the question in class or to repost it. One of our main goals is to encourage more class interaction. If a student can "see" that they are not alone in their confusion, they may be less apprehensive to speak out and ask a question.

Once a student sends a signal via posting an icon, they are blocked from sending additional signals for a brief period (10 seconds in our pilot) to discourage excessive social chatter and monopolization of the channel. While there is some room for abuse as with the backchan.nl system, where some users voted up questions for humor [6], the public availability of the channel is ultimately at the discretion of the lecturer.

PILOT STUDY

We conducted a pilot study to investigate the FSM in the classroom. We began by observing the participation levels before the introduction of the FSM and again with the FSM in place. For this, we observed a required second year course with roughly 180 registered students in the Computer Science department of a large public university. The instructor was not affiliated with our research team. During observation, an average of 115 students were in attendance. Given the number of students, not many had the opportunity to speak, and most did not.

Our initial observations showed very little interaction between audience and lecturer over the course of three 50-minute sessions. The only activity from the audience was in response to questions posed by the lecturer. In reference to a proof "n is divisible by what?" or "What is the cardinality of set Q?" The class averaged about four responses per class. None were initiated by the students themselves, five of the twelve responses were general indefinite murmurs from the class, and two responses involved raising hands. The remaining six questions were answered by roughly 1-3 students speaking up throughout the room.

Prior to testing the FSM in class, we sent out a pre-survey and described the use of the FSM. Feedback from the survey confirmed that students are not comfortable asking questions or asking for clarification during class, though they are more comfortable asking in their smaller recitation sections (Table 1).

We tested the FSM in a single class session and found the students were pro-active in using the system. In class, the lecturer used a central projection screen to work through problems by hand while the public display was projected on a smaller screen to the right of the main projection screen. With the system in place, two initiating messages were sent by students: one to ask for clarification when the instructor didn't finish explaining a proof; the second to

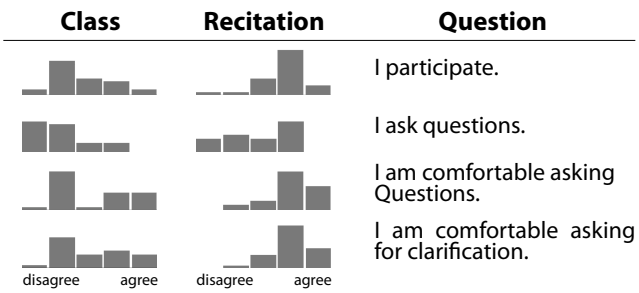

Table 1: Students reported they were uncomfortable asking questions in class, though it was less the case in smaller recitation sections. Survey with 23 respondents.

inquire about acceptable notation in classwork. In total there were seven classroom interactions, three of which were no different than the pre-FSM interactions. The most used signal in the FSM was the yes/agree checkmark. It was used to signal understanding at the end of proofs and as a visual up-vote for the two student initiated FSM questions mentioned earlier.

We had only planned to gather initial observations to refine the system in this first session; however, the instructor was excited to see the students participating and invited us to return with the system for further studies. After the lecture, she indicated that it's always been hard to get this many students to say anything, even with encouragement. The simplicity of the display was also deemed useful, as she could read the questions with a glance. Additionally, the asynchronous nature allowed students to ask their questions while she was still explaining — thus allowing her to work the question into that explanation or come back to it later.

LIMITATIONS AND FUTURE WORK

The FSM indicates the use of text based anonymous feedback has potential for promoting engagement in the classroom. However, our pilot is not a definitive study. The the system needs further testing long term and in multiple classrooms. Many untested facets of the interface can be further explored. We advocate anonymous feedback based on the premise of evaluation anxiety, though we have not yet tested the effects of allowing or enforcing identity in the FSM. We limited the interface to four icons for simplicity, but how many and which are the best to employ? From the limited use we have seen, there is already support for allowing directly up-voting other questions and information in the display.

The FSM interface received a positive response from both students and lecturer. Our initial study highlights the use of anonymous signals in large classroom has potential to draw in more active participation of the students and audience.

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