Designing for Community: The Effects of Gender Representation in Videos on a Web Site

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Abstract

This paper analyzes a professional development Web site for teachers that features 'virtual classroom visits'—video clips of teachers teaching, together with asynchronous forums for discussing the videos. The site was designed with the explicit goal of fostering community among teachers and teachers in training, where community is defined in part as self-sustaining, ongoing interaction. We analyze the relationship between the design of the 'classroom visit' interface and the textual conversations taking place there, pointing out ways in which unintentional bias in the representation of gender in the videos is reflected in asymmetries in participation by males and females, to the detriment of the community design goal. Based on this evidence, we argue that designers of CMC systems should take user gender into account in creating multimodal interfaces that represent humans directly.

1. Introduction

What would it take to design a system that effectively fosters community—sharing of knowledge and expertise, a feeling of familiarity and belonging, an ongoing level of self-sustaining activity—among a geographically-dispersed group of people who share only a professional identity?

This question used to be asked, without the qualification of shared professional identity, mostly in the context of interactive games and social forums on the Internet [see e.g. 11, 41]. Recently, however, virtual community design has also become a concern of organizations, institutions, and educators [7, 28, 51], among them designers of teacher professional development resources. Teachers especially stand to benefit from participation in virtual communities, in that they typically work in isolation from one another, "shut[ting] their classroom doors when the bell rings" [1, p. 27]. A virtual community can be a means for sustaining contact, for example after face-to-face professional development workshops are over and the teachers disperse to their individual schools and classrooms [45]. It can also be a means for teachers in training and new teachers to learn to participate in the profession, through observation of and collaboration with more experienced teachers [1].

Increasingly, designers are making use of emerging Internet technologies to connect teaching professionals with resources and materials on the Web, and with one another to collaborate in producing resources, to solve common problems, and to share experience and advice via synchronous and asynchronous computer-mediated communication (CMC). The advantages of the Internet for these purposes over earlier technologies (such as CD ROMs) [cf. 31] include the possibility of reciprocal interaction, and the ability of teachers to access the system from geographically dispersed sites at their temporal convenience [48]. Examples of Internet sites designed for teacher professional development include asynchronous listservs [42]; teachers' lounge Web sites [16]; Web-based digital video libraries [43]; the Math Forum, which combines mathematics resources with e-mail [40]; and TAPPED IN, a synchronous discussion space in which the primary resource is group conversation [44, 45].

These projects, some of which have succeeded in attracting on-going participation, have nonetheless encountered various challenges. Hardware and software malfunctions, as well as site-specific problems with connectivity, can reduce the functionality of a design, leading to user frustration [31, 43]. Usability problems can arise if the system is over-designed; Mowbray [34, p. 122] notes that "[n]ontraditional users [such as teachers] consistently prefer sites which are quick and simple to use, as opposed to sites with complex navigational structure, or with unnecessary moving images, or which take a long time to access". The amount and quality of the content may be insufficient to motivate users to return repeatedly to the system; this problem is compounded by the fact that digitized content (such as video clips) is expensive and time-

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consuming to produce [31, 43]. Critical mass is arguably the most important requirement for interactive forums: users may find the site socially unappealing if they log on and do not encounter other people there [15]. Other challenges to creating sociability [39] include letting members take ownership of the site, even if disorder results, and encouraging the emergence of leaders from within the membership ranks [42, 45, cf. 28] Notably, however, these studies do not consider the demographics of the users themselves as a variable in the success of a teacher professional development system, beyond that the users are teachers (or teachers in training), and, occasionally, that they specialize in particular grade levels or subject areas [31].

Seventy-five percent of public elementary and secondary school teachers in the United States are female [35], and female teachers are more numerous even in the traditionally "male" subject areas of math (65%) and science (54%) [14]. This demographic potentially affects the quantity and quality of participation on teacher professional development sites. Mowbray [34] classifies women as 'nontraditional' Internet users, relative to 'traditional' users, the prototype for which is a white, male college student. Nontraditional users spend less time online, connect at different times, and engage in different activities from traditional users; in Mowbray's study of an Italian social MUD, nontraditional users engaged in fewer competitive activities and more creative and supportive ones [see also 8]. Gender differences in amount and manner of participation have also been reported in studies of Internet mailing lists [17, 18, 19, 24, 46] and chat rooms [20, 47]. In the former studies, which are most relevant to the present study in that they involve asynchronous CMC, men tend to dominate mixed-sex discussion on academic and professional topics: they post more and longer messages, and are more likely to be assertive, self-promoting and critical of others, whereas women are more likely to post shorter messages, be polite and attenuated, and express support for others [17, 18, 19, 24]. These differences can result in the contributions of women being marginalized in mixed-sex asynchronous CMC [12, 17, 21, 49]. At the same time, the communication practices of an online group as a whole tend to accommodate to the norms of the majority gender, such that, for example, women tend to be more critical in male-predominant groups, and males more supportive in female-predominant groups; women also participate more in groups with a critical mass of women [19, 22]. It follows that the majority gender on a teacher professional development site could shape the norms for the site, with attendant implications for the success of community goals such as creating a comfortable environment and providing critical feedback [1].

Despite findings such as these, gender is rarely discussed in the literature on CMC system design, perhaps because text-based CMC, the predominant mode available on the Internet until several years ago, has traditionally been considered an anonymous, gender-neutral technology [3, but cf. 21]. The gender and design question takes on new dimensions, however, with the introduction of multimodal CMC. Audio, video and graphics convey richer information than do plain text, enabling iconic representations of male and female bodies, for example, in images on the Web [5, 21, 27]. In addition, video captures movement, facial expression and gesture, which vary according to gender and convey gendered meanings [50, 52]. Last but not least, graphical interfaces such as the Web are similar to other interfaces for which gender differences have been found in user color preferences, navigational strategies, and persistence of use in the face of technical difficulties [26, 38]. Designs have social consequences; Clark & Knupfer [9] and McDonough [33] caution designers of virtual environments against unwittingly contributing to patterns of dominance in society by perpetuating gender bias in the representation of images, language and content.

In this paper, we analyze a teacher professional development Web site that features 'virtual classroom visits'—video clips of teachers teaching, together with asynchronous forums in which members can discuss, including with the featured teachers, what they see in the videos. The site, called the Inquiry Learning Forum, is funded by the National Science Foundation and was designed and implemented by faculty and graduate students in the School of Education at Indiana University [1, 2].[1] The site was designed with the explicit goal of fostering community among secondary math and science teachers and teachers in training, where community is defined in part as self-sustaining, ongoing interaction. Consistent with the demographics of the teaching profession, the majority (60%) of registered members on the ILF site are female, and 40% are male. We analyze the relationship between the design of the 'classroom visit' interface and the textual conversations that occur there, making use of content analysis methods for video and text. The analysis reveals a bias in the representation of gender in the videos (females are underrepresented relative to their numbers in the ILF and in the field of teacher education), correlating with gender differences in participation (fewer females than males post messages), to the detriment of the goal of fostering community on the site. Based on this evidence, we argue that designers of CMC systems should take user gender into account, especially in creating multimodal interfaces that represent humans directly.

[1] The first author is a co-PI on the project; the third author is a Postdoctoral Fellow employed by the project; and the second author is a doctoral student affiliated with the project through the first author. None of the authors were involved in the project at the time of its conception or initial implementation, although they have participated in subsequent discussions that have resulted in modifications to the site interface.

2. The ILF site

2.1. The design process

The designers of the ILF site did not set out to create an interface that would discourage female participation. On the contrary, their goal was to encourage participation, especially by in-service and pre-service teachers, the member populations with the highest concentrations of women (Figure 2). Nor is it likely that the design reflects the unconscious gendered interests of its creators [cf. 4], since the development team included both women and men (Figure 2), and a woman was responsible for the classroom video portion of the site. Rather, the underrepresentation of female teachers in the videos was an oversight that any number of people involved in the design process might have noticed, although no one did—or if they did, they dismissed it as unimportant or unavoidable.

The design process was participatory and dynamic, proceeding by means of successive "design experiments" in which innovations were introduced, their impacts studied, and the lessons learned cycled back into the next iteration of the site [2, cf. 6]. The process was participatory in that it incorporated feedback from in-service and pre-service users, a university-external research advisory board, and an internal research team. After an initial mockup of the site had been created, including several videos, a teacher advisory board indicated that the design of the entry to the site was too technical and complex; in response, the main page was redesigned more simply [1]. Later, the research advisory board and research team identified problems and advanced suggestions related to lackluster participation on the site after it had been up and running on the Web for several months. These were incorporated in three sets of revisions to the site, the first in late fall of 2000, the second in late spring of 2001, and the third in early fall of 2001.

As a footnote to this chronology, the authors of this paper joined the research team in August 2000, and pointed out the underrepresentation of female teachers in the videos during the fall 2000 round of discussions. The development team was surprised and concerned to realize that the videos incorporated a gender bias, and efforts were made to recruit more female teachers for the videos, but with limited success.[2] The reasons for this lack of success are related to the nature of the videos and how they were produced (see below).

2.2. Description of the site

The 'classroom visit' portion of the ILF site, intended as the site's centerpiece [1], features video clips of teachers in their classrooms using inquiry-based methods to teach science and math lessons.[3] The videos were originally intended to make available for discussion and critique "the everyday practices of teachers…in a variety of settings" [1, p. 10].

Teachers volunteered, rather than being elected or chosen, to have their classrooms videotaped. This required, in addition to a willingness to have their teaching viewed and critiqued by strangers on the ILF site, a time commitment from each teacher to produce written materials to accompany his or her video, including a lesson plan and reflections on the class. The teacher was also expected to follow up by participating in asynchronous text-based discussions about the video on the site. ILF development team members videotaped the class sessions, then digitized and edited the videos into approximately one to ten minute segments, a subset of which was selected for inclusion on the ILF site.

Figure 1 shows the Visit Classrooms page, on which the videos (represented by a still shot from each) are listed, followed by the first name and initial of the last name of the teacher, the subject matter of the lesson, and the grade level of the class. This page is accessible from the main page of the ILF site via a single link. Clicking on any of the still shots links the user to the Classroom for that teacher. The Classroom pages include a real-time video player with audio and video controls, a selection of numbered video segments that can be viewed in any order by clicking on them, and at the bottom, the lesson plan and reflections by the teacher. Users can view the video and scroll through the text materials simultaneously. Each Classroom page also includes a link to a threaded discussion forum associated with that classroom.

Given the predominance of females in the profession and in the ILF, if the site represents its user demographics accurately, 60% or more of the videos should feature female teachers. In fact, this is not the case. The site was launched on the Web in February 2000; by the time we first began analyzing it in October 2000, there were 10 'featured classrooms', six of math teachers, and four of science teachers. Male and female math teachers were equally represented, with three of each, but all of the science teachers were male.[4] By April 2001, seven more videos had been added to the site, most of them second lessons by the same teachers. This influx did not significantly alter the gender imbalance, however: two more videos were added of female math teachers and one more of a male math teacher, and four more videos were added of male science teachers. The gender breakdown of the teachers in the videos as of April 2001 is shown in Table 1.

[2] After more than a year of recruitment efforts, two female science teacher videos were recently added to the site.

[3] Inquiry, as defined by Barab, MaKinster & Scheckler [2], has two components: student inquiry (learning through discovery), and teacher inquiry (critical reflection on teaching practice) [cf. 36].

[4] One of the male math teachers and one of the male science teachers had two videos each.

Figure 1. The Visit Classrooms interface

Table 1. Videos by gender and subject

	Math	Science	Totals
Male teacher	4	8	12 (71%)
Female teacher	5	0	5 (29%)
Totals	9	8	17 (100%)

The number of individual teachers represented in the videos is shown in Table 2.

Table 2. Individuals in videos by gender and subject

	Math	Science	Totals
Male teacher	2	7	9 (75%)
Female teacher	3	0	3 (25%)
Totals	5	7	12 (100%)

In addition to being fewer, female videos are shorter than male videos, on average: 28.1 minutes vs. 41.5 minutes in length.

Why should it matter whether the teachers in the videos are male or female? First, despite the development team's intention that the videos represent "everyday practice", ILF teachers expect them to be models of "good" teaching, and interpret them as such. Featuring more male videos thus has the (presumably unintended) effect of implying that men are better teachers than women. Second, an earlier study [31] found that pre-service teachers who viewed videos of same-gender teachers tended to emulate them in their student teaching. Male teachers may not provide appropriate role models for female pre-service teachers, who make up the largest single demographic of ILF users. Third and last, as we argue in the following section, the gender of the teachers in the videos affects participation on the ILF site.

Why were not more female teachers included in the videos? No female teacher who volunteered to be videotaped was refused, and no videotaped classes that were taught by female teachers were excluded from the ILF site.[5] Rather, female teachers, and especially female science teachers, were less likely to volunteer to be videotaped in the first place. Several factors might account for female teachers' greater reluctance to volunteer. First, the teachers knew that the videos would be displayed and viewed on the site by hundreds of people, most of them strangers; previous research has found that females are less likely than males to seek out or welcome public attention [25]. Second, to the extent that "good" teachers were sought, females might have felt less confident claiming good teacher

[5] One male video has been rejected thus far, on the grounds that it did not illustrate inquiry methods of teaching.

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
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status, consistent with research that reports lower levels of self-confidence for women than for men in science and mathematics in higher education [29]. Third, females teachers might have had less time to devote to volunteering: a number of women who were approached declined to produce a video because of lack of time due to family commitments.[6] These explanations apply to female teachers in general. The lower participation of female science teachers reflects the solicitation process itself, which was based on personal connections. The ILF teams and the teacher advisory board, which solicited videos, included female math teachers but few or no female science teachers; this may have biased the demographics of the volunteers. More generally, this outcome (as well as the make-up of the ILF teams and the advisory board) is consistent with the relatively lower numbers of women in science than in mathematics [37].

In this section, we have described the classroom portion of the ILF site, how it was designed and how the videos were solicited and produced. The intention of the site developers was that the videos would stimulate and ground online discussions about teaching practice, and that these discussions would form the basis for an emergent community of educators interested in inquiry pedagogy. In the next section, we analyze the actual discussions that have taken place on the site since it was implemented, and relate them to the videos.

2.3. Analysis of the discussions

We analyzed the cumulative text messages posted in the Classroom area from the opening of the site in February 2000 through April 2001 (N=356). The results are considered under three headings: participation, discourse analysis, and video analysis.

2.3.1. Participation. Any ILF member can post messages to the Classroom area. Our analysis controlled for participant gender and status, both of which are provided by each ILF member at the time of registration to the site.[7] As of April 30, 2001, the ILF had 596 registered members in six status categories: pre-service teachers (university students), in-service mathematics teachers, in-service science teachers, school technical coordinators, university instructors, and ILF development team members. In addition to classifying members by job or role, this order can also be understood as a continuum of social status within the educational context of the ILF project, with university professors and the ILF development team at the highest end, and students at the lowest end of the continuum. The breakdown of registered members by status and gender is shown in Figures 2 and 3.

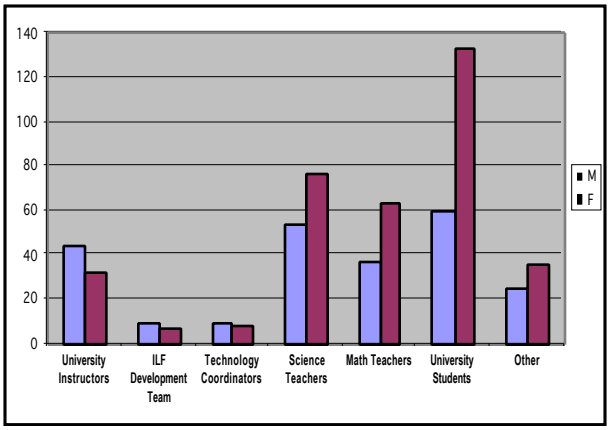

Figure 2. Number of male and female ILF members by status

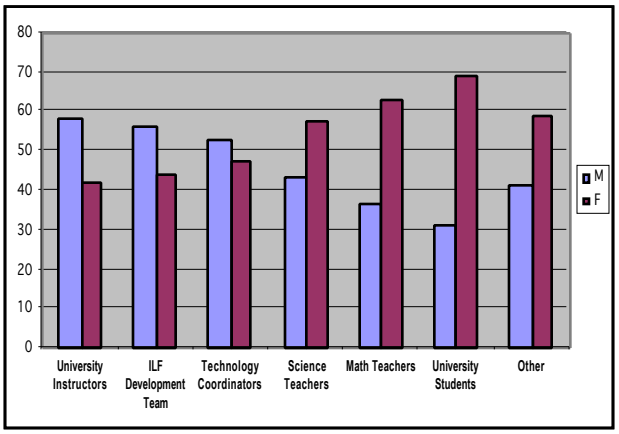

Figure 3. Percentage of male and female ILF members by status

Figure 2 shows that most of the registered members of the ILF are in-service (math and science) teachers and pre-service teachers (university students), the intended target audiences for the site. Figure 3 shows that the gender breakdown varies by status, with males predominating in the three highest status categories,[8] and females predominating in the lower status categories, as well as in the 'Other' category. Overall, 60% of ILF members are female, and 40% are male.

However, all categories of ILF members do not post messages to the classroom discussions in equal proportions to their numerical presence on the site. Figures 4 and 5 show the messages posted by each member category by gender.

[6] In 1996, 76% of elementary and secondary teachers in the U.S. were married [35]. Several female science teachers who were asked to make a video declined because they had recently had a baby or had small children at home.

[7] Human subjects approval was obtained from Indiana University to make use of data collected from the ILF site, and ILF members agreed to this as a condition for registration. Names of members mentioned in this paper are pseudonyms assigned by the authors.

[8] Technology Coordinator is considered a high-status role in the context of the ILF project, which is technology intensive.

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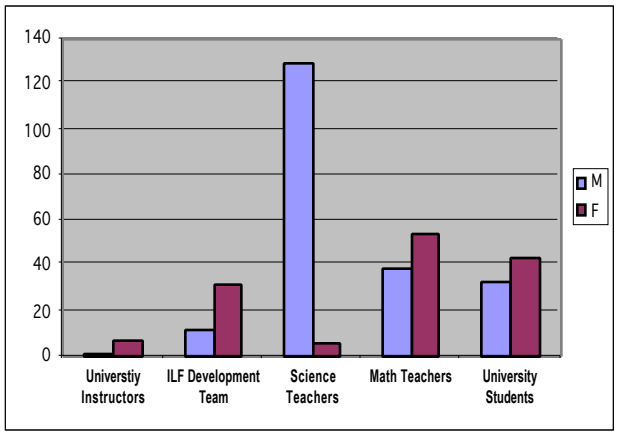

Figure 4. Number of messages posted to classroom discussions by status and gender

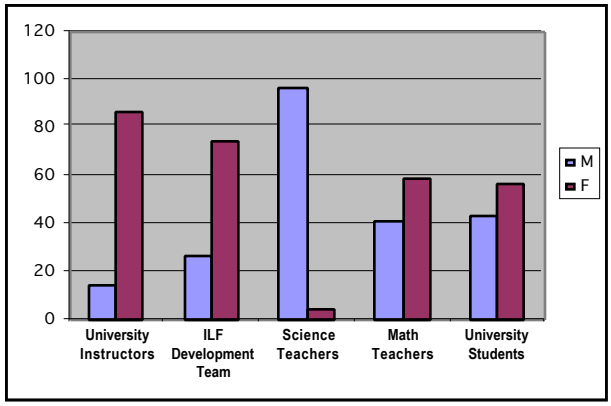

Figure 5. Percentage of messages posted to classroom discussions by status and gender

As Figure 4 shows, the most frequent participants in the classroom discussions are science teachers, followed by math teachers, university students, and the ILF development team. University instructors participate in the discussions relatively little, and technical coordinators not at all. (The results for the 'Other' category are omitted here and henceforth.[9]) Figure 5, when compared with Figure 3, reveals some gender reversals: although the majority of university instructors and development team members are male, the females in those categories post more often. Moreover, and most strikingly, male science teachers post overwhelmingly more often than female science teachers; indeed, female science teachers posted only five messages in the entire 14-month period we analyzed. Males are also overrepresented in the category of university student. The generalization is that females in the "higher-status" categories post more than their male counterparts, and males in the "lower-status" categories post more than their female counterparts, relative to their numerical presence on the site.[10]

Overall, 60% of the messages in the classroom discussions were posted by males, and 40% by females. This is the inverse of what the ILF membership data would predict, assuming representative participation, and thus we have our first main result: males dominate in amount of posting on the ILF site, consistent with the findings for professional asynchronous discussion lists on the Internet [17, 19]. However, two qualifications must be made to this result. Most of the male participation comes from male science teachers, and a considerable portion of this is contributed by the teachers featured in the videos, including one teacher, Brad, who posted 53 messages to his own classroom. In general, male teachers are more likely than female teachers to contribute to their classroom discussions, and this accounts for much of the posting by the male science teachers. However, female science teachers still post disproportionately little, and even when Brad's messages are excluded, male science teachers still post more than any other single category of participant.

The second qualification is that the gender of posters varies according to the gender of teachers in the videos. Males contribute more to discussions about male videos, and females contribute more to discussions about female videos.[11] This result is broken down in Figure 6 according to whether the video features a science or a math teacher.

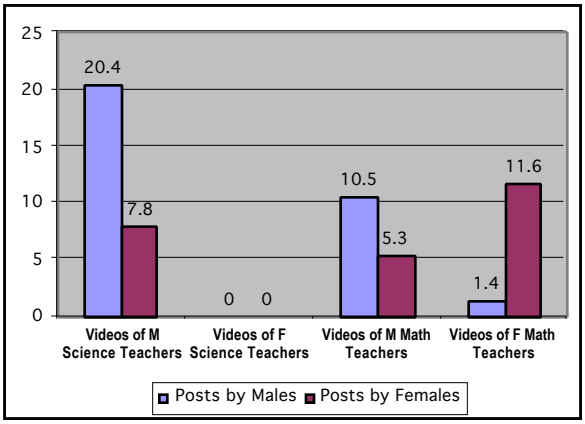

Figure 6. Average number of responses by gender of participants to teachers in videos

Figure 6 compares the average number of messages posted by men and women to male and female math videos and to male science videos (since there are no female science videos), adjusted for the number of videos in each category. The results for the male math videos do not differ significantly from the expected

[9] Four messages were posted in the 'Other' category, three of them from individuals of unknown gender. Excluding them reduces the total number of messages analyzed to 352.

[10] All of these differences are significant ($p < .02$) using a Pearson's chi-square test, with the exception of math teachers.

[11] Pearson's chi-square test, $p < .001$.

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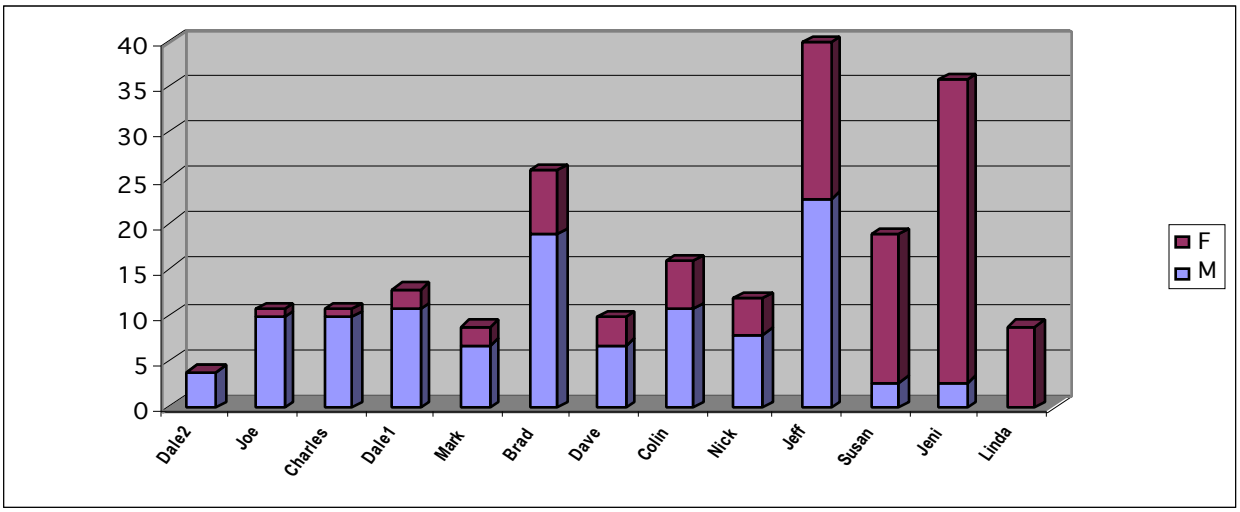

Figure 7. Number of male and female responses to individual videos

distribution based on the proportion of male and female participants in the discussions (p=.28). However, the results for male science videos and female math videos show a significant same-sex bias (p<.001). Moreover, men are nearly 42 times more likely than women to post messages to videos featuring a teacher of their own sex.[12] Thus we have our second main result: ILF members respond preferentially to same-sex videos. Since there are only five female videos (compared to 12 male videos) on the site, this provides an explanation for the lower rate of female participation in the discussions overall. It also implies, conversely, that if the site were to include more female videos, it would attract greater participation by women.

Taken together, the first and second results suggest a cause-and-effect relationship between the absence of videos of female science teachers, and the almost non-existent participation by female science teachers in the classroom discussions.

2.3.2. Discourse analysis. Another possible explanation for the lower rate of participation by women, and the gender differentiated responses to male and female videos, is manner of discussion, rather than the gender of the teacher in the video *per se.* For example, if discussions of the male videos make use of more masculine discourse features, such as strong assertions and criticism, then female ILF members might seek to avoid those discussions, as was observed for discussion groups on the Internet [17, 18]. Conversely, if discussions of the female videos make use of female discourse features, such as attenuation, expressivity, and support, females might feel more comfortable, and males less comfortable, participating in them [18, 21]. This hypothesis, moreover, could potentially account for the variable response rates to individual videos, as opposed to grouping all male and all female videos together in an undifferentiated manner. Figure 7 shows this variation.

To test the above hypothesis, we coded the discussions in 13 classrooms (one for each teacher represented on the site,[13] plus a second video for one of the males, Dale, for a total of 216 messages) for a number of linguistic features that have been identified in previous research to correlate with participant gender. These include hedges (qualifying words such as 'maybe', 'sort of', 'a bit'), self-effacement (overtly modest or deprecating comments about oneself), expressive language (emphasis indicators such as repeated punctuation; overt expressions of emotion, such as 'I love/hate…'), and questions[14]—traditionally tending to be used more frequently by females [30]—and boosters ('confidence' words such as 'obviously', 'clearly', 'of course'), strong assertions (statements of opinion presented as 'fact'), self-praise, and criticism of others—traditionally tending to be used more frequently by males [17]. We also coded for giving advice (e.g., about how to handle problems in the classroom) and use of signatures (name, optionally accompanied by title and affiliation), because these behaviors were observed to be distributed variably across messages, and because both have social meanings that can plausibly be interpreted in relation to gender. The results of the discourse analysis are summarized by gender in Table 3. Significance values were determined by a Pearson's chi-square test.

[12] Males favor male videos over female videos by a ratio of 29.3; females favor female videos over male videos by a ratio of .70. These results were calculated from the raw data, rather than from the data adjusted for number of videos.

[13] One-third of the discussion for Brad's class was analyzed, so as not to bias the results because his discussion was so much longer than the others (and because he himself was such an active participant in it).

[14] Only questions posted by featured teachers on their classroom pages were counted in this analysis.

Table 3. Discourse features by participant gender

Feature	M msgs (N=116)	F msgs (N=100)	p
Hedges	104	146	<.001
Self-effacement	20	23	ns
Expressive lg.	14	42	<.001
Questions	39	5	<.001
Boosters	12	6	ns
Strong assertions	33	33	ns
Self-praise	6	4	ns
Criticism	9	21	.009
Advice	15	23	(.078)
Signatures	32	8	<.001

Three sets of observations can be made based on the results in Table 3. The first is that females use more hedges and expressive language, consistent with the findings of previous studies. Similarly, males use more signatures, which can be considered a means of drawing attention to one's self; male signatures are also more likely to include status indicators in the form of titles.[15] These findings provide some support for gender differences in discourse style along the lines observed in studies of discussion groups on the Internet. In contrast, the second set of observations appears to violate traditional gender expectations. Male teachers ask more questions (in their own classrooms), and females are more critical, as well as tending to offer more advice. However, questions in this context are a means of generating response, interactive rather than powerless [10], and the females who are critical are cooperating with the goal of the ILF project to foster critical reflection on teaching practices.[16] Third and last, participants of both genders manifest features of an attenuated, traditionally female style irrespective of their gender, as reflected in their overall relatively high use of hedges and self-effacement, and their relative avoidance of self-praise, boosters, and criticism. This overall tendency can be interpreted as a reflection of the predominance of females in the field of teacher education, consistent with the finding for Internet discussion lists that the majority gender sets the discursive norms for the group as a whole [19].

However, two further refinements must be made of these findings. The first is that discourse style varies by member category. Male in-service teachers (especially, the teachers featured in the videos) pattern together with female university instructors and female ILF development team members: both groups make disproportionate use of the discourse features 'strong assertions', 'advice', 'self-praise', and 'signatures'. These can be considered features of 'powerful' language: making assertions and giving advice threaten other people's face; self-praise indexes confidence, and signatures often signal status. In contrast, the female teachers (including those in the videos) and students of both genders make disproportionate use of hedges and expressive language, sometimes considered to be features of 'powerless' language [30]. Thus it is not the case that female-predominant discussions necessarily use female discourse features, or that male-predominant discussions are necessarily characterized by male discourse features; rather it depends on who is posting, and several of the most frequent users of 'powerful' language post in both male and female classrooms.

The second refinement concerns variation in discourse style according to individual classrooms. Here no systematic patterns emerge. Jeff's classroom, which is popular with females (Figure 7), has a high incidence of female discourse features such as expressivity (including by Jeff), suggesting that the tone of the discourse might draw women to participate more than in other male-video centered discussions. Similarly, Jeni's discussion is characterized by female discourse features such as support, appreciation, self-effacement and expressive language, and it is the most popular discussion among women on the site. However, other female classrooms (such as Linda's) have a low incidence of female discourse features, and male classrooms with higher concentrations of male discourse features (such as Brad's) still attract messages by a number of women. Taken together, these two refinements suggest that discourse style, although associated with gender and rank, does not map in any simple way on to the classroom discussions. We come back to the gender of the teacher in the videos as the most likely determinant of the asymmetrical response patterns observed in the classrooms.

2.3.3. Video analysis. Yet a third possibility is that it is not the teacher's gender *per se*, but rather particular behaviors or qualities captured in the videos that attract males and females to respond to them differently. In order to test this hypothesis, we conducted a qualitative semiotic analysis of teacher movement and gestures in the first clip for each video, based on the hypothesis that viewers are likely to form their first and strongest impressions from the introduction to the lesson. Previous research into gender and physical alignment has found that males typically sit or stand in such a way as to take up more space than females, e.g., by extending their arms or legs, and are more physically restless, rising more often to move about the room. Females, in contrast, are more likely to remain still and keep their limbs close to their bodies, in some cases curling or folding their bodies so as to take up less space when seated [50, 52]. A similar pattern was found in the teacher videos: the male teachers make more frequent and more fully extended gestures with their arms and hands, including

[15] 88% of male signatures mention job titles (e.g., Physics Teacher), as compared to only 38% of female signatures.
[16] Two of the most critical females are full-time employees of the ILF project.

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
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putting their hands in and removing them from their pants' pockets, in contrast to female teachers, who gesture less and keep their arms close to their sides when they do so. Moreover, the male teachers tend to pace around the classroom, back and forth in front of the blackboard, and forward and back among the students' chairs, much more frequently than the female teachers, who displace themselves across a smaller area, and tend to move among the students only if they have a purpose for so doing, e.g., to check on a student's work. This result is consistent with previous findings that men are more physically active, and occupy more space, than females. It further suggests that men and women have different physical styles of teaching. At the same time, in as much as these findings are largely congruent with the gender of the teacher in the video, they do not provide any additional explanation for why the response to the male and female videos is different.

We considered the hypothesis that the videos in which male teachers are more physically active would attract more female (and male) response (cf. Figure 7). However, once again, this seems to explain the most popular male video, in that Jeff is very active, flapping his arms and 'flying' around the classroom to illustrate the movements of a crane, but it does not explain why less active videos (such as Dave's) are also popular, or why the least popular video (Dale2) has a physically active male teacher.

Finally, we hypothesized that the position of a video in the list on the Visit Classrooms page would influence how much discussion that video attracts, with videos at the top more likely to attract discussion than those at the bottom, since they can be viewed without scrolling down the page. We found that the female videos appeared lower on the list—on average, in 7th position out of 10 in the original videos we analyzed in October 2000—than the male videos, which appeared in 5th position on average. Moreover, the first three videos were of male teachers, and the last was of a female teacher. This order, which is alphabetical based on the initial of the teacher's last name, inadvertently biases users towards viewing male videos over female videos, in that the female teachers happen to have last names that start with letters occurring later in the alphabet. This is consistent with our research findings. However, the linear order hypothesis does not explain variation in the popularity of individual videos (cf. Figure 7): Jeff is at the top and popular, but Dale is at the top and unpopular, and Susan, in fourth position, is less popular than Jeni, in sixth position.[17]

[17] In the newer version of the interface (show in Figure 1) which includes seven more videos, the designers changed the ordering principle from alphabetical to the order in which the videos were first placed on the site, with the newest videos at the top and the oldest videos at the bottom. As of April 2001, this system had the effect of neutralizing the gender bias (both females and males average 9th position out of 17), and is inherently more democratic, in that each (new) video gets its turn at the top.

3. Discussion

When all of this evidence is considered together, the gender of the teacher in the video clips remains the most likely explanation for why a member decides to contribute to a particular classroom discussion on the ILF site. This explanation, albeit simple, is inherently plausible for two reasons. First, the videos are time-consuming to watch, ranging from 15 to 50 minutes in length, if one were to watch all of the clips straight through without pausing. However, the average visitor to the ILF site spends less than 15 minutes on the site per visit. It is likely that many users select a video to view on the basis of an initial preference, rather than on the basis of having viewed and compared many videos. That female users respond preferentially to female videos, even when they have to scroll down the page to do so, lends additional support to the notion that ILF users' initial preferences are gender-based.

Second, gender similarity is a rational basis for preferring to view a video, in the context of a professional development site where the videos are presented as (implicit) models for teaching behavior. We naturally seek to model our behaviors on those of people whom it would be appropriate for us emulate, and the activity of teaching is not the same for males and females, as the differences we observed in physical movement in the videos show. One male student studied by Lambdin et al. [31, p. 196] explicitly remarked that watching a video of a male teacher gave him "a better understanding of how teachers can move around a classroom". The need for gender-appropriate role models can also cause students to evaluate same-sex teachers more positively than opposite-sex teachers. As one female student remarked about a female teacher in Lambdin et al.'s video system, "I thought Vickie Bill was more effective and that would be self evident to everyone. But this was far from true." [31, p. 198]. These comments are consistent with the presumably unconscious assessments of ILF members who gravitate to the videos (and the discussions) of teachers of the same gender as themselves.

4. Design implications

The ILF site incorporates many design features that potentially impact communication that have not been addressed here, for example, the fact that the asynchronous discussion forums are not linked to one another, and that there is no immediately obvious way for users to log on and see if a forum is active or not (i.e., it is not a socially translucent system [13]). Rather, we have focused on one aspect of the interface, the video clips and how they function to encourage or discourage participation on the site. Nor have we addressed all the features that make the videos potentially engaging or unappealing—the size and

resolution of the visual display, the quality of the audio, etc. [32]—but have focused instead on gender representation as a means to understand different rates of user participation. We conclude that the underrepresentation of female teachers in the videos, although not an intentional feature of the design, nonetheless has clear and important consequences for the ability of the site to meet its stated goals of fostering online community. Given that participation on the ILF site is low and has been declining [1], the project can ill afford to discourage a majority of its population from contributing.

Fortunately, the technical solution to this problem is not difficult. The videos should represent the site's user demographics; videos should be added (or removed) such that videos of female math and science teachers are proportionate to the number of female in-service and pre-service teachers, the site's target audience. Moreover, the female videos should not be clustered towards the bottom of a vertical list, where users must scroll down to find them (as was originally the case), but rather should be as prominent as is warranted by the proportion of women in the target user group.

A greater challenge is convincing designers of multimodal CMC systems that gender should be an *a priori* concern. The ILF development team initially failed to notice any gender disparity, even though only 25% of the teachers featured on the site were female. Nor was the disparity noted by the teacher advisory board, the research advisory board, or the ILF research team. This is consistent with a general phenomenon whereby 25-30% female representation in mixed-sex public contexts tends to be perceived by both women and men as gender equality [23]. That is, women's lesser representation in public settings, especially in focal roles, has been naturalized to the point of being largely invisible to any but gender-sensitized observers. This point has implications not just for the design of professional development Web sites, but for the Web more generally, where human beings figure increasingly in graphics, photographic images, and videos on Web pages. Female designers do not necessarily create gender unbiased designs, any more than male designers are incapable of doing so. Rather, unbiased designs result from conscious attention to the kinds of social bias—such as gender bias—that are naturalized and hard to see.

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