Anonymity Options and Professional Participation in an Online Community of Practice

Peter G. Kilner
Instructional Systems Program,
Penn State University, and
U.S. Military Academy
pgk111@psu.edu

Christopher M. Hoadley
College of Education, and School of
Information Science & Technology
Penn State University
cscl05-anon@tophe.net

Abstract. In this paper, we analyze a natural experiment regarding anonymity options and participation in a large, successful online community of practice (CoP) for U.S. soldiers. We study the impacts of changes of anonymity options on comment quality for productive discussion and professionalism. Four levels of personal attribution or anonymity of comments are significantly correlated with comment quality under some, but not all, circumstances. Eliminating anonymity options produced significantly fewer antisocial comments and fewer comments overall, although it did not affect overall peripheral participation as measured by logins and page views. Online identity or reputation appears to be more of a factor than external culpability in shaping user behaviors. Attitudes of participants and the evolution of norms over time are presented, and implications for the design of online learning communities are discussed.

Keywords: Community of practice, anonymity, norms, flaming, facilitation, moderation, participation, online discussion, asynchronous discussion

INTRODUCTION

The development of the theory of communities of practice (Lave & Wenger, 1991; Orr, 1990; Wenger, 1998) has led to numerous attempts to create, support, and shape online communities of practice for social learning. Communities of practice are networks of practitioners who interact socially to become more effective in their practice individually and collectively. Through such networks, novices are initiated into the practices of the group, norms for the practice are negotiated and communicated, and increasing expertise in and identification with the practice is accompanied by more centrality in the community. The model is linked to Vygotskian notions of social appropriation of knowledge (Newman, Griffin, & Cole; Wertsch, 1985).

Although many communities of practice do occur naturally without external intervention or initiation, their deliberate facilitation as a means to learning, especially in professional contexts, has been widely proposed and sought. Oftentimes, such approaches rely on the use of technology to support or sustain the community, especially in fields where the practitioners may be isolated from each other, for instance among teachers (Schlager, Fusco, & Schank, 2003; Barab & Duffy, 2000), engineers and international development experts {Wenger, McDermott, & Snyder, 2002}, U.S Army officers (Dixon, Allen, Burgess, Kilner, & Schweitzer, 2005), Canadian educational coordinators (Gray, 2004), and globally distributed scholars (Scardamalia, 2003).

Communities of practice differ from some other forms of online learning in that they are primarily centered on learning via apprenticeship or legitimate peripheral participation, and thus there is no "teacher." Any member of the community sufficiently central to the practices of the community can support the learning of other, less enculturated members, and even the questions and errant comments of novices can spark learning across the community. The relevant knowledge is presumed to reside in and among the minds of the practitioners themselves (Dixon, et al.; Wenger, 1998), and CoPs are valuable to the extent that they draw out, share, and generate that knowledge.

What, then, drives individuals to learn in a CoP? Identity is an important component of learning in a community of practice. Indeed, identity can be viewed as the driving factor that connects individual cognitive experiences to joining, or repulsing, a community of practice, and hence, learning (Nasir, 2002). Individuals perform their expertise to legitimize and more fully realize their membership in the community.

Technology plays a powerful mediating role in how identity is developed and expressed (Turkle, 1995), and thus provides a lever for changing what kinds of behaviors and norms develop within online or blended communities. Technology provides new opportunities for attribution and anonymity, and may permit the construction of alternative identities in a learning context (Chester & Gwynne, 1998). This fluidity may create a safe space for individuals to explore identity development, which is an important component of development and learning (Halverson, 2004), but it also has implications for social norms and standards. In particular, personal responsibility for one's actions and social norms such as reciprocity, honesty, trust, and so forth may be damaged in environments where identity is too fluid (Chester & Gwynne, 1998; Herring, 1996).

Research on the impact of anonymity on participation in an online learning community is inconclusive. Chan, Bandar, Oh, & Chan (2004) found that the use of actual identities in an online community increased participation, a position supported by Millen and Patterson (2003). In contrast, Chester and Gwynne (1998) found that anonymity increased participation, especially among minority students. In Hsi and Hoadley (1997), anonymity was not found to significantly affect the amount or quality of participation, although it did alter the students' perceptions of social safety. But later work found that the *possibility* of anonymity could contribute to perceptions of social safety, without actually being commonly used. Moreover, anonymity can erode effective participation in online learning conversations; later work in the same context found that learners were less likely to read comments that were posted anonymously (Hoadley, 2002, 2004). Because this is hypothesized to challenge the conditions of a productive discussion (Hoadley, 1999; Hsi, 1997), anonymity can be of mixed value in fostering learning in an online community.

A significant challenge to understanding the interplay of anonymity, identity, participation, and learning in an online community of practice is the many varieties of CoPs (educational, professional, distributed, blended, etc.). Comparisons of the effects of relative anonymity are difficult to make when the CoPs being compared are themselves different. In our review of the literature, we did not find any study like this one, which examines how a change in anonymity options affected a single, robust online community.

METHODS

In the following sections, we explore the results of a natural experiment with anonymity options in an online community of practice for peer learning among soldiers in the U.S. Army. First, we describe the online community as a context for professional learning. Next, we describe how circumstances led to policy changes on anonymity. These policy changes created a natural experiment for different kinds of identity options ranging from full anonymity to linkage with a user's online identity to linkage with the user's offline identity. Finally, we examine the impacts of these shifting options on participation and learning-oriented behaviors in the online community, and discuss the relationship between identity and communities for learning.

The PlatoonLeader community

PlatoonLeader is an online community of practice of platoon leaders in the U.S. Army. Platoon leaders are responsible for groups that typically include 20-40 people, and being a platoon leader is usually a newly commissioned officer's first job in the Army after completing initial training. The Web site brings together past, present, and future platoon leaders in an open exchange of leadership experiences, tools, and ideas related to becoming more effective leaders. The purpose and values of PlatoonLeader are stated across the top of its homepage:

> PlatoonLeader is the professional forum for United States Army platoon leaders--current, past, and future. We support each other's efforts to become more effective platoon leaders.
>
> Professionalism is our watchword. We speak candidly, but always with respect to each other and loyalty to our commission. We tackle our leadership challenges with a positive voice, focused solely on building and leading combat-ready teams.

PlatoonLeader was launched in 2001 as a private, non-profit effort by Army officers who recognized that their own professional learning developed primarily through experience and through conversations with their peers, rather than formal training. They sought to connect current platoon leaders with each other for mutual support and learning, and to connect experienced platoon leaders with novice ones to promote the sharing of experiential knowledge. The community was successful, and in 2002 the Army

began to fund its operations. As of this writing in November 2004, PlatoonLeader has over 16,000 registered members and is growing consistently at a rate of 25 new members per day. In the 30 days prior to this writing, the site averaged more than 700 unique visits, 9000 page views, and 50 new discussion comments per day. Membership and participation in PlatoonLeader is entirely voluntary.

In its initial two years of operation, PlatoonLeader was open to the public and did not require participants to login. Participants could post anonymously. By August 2003, however, the moderators of the community were frustrated by frequent "flame" comments that threatened to give the community a negative tone. Online behavior was becoming inconsistent with the community's stated purpose and values. Several community members told the moderators that they no longer participated because of the unprofessional behavior of some participants, almost all of whom posted anonymously. In an attempt to promote productive professional conversation by discouraging anti-social comments, on September 15, 2003 the moderators changed the rules of the site to forbid anonymous postings. Members had to login to post, and their usernames appeared with their comments. This change led to an immediate and noticeable decrease in anti-social comments. In the spring of 2004, in response to concerns about information security in a time of war, the moderators of the site restricted access to PlatoonLeader to members of the U.S. military. Beginning in March 2004, all new members had to register using their military email address (linked to their real name), and in April 2004 all existing members were told to update their accounts with their military email addresses. In May 2004 all accounts not linked to a military email address were purged. Because military email addresses include the soldiers' real names and official contact information, by June 2004 participants in PlatoonLeader were aware that the moderators of the site (although not the site's other members) had access to their real identities. The purpose of this study was to determine if the tone of the conversation had indeed improved, and, if so, the likelihood that the improvement was due only to chance.

Data sources and coding

In the section that follows, we describe our participation data from the PlatoonLeader community under the three different anonymity conditions. The primary data came from the comments produced during three sample months: August 2003 (when anonymous posts were still permitted), October 2003 (immediately after the requirement that participants had to be logged in to post a comment), and June 2004 (immediately after all accounts that didn't link to the member's real identity were purged). Comments from every third discussion thread were collected and analyzed (threads 1, 4, 7, and so on). Only comments produced during the months of analysis were considered (many threads have comments spanning several months.)

Table 1: Conditions Determined by Months and the Policy Rules in Place

Sample	Month	Policy-Determined Minimal Level of Attribution
Condition 1	August 2003	Anonymous comments permitted (Guests can post messages without logging in at all)
Condition 2	October 2003	Comments required to have handles/usernames (Users must register with a valid email address, and must be logged in to post, but profile information is not validated; all comments are linked to username)
Condition 3	June 2004	Comments required to have usernames linked to actual identities (Users must register with email addresses provided by the military which are linked to real identity; all comments are linked to username, and administrators can uncover real names)

In addition, users participated in an online poll (survey) linked off the opening page of the website which was available for nine days in April 2004. User comments from this survey (and in some cases, follow-up email comments) shed light on participant attitudes towards the site. These polls were, however, a self-selected sample of the users of the website; members were not forced to respond to the poll in order to participate in the online community. Finally, site logs were used to help determine overall rates of participation on the site.

Coding rubrics: Anonymity and comment quality
Each of the comments in the sample was coded on two dimensions: attribution or anonymity, and comment quality (with respect to professionalism and productive discussion).

Comments were coded for one of four levels of anonymity. Level-1 (anonymous) comments were made by guests who weren't logged in to the system and were thus completely anonymous. Level-2

(pseudonymous) comments required user login and were linked to a username, but weren't linked to a user's real name or identity. Level-3 comments were attributed to an individual because the member had chosen a username that indicates his or her real name (e.g., johndoe). Level-4 attribution occurred when a user explicitly highlighted their real name in the body of the post itself by signing it or including their signature block. The system permitted such a signature to be configured as a default for each comment, but users could easily turn this feature on or off for each post.

Table 2: Coding Rubric for Anonymity of Discussion Comments

Level of Anonymity	Description	Example identifier
Level 1	Anonymous	Anonymous
Level 2	Username only	Rogue6
Level 3	Username that indicates real name	Timsmith
Level 4	Signed with real name	s/Timothy Smith, 123rd Armor Bn

Comments were also coded for quality, a construct that captured what effect they would be expected to have on professional conversation and other members' willingness to participate constructively. Level-1 comments were very negative posts that included vulgarity as they demeaned another member, were obvious "flame bait," or were cynical toward the profession. An example Level-1 comment is, "Yeah, it's called CTLT, dumbass. I hate to say it, but that 'don't need to eat shit' nut job was right. Now shut up and go back to ROTC." Level-2 comments were negative posts that criticized another participant (criticism of ideas was acceptable) or were cynical toward the profession but did not include vulgarity. An example Level-2 comment is, "Please tell me you're joking when you say you can't remember if live rounds are crimped or not. No one can be that dumb. One round is missing the projectile, one isn't." Level-3 comments were positive posts that asked a relevant question, answered a question, encouraged or validated a previous poster, chatted in a friendly way, redirected a discussion positively, expressed thanks to another member, or added humor to the discussion. A typical Level-3 comment was, "I think it's division policy here that no one can wear contacts. You set yourself up for problems with all the sand getting in your eyes. You have a greater risk of infections, etc. Maybe check with the eye doctor on post for their take or the official policy." Comments deemed neutral in their effect were coded as Level-3, on the assumption that any participation that isn't negative at least involved a member and is thus a positive act. Level-4 comments were very positive posts that included two or more of the criteria for a positive post, were exceptionally long with quality information, or included specific information (e.g., a link to a specific part of a regulation) that indicated a commitment of time and effort to help another member. A Level-4 comment that immediately followed the example Level-3 comment was, "You can get LASIK and PRK done by the Army depending on where you are stationed. Be aware that after surgery you are non-deployable during healing (~6 months). You can find more info at… [URL to information resource]"

Table 3: Coding Rubric for Comment Quality

Quality of Comment	Description	Example
Level 1	Very negative: demeans with vulgarity	Get lost you dumbsh*t!
Level 2	Negative: critical of another, or cynical	You're as screwed up as the Army.
Level 3	Positive: supportive of another or Army	The way I did it was…
Level 4	Very positive: include multiple positive criteria	Here's the url you need…good luck!

Research ethics

Institutional Review Board (IRB) approval was obtained for this study. Informed consent was obtained from those who completed the survey. The discussion comments were treated as publicly available data. Under conditions 1 and 2, they were directly available to the worldwide public. In condition 3, they were available to over one million U.S. Department of Defense personnel. All data was aggregated, and no effort was or will be made to link it to anyone's identity.

Intercoder reliability

A volunteer not related to the study but who is a member of the PlatoonLeader community independently evaluated 100 of the comments based on the quality rubric to determine intercoder reliability. This second coder had 93% concurrence in terms of whether comments were positive or negative, and 84% agreement on the intensity of the comments (i.e., exact coding match).

RESULTS

Below, we discuss the results of three distinct analyses. First, we describe patterns of anonymity and participation in each of the three conditions. Then, we discuss the relationship between anonymity and comment quality (productiveness or professionalism). Finally, we discuss the results of the user poll and provide some participants' beliefs on anonymity in the community.

Patterns of anonymity and participation by condition

In the first condition, where users were permitted free choice of whether to comment anonymously or not, nearly half of all posters did so anonymously. In our sample, 348 of 707 comments were made anonymously (Level 1) in August 2003 (Condition 1). This may have been due to an explicit desire to remain anonymous, or due to the ease of commenting without bothering to log in to the system.
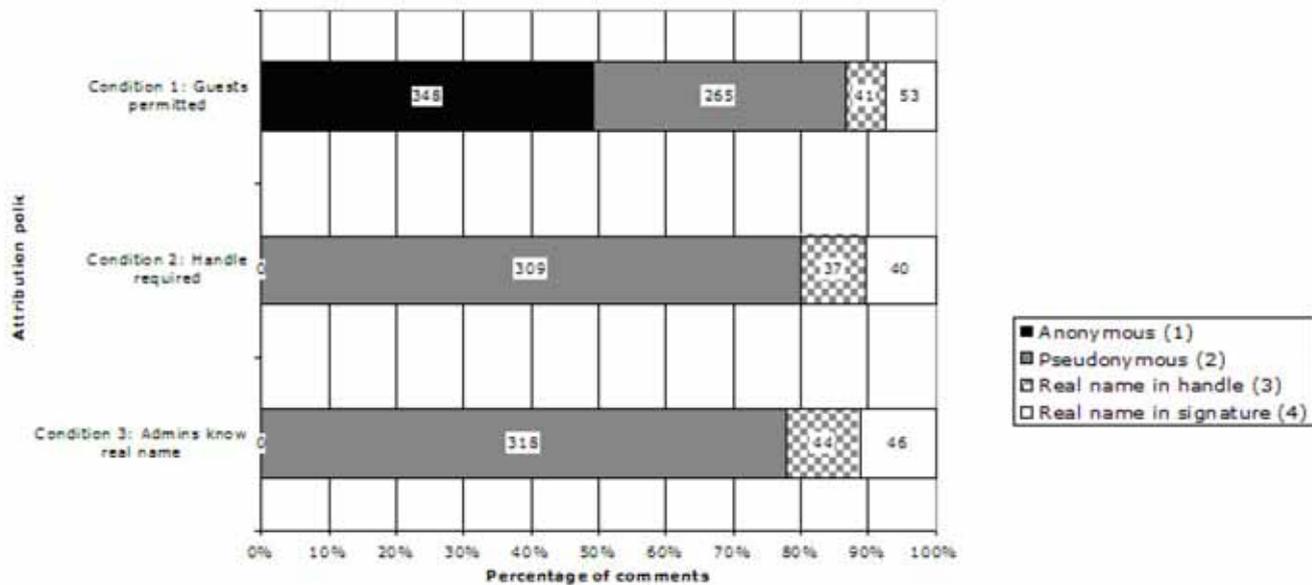
Figure 1: Attribution by condition

Figure 1 shows the patterns of anonymity in each condition. In Conditions 2 and 3, most users still preferred to stick to Anonymity Level 2, in which their words were identified by only a handle or username, and this username did not reflect their real name. This would be the default choice provided by the system, assuming the user had not selected a username that contained their real name. Even so, the percentages of comments linked to identities did go up over time (13% in Condition 1, 20% in Condition 2, 22% in Condition 3).

Elimination of the option to post anonymously appears to have led to a substantial decrease in overall comments posted in the community and to a moderate increase in peripheral participation. 2,148 comments were posted under Condition 1 in August 2003. Under Condition 2 in October, only 1,283 comments were posted, a 40% decrease. Yet, measures of peripheral participation increased. Between August and October, unique visits to the site and page views increased approximately 10%. Unfortunately, a server crash resulted in the loss of participation data from January-July 2004, so we cannot report participation data for Condition 3.

Table 4: Condition and Participation

Anonymity Rules and Month	Unique Visits/ Page Views	Posts Contributed
Condition 1: Augusts 2003	46,040 / 339,067	2,148
Condition 2: October 2003	51,374 / 371,029	1,283
Condition 3: June 2004	N/A	N/A

Anonymity and comment quality

Comments in the system were generally positive and helpful, with a mean of 3.1 (n=1501, sd=0.47). In particular, only 90 (6%) of the 1501 comments were "flames" (coded as negative or very negative), and only three earned the worst rating. 248 comments (17%) were coded at the highest quality level.

Overall, there is a strong relationship between anonymity and our measure of quality (professionalism and productive discussion). Anonymity as measured on our four-point scale correlated significantly with the quality measure $r=.217$, N=1501, $p<.0001$. Of the 90 negative comments (Quality Levels 1 and 2), 84 (93%) were made with some level of anonymity (Anonymity Level 1 or 2), and only six were linked to the participant's real name (Anonymity Level 3 or 4). On the other hand, 73 (29%) of the 248 most positive comments (Quality Level 4), were linked to the participant's real name, and 40 (16%) were explicitly signed by the contributor (Anonymity Level 4). Clearly, people prefer to make negative comments anonymously.

Quality by condition

How did the change in anonymity policies affect the professionalism or productiveness of the comments? Elimination of the option to post anonymously achieved the moderators' desired effect: flaming decreased sharply, from 11% to 2% of all comments. An ANOVA on condition revealed a significant main effect $F_{(2, 1498)}=19.48$, $p<.0001$. Using Fisher's PLSD, Condition 1 was significantly different than each of Conditions 2 and 3, but these last two conditions were not significantly different from each other. See Tables 4 and Table 5.

Table 5: Comment Quality by Condition

	1-Very Negative	2-Negative	3-Positive	4-Very Positive	Mean
Condition 1 (n=707)	0% (2)	11% (77)	75% (530)	14% (98)	3.02
Condition 2 (n=386)	0% (0)	2% (7)	79% (306)	19% (73)	3.17
Condition 3 (n=408)	0% (1)	1% (3)	80% (327)	19% (77)	3.17

Table 6: Effects of condition on quality

Fisher's PLSD for comment quality

	Mean Diff.	Crit. Diff.	P-value
Condition 1, Condition 2	-.147	.058	<.0001*
Condition 1, Condition 3	-.152	.057	<.0001*
Condition 2, Condition 3	-.005	.065	.8678

The relationship between quality and anonymity varied across the three conditions. The correlations between quality and anonymity in Conditions 1 and 3 were significant and positive ($r=.215$, N=707, $p<.0001$; $r=.166$, N=408, $p=.0007$) while the correlation in Condition 2 was positive but insignificant ($r=.057$, N=386, $p=.2650$).

Participant reactions: In their own words

In April 2004, after the option to post anonymously had been removed but before most accounts were linked to personal identifiers available to the administrators, we polled members on their preferred level of anonymity for the community and offered them the chance to explain their vote. Sixty-three members participated in the voluntary poll, and forty-six of them added comments. Although 17% of respondents preferred total anonymity, twice that percentage (36%) preferred options that attributed the contributor's real name to each comment. Almost one-half of the respondents, however, indicated a preference for a middle-ground position in which posts were attributed to the contributor's username. The preferred level of anonymity, then, was the one used most often by users under all contributions during the course of this study—comments attributed only to the contributor's username.

Table 7: Member Preferences on Anonymity Policy

Anonymity Policy	Respondents Preferring
Total anonymity permitted in posts	17.2%
Username only	45.3%
Username with real name available in profile	18.8%
Actual name required in posts	17.2%

The reasons respondents offered reflected a tension between the dual community goods of candor and responsibility. Those who thought that anonymous comments should be permitted appealed overwhelmingly to the perceived need to speak candidly without being constrained by a fear of retribution. "The forum should be a place where leaders can vent and express opinions without fear of

repercussions," said one respondent. Another member commented, "I'd be reluctant to say what I truly feel, especially if it's unpopular, if I thought it may come back to haunt me. You never know who you can [anger] out there or whose command you wind up in later on down the road."

At the other end of the spectrum, respondents who thought that all posts should include the member's real name justified their position in terms of promoting responsible online behavior and credibility of information. One member put it this way:

> I object to anonymous posting for several reasons. The first is a matter of trust. This is a
> professional forum; if you place enough value in your opinion to have posted it for
> everyone to read, you should be brave enough to attach your name. Anonymous messages
> have -zero- credibility: if you don't have the integrity to attach your name to your opinion,
> why should I take the time out of a busy day to read it?   Secondly, I have seen the effects
> of anonymous posting back when it was allowed on platoonleader. This led to thousands
> upon thousands of stupid, time- and resource-wasting 'joke' messages. I come to the site to
> discuss serious things with serious people, not read ten thousand anonymous messages
> about [stupid topics].   There are supposedly benefits to having anonymous postings. I
> have heard the 'worrying about repercussions' argument, among others, but it just doesn't
> seem to hold water. The benefits, if any, are minuscule; the problems anonymous posting
> creates are enormous and wasteful.   Please don't bring it back.

Nearly half of the respondents supported the option for pseudonymity in their community. Their comments emphasized that this option facilitated candor while reigning in the excesses of total anonymity. As one member put it:

> While I think that the anonymous posters, as a group, detracted from the professionalism of
> the site, I still think a limited amount of anonymity is a good idea. It fosters a more heated
> debate forum where real opinions, rather than the "party line" can be expressed. Anything
> dangerous or truly unprofessional can be pursued by a moderator of the forum through the
> user's army.mil address, but for the most part, this site should still remain a vaguely
> anonymous arena for honest and candid discussion.

Interestingly, the arguments for anonymity generally argued from the point of view of the poster, while the arguments for attribution argued from the point of view of the reader. We return to this issue later.

DISCUSSION

To sum up, attribution or anonymity policies can have a significant effect on the professionalism and productiveness of comments posted in an online community of practice. Eliminating the option to post anonymously nearly eliminated negative comments, reducing their occurrence by 89% during a period in which member visits and page views increased approximately 10%. By increasing attribution within the community dialogue, a higher percentage of productive comments were read by more members more often.

Interestingly, pseudonymity is compatible with responsible online behavior. There was no statistically significant change in comment quality when actual identities were linked to usernames. This helps shed an important light on why attribution matters. In Condition 2, users had the option to participate online using a "throwaway" email account, such as a hotmail or yahoo email address. Thus, it is unlikely that there would be any real-world negative repercussions to inappropriate behavior. And, given that the vast majority of comments posted were at Anonymity Level 2, users were unlikely to obtain real-world recognition for their positive behavior. Why then did behavior change radically between Conditions 1 and 2, but not between Conditions 2 and 3? Online social reputation may be more significant than concern for adverse repercussions in shaping participant behavior. In other words, these results suggest that building and maintaining an identity within the community of practice may be more important than real-world professional rewards or sanctions such as raises or disciplinary actions.

Two incidents that occurred outside the direct scope of this study corroborate this interpretation. In the course of this research, we discovered one section of the site that the moderators had overlooked when they turned off the option to post anonymously and thus allowed users to violate the standard site policies about attribution. That section had 13 posts, 4 of which were posted anonymously. Of those 4 posts, 1 would have been coded as negative in quality. So, 1 of the 13 comments, or 7%, were negative, which is well above the rate for the rest of the site during that time period. This anecdote, while statistically insignificant, is nevertheless consistent with our finding that many members will post anonymously if given the option, and will be more likely to make negative comments if they post anonymously.

A second incident reveals the importance of online reputation in a pseudonymous environment. In October 2004, an active member (179 posts) uncharacteristically posted a very negative comment about another member. Immediately, other members of the community pointed out the inappropriateness of the

comment, and the poster edited it. The target of the libel, however, contacted the moderators of the site to request the poster's identity to pursue legal charges. When the moderators contacted the wayward poster about the issue, the member had a two-fold response. On the one hand, he took responsibility for his actions, expressed his willingness to face legal punishment, and contacted the person he had libeled and apologized. On the other hand, he asked that his username be changed, saying, "People will hold it against me. I need a fresh start." Remarkably, he seemed more concerned about his status in the community than he was about facing possible legal proceedings.

The latter story provides insight into a strength of the PlatoonLeader community—the high level of trust between the moderators and the members. The strong support for pseudonymity in the member survey was augmented by statements of confidence in the moderators' role in addressing bad behavior. Absent this confidence that the moderators would protect them from flamers and protect their identities, members might be more inclined either to demand more attribution (to deter flames) or to want more anonymity (to protect their own ability to speak candidly). This moderation may be the key to negotiating the differing goals of the posters and the readers that were evident in the poll.

A natural constraint that increases the validity of this natural experiment is that the moderators did not have the option to delete member accounts; doing so would have caused any threads the members participated in to crash. The improved member conduct in Conditions 2 and 3, then, is apparently not due to "culling the herd" of troublesome members.

In this study, we measured "comment quality" in terms of its professionalism and impact on productive discussion, but we did not attempt to judge its quality directly in terms of learning value. Coming from the perspective of social learning theory (Wenger, 1998), we believe that learning occurs through participation in a community of practice. Through members' legitimate peripheral participation in a community, they come increasingly to adopt the community's practices, identify with it, and find meaning in it. In this study, we see that increased levels of online identification (through the elimination of online anonymity) led to a higher ratio of professional interaction among members and increased peripheral participation by members. Those are indications of increased learning value in the community.

An interesting question for further research is the role that a community's maturation has on whether anonymity levels affect productive behavior and learning. The relatively short duration of this study in a community that was already two-years old would seem to limit the impact of maturation as a conflating variable. Still, it's unknown how the community would have reacted to the elimination of anonymity if it had been less mature. There is need for further study to gain a better understanding of the relationships between online anonymity, online behavior, identity formation, community maturity, and learning in an online community of practice.

ACKNOWLEDGMENTS

REFERENCES

Barab, S. A., & Duffy, T. (2000). From practice fields to communities of practice. In D. Jonassen, & S. M. Land. (Eds.). *Theoretical foundations of learning environments* (pp. 25-56). Mahwah, NJ: Lawrence Erlbaum Associates.

Chan, C. M., Bhandar, M., Oh, L., & Chan, H. (2004). Recognition and participation in a virtual community. Proceedings of the 37th Hawaii International Conference on System Sciences (January 2004, Hawaii), IEEE Computer Society, 1-10.

Chester, A., & Gwynne, G. (1998). Online teaching: Encouraging collaboration through anonymity. *Journal of Computer-Mediated Communication [On-line], 4*(2).

Dixon, N., Allen, N., Burgess, T., Kilner, P., & Schweitzer, S. (2005). *CompanyCommand: Unleashing the power of the Army profession.* West Point, NY: Center for the Advancement of Leader Development & Organizational Learning.

Gray, B. (2004). Informal learning in an online community of practice. *Journal of Distance Education*, 19(1), 20-35.

Halverson, E. R. (2004). Narrative and Identity: Constructing Oppositional Identities in Performance Communities. In Y. B. Kafai, W. A. Sandoval, N. Enyedy, A. Scott Nixon & F. Herrera (Eds.),

Sixth international conference of the learning sciences (ICLS 2004): Embracing diversity in the learning sciences (pp. 246-253). Los Angeles, CA: Lawrence Erlbaum Associates.

Herring, S. (1996). Posting in a different voice: gender and ethics in computer-mediated communication. In C. Ess (Ed.), *Philosophical perspectives in computer-mediated communication* (pp. 115-146). Albany, New York: State University of New York Press.

Hoadley, C. (1999). *Scaffolding scientific discussion using socially relevant representations in networked multimedia.* Unpublished Ph.D. Dissertation, University of California, Berkeley, CA.

Hoadley, C. (2002). Creating context: Design-based research in creating and understanding CSCL. In G. Stahl (Ed.), *Computer Support for Collaborative Learning 2002* (pp. 453-462). Mahwah, NJ: Lawrence Erlbaum Associates.

Hoadley, C. (2004). Methodological alignment in design-based research. *Educational Psychologist, 39*(4), 203-212.

Hsi, S. (1997). *Facilitating knowledge integration in science through electronic discussion: the Multimedia Forum Kiosk.* Unpublished Ph.D. dissertation, University of California, Berkeley, CA.

Hsi, S., & Hoadley, C. (1997). Productive discussion in science: gender equity through electronic discourse. *Journal of Science Education and Technology, 10*(1), 23-36.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Millen, D. R., & Patterson, J. F. (2003). Identity disclosure and the creation of social capital. Proceedings of CHI '03 (Fort Lauderdale, FL, April 2003), ACM Press, 720-721.

Nasir, N. I. S. (2002). Identity, goals, and learning: Mathematics in cultural practice. *Mathematical Thinking & Learning, 4*(2/3), 213-248.

Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in school*. New York: Cambridge University Press.

Orr, J. E. (1990). Sharing knowledge, celebrating identity: Community memory in a service culture. In D. Middleton & D. Edwards (Eds.), *Collective remembering* (pp. 169-189). Newbury Park, CA: Sage Publications.

Scardamalia, M. (2003). Knowledge Society Network (KSN): Toward an expert society for democratizing knowledge. *Journal of Distance Education, 17*(3), 63-66.

Schlager, M., Fusco, J., & Schank, P. K. (2003). Evolution of an online education community of practice. In K. A. Renninger & W. Shumar (Eds.), *Building virtual communities: learning and change in cyberspace*. New York: Cambridge University Press.

Turkle, S. (1995). *Life on the screen: identity in the age of the Internet*. New York: Simon & Schuster.

Wenger, E. (1998). *Communities of practice*. New York: Cambridge University Press.

Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating Communities of Practice: A guide to managing knowledge.* Cambridge, MA: Harvard Business School Press.

Wertsch, J. (1985). *Vygotsky and the Social Formation of Mind*. Cambridge, MA: Harvard University Press.