Levels and Patterns of Participation and Social Interaction in an Online Learning Community for Learning to Teach

Abstract
This study was aimed to understand how members participate in an online learning community for learning to teach. Members' levels and patterns of participation and social interaction were examined via social network analysis of members' log files and content analysis of interviews. The results of the analyses show that: 1) members' levels and patterns of participation varied across time, member types, and tools; 2) members' identity and levels of participation were reciprocally associated; 3) there were similarities and differences in members' usage of computer-mediated communication (CMC) tools, and members showed growth of their knowledge and skills for teaching via mutual engagement, creating joint enterprise, and establishing shared repertoire supported by CMC tools; and 4) lack of time influences members' levels of participation.

Introduction
Researchers in teacher education have particular interest in CoP as a method for diminishing the gaps and disconnection between the stages of teachers' professional development. Previous studies have recognized the importance of a professional continuum of learning that spans pre-service teacher education, induction of beginning teachers, and continued professional development (e.g., Feiman-Nemser, 2001). Some cases of applying online systems to support the continuum of teachers' professional development have been found effective but not easy to sustain. (Job-Sluder & Barab, 2004; Gray & Tatar, 2004; Roup, Gal, Drayton, & Pfister, 1993; Desimone, Porter, Garet, Suk Yoon, & Birmnan, 2002). To better understand how teachers can be supported and sustained in an online community of practice, this study investigated the participation and interaction of the online learning community via examining members' actual and overtime levels and patterns of participation in the online learning community of practice, NETwork (Nurturing Elementary Teachers' work).

Theoretical Perspectives
In the interest of the brevity needed for the proposal, more detailed literature review will be included in the final paper.

CoP in Science Teacher Education
A CoP framework has been identified as an effective model to support the reform of teacher practice and teaching reflection by a number of teacher education researchers (Hollins, McIntyre, DeBose, Hollins, & Towner, 2004; Andrews & Lewis, 2002; Strahan, 2003). However, teachers' time commitment has been a challenge for participating in PLC. Given the geographical distribution of teachers upon graduation from a university, this poses a challenge for establishing a long-term PLC across teacher education to school practice. Taking advantage of computer-mediated communication (CMC) tools and the Internet, researchers have constructed teachers' PLC in online learning environments. Some of the most prominent online PLC's for teachers are LabNet (Roup, et al., 1993), Inquiry Learning Forum (Barab, Makinster, & Scheckler, 2004), and Tapped In (Schlager & Fusco, 2004). Studies identify that a key determinant of how teachers' long-term education can be effectively supported in an online community of practice depends on how

well the social interaction can be engaged and sustained by the CMC tools, such as chat room and discussion boards.

Measurement of Participation and Interaction of CoP

According to the framework for CoP (Wenger, 1998), learning outcomes of a CoP include not only the knowledge or skills gained in the CoP but also changes of social constructs, such as sense of community, social ability, identity, levels of participation, and social relationships with others. These changes happen when members interact with others through textual communication. However, Paccagnella (1997) found limitations in studying a community only through reading the textual messages and logs. Similar to Paccagnella, Mason (1999) found that in only reading the posted messages the researchers miss out on the actions that happen around the messages. In addition to only analyzing the content of messages Mason (1999) indicated that using an online survey or email interview are important methods for studying a text-based virtual community. These findings suggest that studies, such as the current study of the NETwork community should not only analyze textual messages and activity logs but also implement survey and interview approaches in order to understand members' experiences.

Research Question

The purpose of this study was to understand how members participate in an online learning community for learning to teach. Two research questions guided the study.
1. What are the characterizations of member activity that represent different levels of participating in the community, and to what extent did members participate?
2. What are the characterizations of member activity that represent different patterns of participating in the community? Are there differences in the patterns of participation for experienced members and new members and for pre-service and in-service teachers?

Research Method

Research Context and Participants

An online teacher community, NETwork (Nurturing Elementary Teachers' work), has been in place using the Sakai 2.0 course management system to support K-8 science teaching since August 2006. The purpose of NETwork at the University of Missouri is to overcome the current disconnection between pre-service teacher education and in-service teaching practice and to provide pre-service and in-service teachers a collaborative learning environment. Table 1 shows the number of members types of in- and pre-service teachers. Members who participated since Fall 2006 semester were classified as old members and new members are members joining in Spring 2007.

Table 1 *Member Types*

Types of NETwork Members		N
Old Members (Since Aug. 2006)	Pre-service Teachers (PO)	38
	In-service Teachers (IO)	17
New Members (Since Jan. 2007)	Pre-service Teachers (PN)	30
	In-service Teachers (IN)	7
Total		92

Note. "P"=Pre-service Teachers; "I"= In-service Teachers; "O"=Old Members since Aug. 2006; "N"=New Member during Jan. 2007

Data Collection
A set of semi-structured serial interviews, semester-end interviews, members' activity logs recorded in the Context-aware Activity Notification System (CANS, Amelung, 2005), and discussion content recorded in the Sakai system were collected and analyzed to articulate members' behaviors in NETwork. Table 2 shows the number of participants.

Table 2 *Research Participants*

Types of NETwork Members		N	Serial Interviews	Semester-end Interviews
Old Members (Since Aug. 2006)	Pre-service Teachers (PO)	38	2	2
	In-service Teachers (IO)	17	1	2
New Members (Since Jan. 2007)	Pre-service Teachers (PN)	30	2	4
	In-service Teachers (IN)	7	0	0
Total		92	5	8
Time for Participation			During Spring 2007 semester	End of the Spring 2007 semester

Data Analysis
Social Network Analysis (SNA) was applied in analyzing CANS data for characterizing members' levels and patterns of participation in discussion board (DB), chat room (CR), and resource sharing space (RS). Additionally, the qualitative data, including transcripts of serial interviews and semester-end interviews and descriptive discussion content, were analyzed via content analysis. A combination of the framework of Community of Practice (Author, 2005) and Interaction Analysis Model (IAM) developed by Gunawardena et al. (1997) were adapted to develop coding schemes.

Results

In the interest of the brevity needed for the proposal the statistical indices of SNA and the detailed explanation and quotations from participants of content analysis will be included in the final paper but are excluded from this proposal.

Results of SNA
The results of the social network analysis can be classified into four primary sections, including login frequency, levels and patterns of participation in DB, RS, and CR. Table 3 and 4 summarize members' login frequency and levels of participation in DB, RS, and CR across months and member types.

Table 3 *Average of Activity Frequency for Login, DB, RS, & CR*

Included Discussion Activities	Nov 06	Dec 06	Jan 07	Feb 07	March 07	April 07	May 07
Login Frequency	n/a	n/a	102	↘ 85	↘ 69	↗ 78	↘ 43
DB: Posting Activity	n/a	n/a	2.8	↗ 9.3	↘ 7.3	↘ 3.6	↘ 0.9
DB: Reading Activity	n/a	n/a	3.4	↗ 101.2	↗ 120.3	↘ 64.3	↘ 25.9
RS: Reviewing Activity	n/a	n/a	13.1	↗ 14.6	↘ 8.0	↗ 22.1	↘ 4.7
RS: Uploading Activity	1.06	↘ .13	↘ 0	→ 0	→ 0	↗ .16	↘ .14
CR Chatting Frequency	n/a	n/a	3.8	↗ 4.0	↘ 1.5	↘ 0.2	↘ 0

Note. n/a represents "not applicable"; ↗represents "increase"; ↘ represents "decrease"; → represents "no change." The average is the mean number of events per day for the number of days in the month.

Table 4 *Average of Activity Frequency during the Whole Semester*

Included Discussion Activities	PN	PO	IN	IO
Login Frequency	292.4 (**1**)	14.1 (**3**)	9 (**4**)	35.3 (**2**)
DB: Posting Activity	19.6 (**1**)	2.0 (**3**)	0 (**4**)	9.0 (**2**)
DB: Reading Activity	260.1 (**1**)	40.6 (**3**)	13.5 (**4**)	141.7 (**2**)
RS: Reviewing Activity	49.9 (**1**)	15.3 (**2**)	5 (**3**)	4 (**4**)
RS: Uploading Activity	0.2 (**2**)	.97 (**1**)	0 (**3**)	0 (**3**)
CR Chatting Frequency	7.2 (**2**)	26 (**1**)	0 (**4**)	1 (**3**)

Note. Values with in the brackets present the ranking order; 1 to 4 indicates high to low. The average is the mean number of events per member in the member type.

NETwork, members' login frequency started relatively high in January 2007 and remained fairly consistent throughout the semester but dropped at the end of the semester. Comparing the login frequency across member types, the rank from high to low frequency were PNs, POs, INs, and IOs. Figure 1 presented members' individual login frequency across member types, and Figure 2 showed the comparison of member types' monthly login frequency.
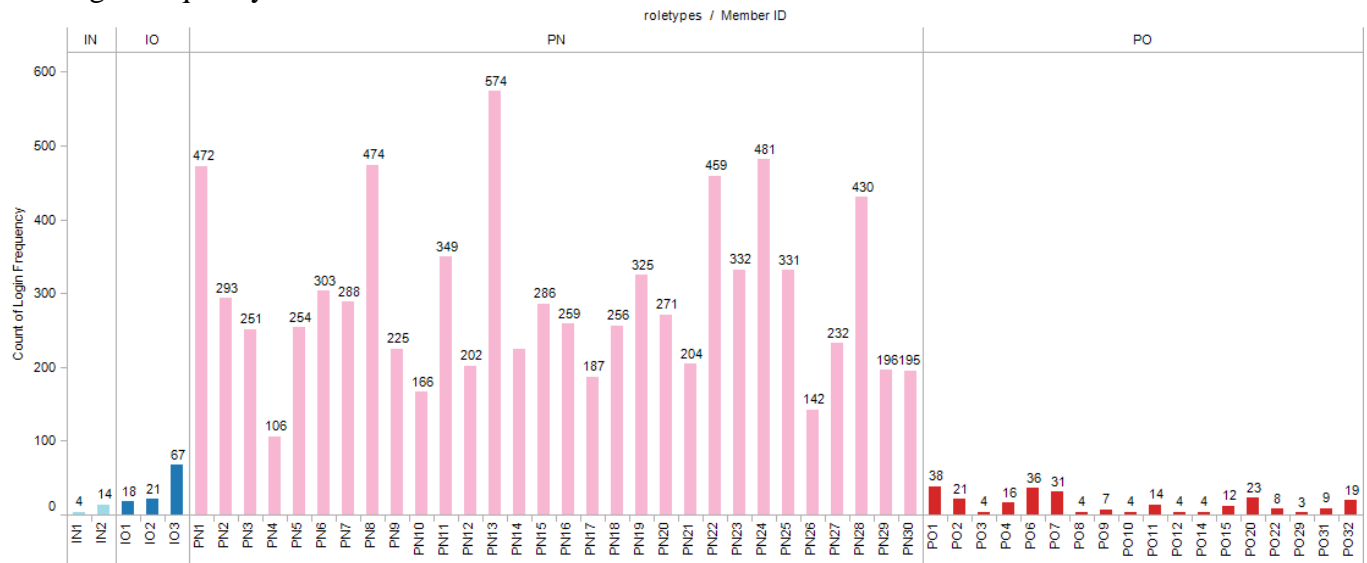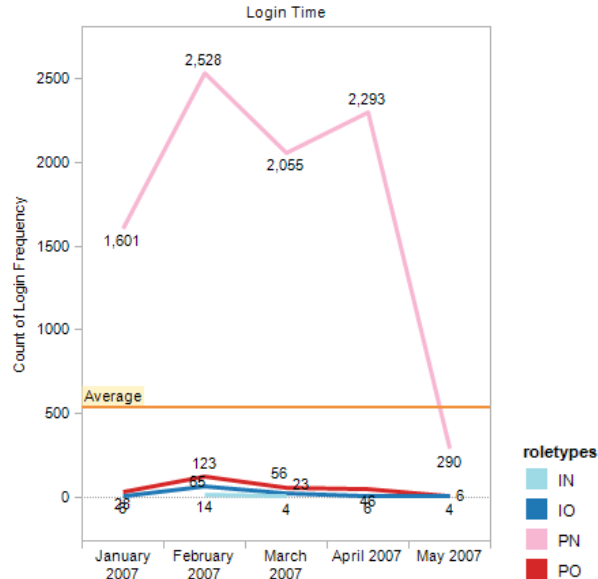

Figure 1. Comparison of Login Frequency

Figure 2. Monthly Trajectory of Login Frequency

For members' levels and patterns of participation in DB, members' posting activity increased in February but kept decreasing in March, April, and May. The frequency of reading activity in the DB increased in February and March but dropped in April and May. Comparing the posting and reading activity across member types, the rank from high to low frequency was PNs, IOs, POs, and INs.

According to Figure 3, the social network diagram of members' interaction in DB, PNs had most intensive interaction within their group, but most of them also read messages that originated from POs, IOs, and INs. Especially PNs read a lot of messages posted by some particular POs and IOs who had more reading activity compared to other POs and IOs. These active POs and IOs also had more reciprocal interaction with PNs. Some POs and INs were identified as peripheral members because they did not post or only posted few messages but had more reading activity. These members were easily ignored by other members because their messages were rarely read by other members.
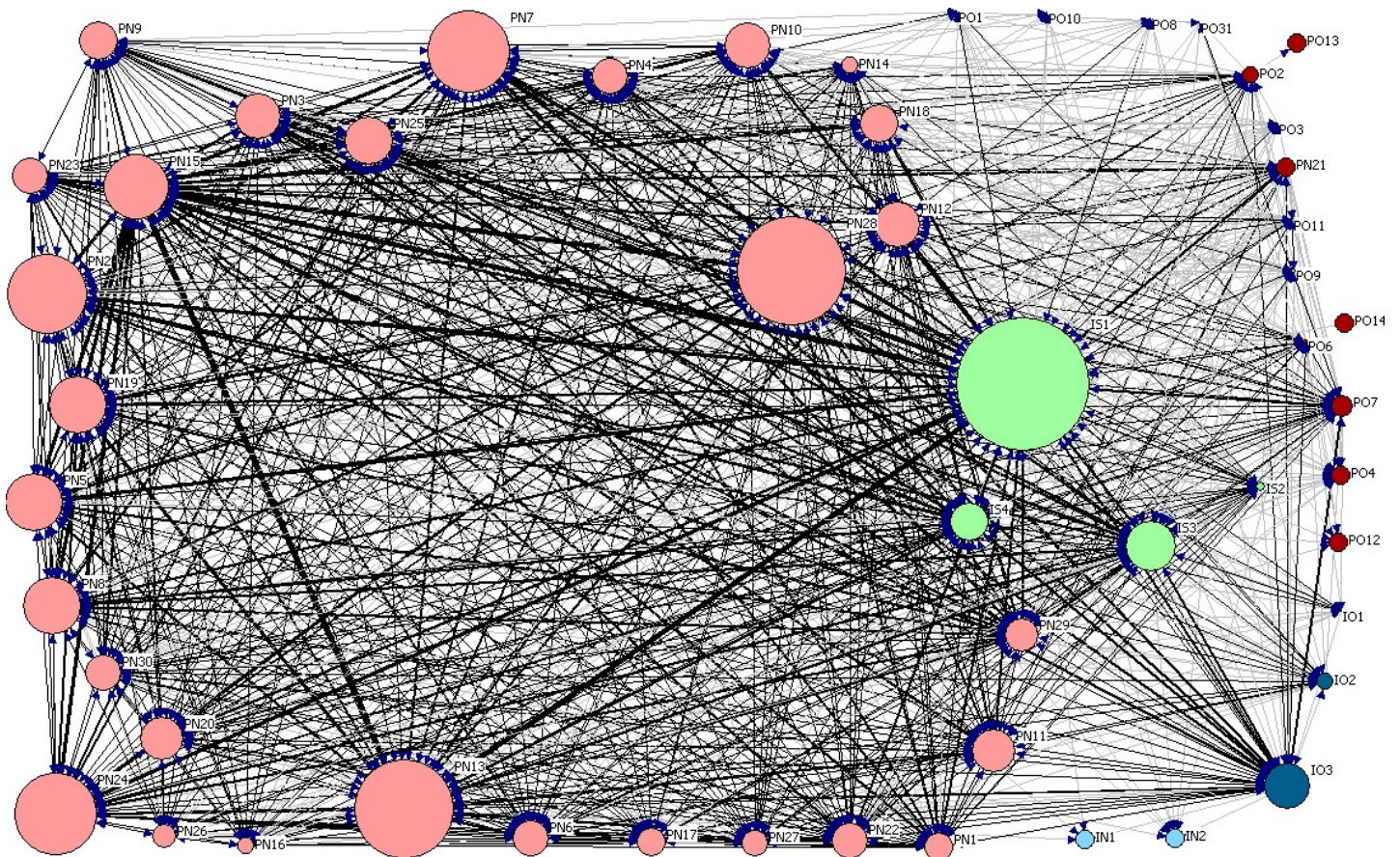
*Figure 3.* Interaction Patterns Diagram for Discussion Board

Note. a. Each node of the diagram represented one member and each color represented one type of members. b. Lighter blue nodes represent in-service teachers/new members (IN). Darker blue nodes represent in-service teachers/old members (IO). Lighter red nodes represent pre-service teachers/new members (PN), as well as darker red nodes for pre-service teachers/old members (PO). Green color nodes represent instructors (IS). c. The lines between a pair of nodes indicated interaction between two members, and the gray lines indicated the one-way interaction as well as black lines were reciprocal interaction.

In RS, most of the resources were uploaded by the professors and POs when they were taking the field experience courses in Fall 2006, while only a few PNs and professors uploaded resources in Spring 2007. Members' frequency of reviewing resources was different across member types. The ranking level from high to low of reviewing frequency by member types was PNs, POs, INs, and IOs. In the Figure 4, the node sizes among the members who uploaded the resources are fairly even because most of them uploaded only 1 resource. The instructors have bigger nodes because they were the primary people to upload resources. Members who reviewed resources but did not upload any were represented with a small circle. By examining the directions of information flow, many one-way direction arrow lines were from POs to PNs and in-service teachers.

Figure 4. Interaction Patterns Diagram for Resources Sharing Space
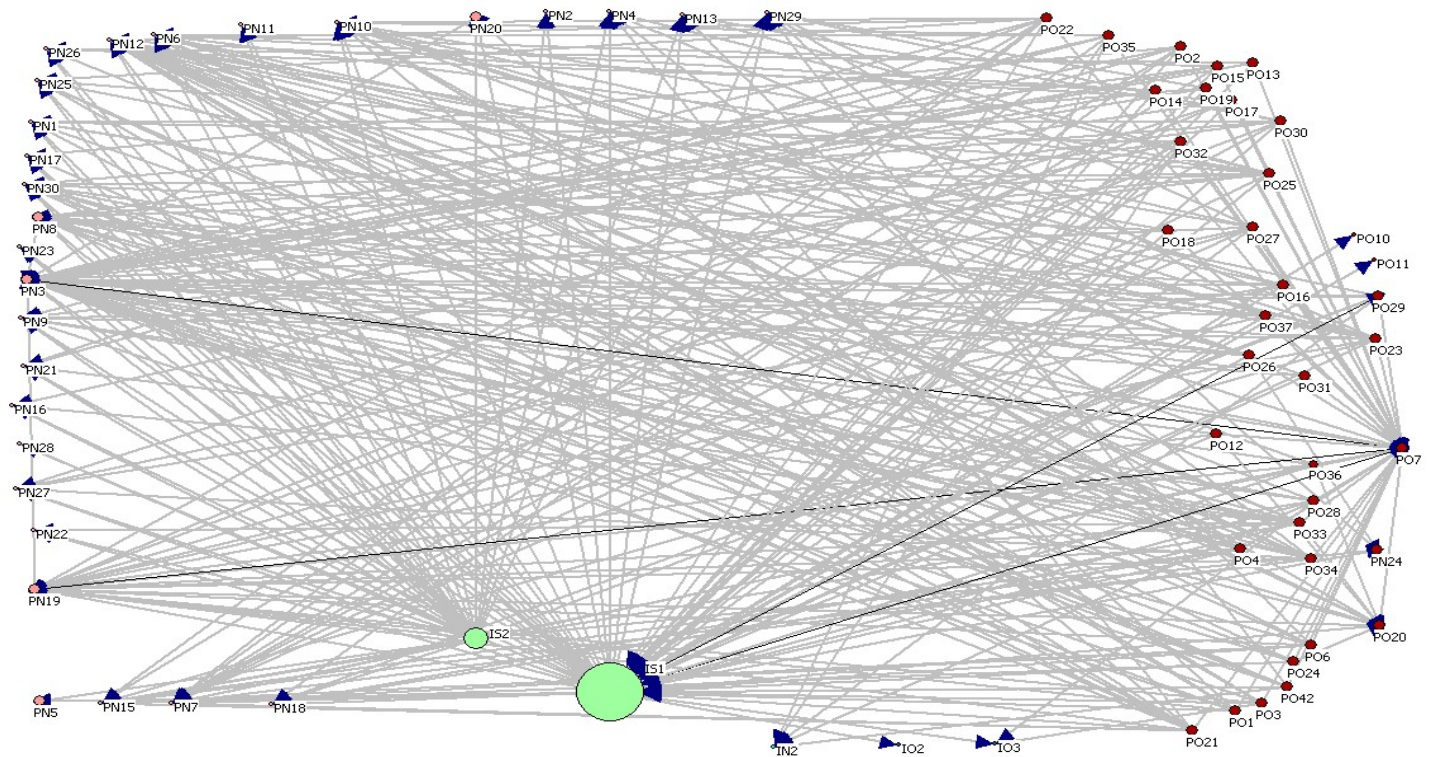
In CR, members' overall chatting frequency was higher during the time periods when discussion topics were scheduled. Chatting frequency increased in February, and dropped gradually in March, April, and May. Compared to the arranged discussion topics, members' ad hoc chatting activity contained more social information. Members participating in discussion topics mostly started their conversation with some socialization sentences and moved to focus more on the discussion topics, which was different from the non-scheduled chatting when included more social information to ask for help or suggestions. Figure 5 presented members' individual chatting frequency across member types and Figure 6 showed the comparison of member types' monthly chatting frequency.
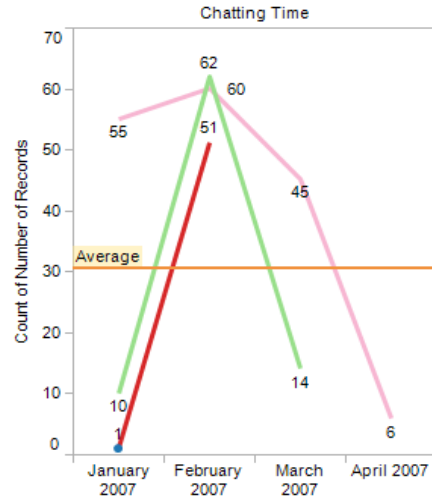

Figure 5. Comparison of Chatting Frequency in Chat Room
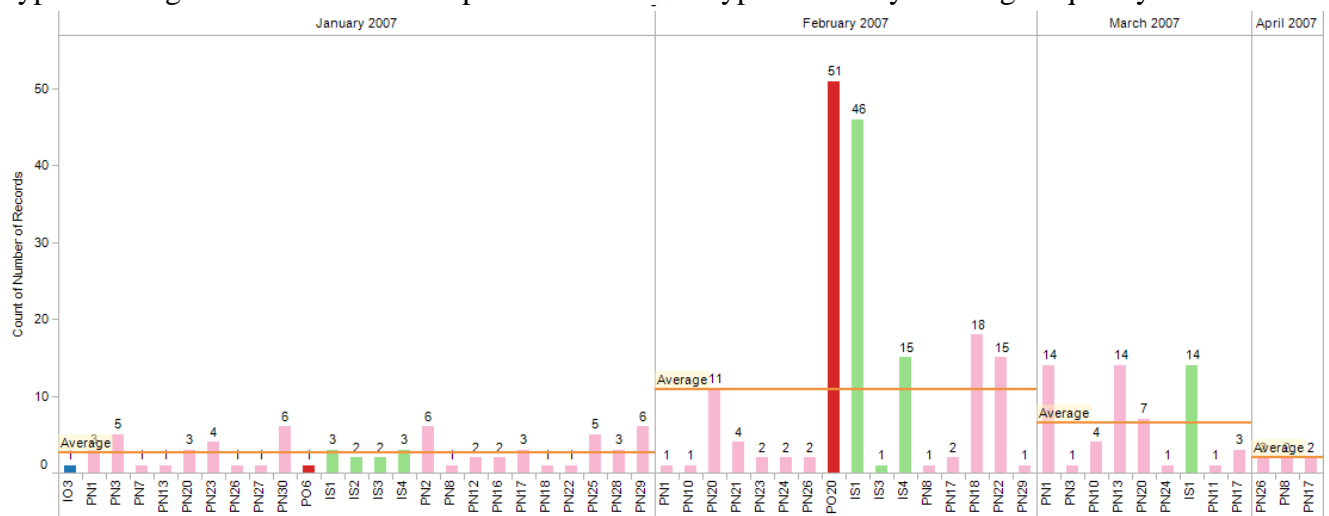
Figure 6. Monthly trajectory of Chatting in Chat Room

Results of Content Analysis

Four themes were found based on the coding process of serial interviews. The themes include: 1) the participation patterns of the in-service teacher (IO2) who participated in the serial interviews changed over the course of the semester; 2) pre-service teacher/new members' attitudes about participating in NETwork changed through the semester; 3) levels of participation of the pre-service teachers/old members who participated started low and remained low; and 4) members perceived advantages of DB, CR, and RS when participating in NETwork.

Additionally, six themes were yielded from the content analysis of semester-end interviews. The themes include: 1) members perceived the information provided from different types of members differently and constructed an identity and role for themselves that related to their position in the community; 2) pre-service teachers who were taking field experience courses perceived the voluntary and required discussions in NETwork differently; 3) members participation in discussion topics was influenced by their interests; 4) members saw advantages of NETwork tools (i.e. DB, CR, and RS); 5) pre-service teachers/new members' attitude of having NETwork as part of their learning changed over the semester; and 6) members stated that a lack of time has been an issue for their participation of NETwork.

Discussion

Similar to what was found in prior studies (Fusco, 2002; Kling and Courtright, 2003) examining members' levels of participation in teacher online learning communities (Tapped In and ILF), time is a variable related to members' levels of participation. Although prior studies used time as a variable to examine changes in the levels and patterns of participation, the forms of examination were limited to only login frequency and number of messages posted. Going beyond prior research (Gray & Tatar, 2004; Fusco, 2002; Kling and Courtright, 2003), the present study utilized multiple indicators, including members' posting and reading activity in DB, chatting activity in CR, resources reviewing and uploading activity in RS. Additionally, this study employed the social network diagrams and statistical indices to present members' patterns of participation across member types and communication tools, which were not found in previous studies.

Wenger (1998) indicated that members' identities are formed via participation and non-participation (i.e. being an outsider or peripheral and marginalized participant). The present study found that members' levels of participation and the way they perceived their role in the community were reciprocal. Members' perceptions of their identities in the community were shaped through discussions with others, learning from diverse perspectives about practical teaching, and associating with others during community events.

Previous studies have found that discussion threads sometimes stop more quickly than expected because of too many participants and superficial content (Cheung & Hew, 2005; Hewitt, 2005). However, NETwork members valued the online discussion because of their engagement and support they got from other members in DB and CR. Differing from Kling and Courtright (2003), professors facilitating members' discussion guided the discussion by providing appropriate prompts, questions, or suggestions; thus, while members did have some social conversation the discussions were always relevant to the topics. To conclude, effective online discussion needs to have members' continued participation and presence and supportive CMC tools (Watson, 1997) as well as a discussion facilitator.

Importance of the Study

The study demonstrates a new way to visualize the levels and patterns of members' participation and interaction within different online activities. The results of the analysis should help researchers better understand members' actual levels of participation instead of only utilizing members' perception to explain social interaction. Additionally, this study was implemented in a teacher online CoP, NETwork. The results of this study should help researchers better understand how members act and interact in an online learning community without course-based requirements.

References

Amelung, C. (2005). *A context-aware notification framework for developers of computer supported collaborative environments*. Unpublished doctoral dissertation, University of Missouri, Columbia.

Andrews, D., & Lewis, M. (2002). The experience of a professional community: Teachers developing a new image of themselves and their workplace. *Educational Research, 44*(3), 237-254.

Laffey, J. (2005). [Framework of computer mediated community of practice (CMCOP) presented in the Social Computing Study Group of the School of Information Science and Learning Technologies, University of Missouri-Columbia].

Barab, S.A., Makinster, J., & Scheckler, R. (2004). Designing system dualities: Characterizing an online professional development community. In S. Barab, R. Kling, & J. Gray (Eds.), *Designing for virtual communities in the service of learning* (pp. 53-90). Cambridge, MA: Cambridge University Press.

Cheung, W. S., & Hew, K. F. (2005). Use of asynchronous online discussion in a hypermedia design class: Pre-service teachers' perceptions. *Proceedings of the ASCILITE 2005 Conference, Australasian Society for Computers in Learning in Tertiary Education. Brisbane, Australia.*

Desimone, L., Porter, A. A., Garet, M., Suk Yoon, K., & Birman, B. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation and Policy Analysis, 24*(2), 81-112.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103*(6), 1013-1055.

Fusco, J. (2002). Personal communication. (Source from Gray, J. H., & Tatar, D. (2004)).

Gray, J. H., & Tatar, D. (2004). Sociocultural analysis of online professional development: A case study of personal, interpersonal, community, and technical aspects. In S. A. Barab, R. Kling & J. H. Gray (Eds.), *Designing for virtual communities in the service of learning* (pp.404-436). New York, NY: Cambridge University Press.

Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Hewitt, J. (2005). Toward and understanding of how threads die in asynchronous computer conferences. *The Journal of the Learning Science, 14*(4), 567-589.

Hollins, E. R., McIntyre, L. R. DeBose, C., Hollins, K. S., & Towner, A. (2004). Promoting a self-sustaining learning community: Investigating an internal model fro teacher development. *International Journal of Qualitative Studies in Education, 17*(2), 247-264.

Job-Sluder, K., & Barab, S. A. (2004). Shared "We" and shared "They" indicators of group identity in online teacher professional development. In S. A. Barab, R. Kling, & J. H. Gray (Eds.), *Designing for virtual communities in the service of learning* (pp.377-403). New York, N.Y.: Cambridge University Press.

Kling, R., & Courtright, C. (2003). Group behavior and learning in electronic forums: A sociotechnical approach. *The Information Society, 19*, 221-235.

Mason, B. (1999). Issues in virtual ethnography. In K. Buckner (Ed.), *Ethnographic studies in real and virtual environments: Inhabited information spaces and connected communities. Proceedings of Esprit i3 workshop on ethnographic studies* (pp. 61-69). Edinburgh: Queen Margaret College.

Paccagnella, L. (1997). Getting the Seats of YourPants Dirty: Strategies for Ethnographic Research on Virtual Communities. *Journal of Computer-Mediated Communication, 3* (1). Retrieved December 22, 2006, from http://dissertation.martinaspeli.net/papers/methodology/paccagnella-1997-ethnographic-research-on-virtual-communities/paccagnella-virtual-ethnography.html

Roup, R., Gal, S., Drayton, B., & Pfister, M. (Eds.). (1993). *LabNet: Toward a community of practice.* New Jersey: Lawrence Erlbaum Associates, Inc.

Schlager M. S., & Fusco, J. (2004). Teacher professional development, technology, and communities of practice: Are we putting the cart before the horse? In S. Barab, S. R. Kling, R. Gray, J. (Eds.) *Designing Virtual Communities in the Service of Learning* (pp. 120-153). Cambridge, MA: Cambridge University Press.

Strahan, D. (2003). Promoting a collaborative professional culture in three elementary schools that have beaten the odds. *The Elementary School Journal, 104*(2), 127-146.

Watson, N. (1997). Why we argue about virtual community: A case study of the Phish.Net fan community. In S. G. Jones (Ed.), *Virtual culture: Identity and communication in cybersociety* (pp.102-132). Thousand Oaks, CA: Sage.

Wenger, E. (1998). *Communities of practice: learning, meaning, and identity.* New York, N.Y.: Cambridge University Press.