

Legitimate peripheral participation of pre-service science teachers: Collaborative reflections in an online community of practice, Twitter

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ABSTRACT: As a key to decide a success or risk of a community of practice, legitimacy of a participant has been conceptually discussed in abundant theoretical literature. Achieving legitimacy is interpreted as gaining credibility from peers, enlarging divisions of labor in a social environment, collecting reinforcement from colleague teachers in the progress model of collaborative reflection, increasing social recognition, and demonstrating leadership. However, there has not been a feasible, empirical measurement of legitimacy, other than measuring a time variable of a novice participant. Hence, this study examined a community of practice developed for a course of school internship. During the 14-week course, the author assisted to implement a community of practice on the social network service—Twitter, working with 28 pre-service teachers and 2 instructors. Findings show that counting citations is a valid measurement of socially-recognized legitimacy identified in branch-shape conversations. Thus, numbers of posted messages and received citations are efficient and valid measurements to categorize the participants into *contributors*, *advisors*, *audiences*, and *silent participants*. Further research questions are discussed in terms of promoting silent participants into contributors along with enhancement of the current method that employs relative *z*-scores.

KEY WORDS: community of practice, legitimate peripheral participation, legitimacy, silent participant

INTRODUCTION

Social network service: Twitter

In studies on communities of teacher practice, communicative aspects have gained more importance, as establishing discourse communities empowers teachers to improve their pedagogical practices. In Rasku-Puttonen et al's (2004) international study, bridging two schools in Finland and UK by a network-based learning environment, the participant teachers were offered chances to share lesson plans, to monitor innovative

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teaching strategies, and eventually to promote collaborative reflections through these shared experiences. The participant teachers from the two nations found the community of practice as being equivalent to authentic school contexts. Another advantageous aspect of using informative technology for long-distance communication was found that the researchers who were teacher educators did not have to provide any solution to participant teachers' instructional issues, other than assisting their technology uses. The participant teachers themselves were "the agents" of the study, "teachers seemed to grasp an idea of how to continue an issue with students and what topics they had to treat more thoroughly before proceeding on the course" (p. 57).

According to Wozney et al. (2006), the foremost functional reason of using technology among 764 schoolteachers is studied as being informative; 48% of the participants responded "Fairly Often", "Very Often", or "Almost Always" on the task of searching instructional materials through informational technology. This functional reason is followed by the expressive reason that involves word-processing and online journaling (39%), and the communicative reason that indicates any telecommunication with peer teachers (20%). This quantitative result shows that although the significant number of schoolteachers employs the technology for searching and producing instructional materials, teachers use the technology least as a viable medium for sharing these resources with colleague teachers. In this light, there emerges a need to promote the communicative technology use for collaborative professional development.

Recently, Twitter as the social network service (SNS) is characterized by its simplicity and efficiency for user conversation. This popular SNS has been employed not only for enterprise purposes but also for educational studies, since it facilitates ubiquitous communities with less initial requirements or technology capability. For example, Java et al. (2007) categorized types of Twitter messages into daily chatter, conversations, sharing information, and reporting news, through analyzing public messages posted on Twitter. They address the efficient limitation of 140 characters and define the act of posting such short messages as micro-blogging.

Compared to regular blogging, microblogging fulfills a need for an even faster mode of communication. By encouraging shorter posts, it lowers users' requirement of time and thought investment for content generation. This is also one of its main differentiating factors from blogging in general. The second important difference is the frequency of update. On average, a prolific blogger may update her blog once every few days; on the other hand a microblogger may post several updates in a single day. (Java et al., 2007, p. 57)

Community for professional development

As the literature has revealed that pre-service teachers develop their expertise in a specific society with mentors, professional learning communities were proved to provide opportunities of teacher inquires about teaching practices (Snow-Gerono, 2005). In the communities, participant teachers are more likely to increase their self-confidence by referring to experienced mentors: senior teachers, program organizers, or researchers (Wilcox, Schram, Lappan, & Lanier, 1991). Effective collaboration takes place in their culture of discussion carried out both inside and outside of the practice.

However, not all online discussion forums are proved to be effective in a teacher formation program to expand pre-service teacher's professional development. Chen et al. (Chen, Chen, & Tsai, 2009) organized an avenue for teachers to require and provide socialized supports. Their analysis of teachers' messages revealed that the teacher discussion did not include cognitive or metacognitive knowledge. The interview data likewise identified little advantage of the online discussion. Reasons of the insignificant effects were reflected: lack of participants' self-regulation and moderators' scaffolding role.

These inconsistent results of using a discussion forum must have originated from incomplete fulfillment of the premise that a online learning communities should be constructed to promote an solid interwoven social network (Çavaş & Kesercioğlu, 2010). Penuel et al. (2009) examined a teacher community as "a network through which resources and expertise flow more or less freely, abundantly, and effectively to achieve the goal of improving schools" (p. 22). The importance of social network is closely linked to Lave and Wenger's (1991) address on the last interpretation of zone of proximal development (ZPD), "learning is often presented as located in instructional environments and as occurring in the context of pedagogical intentions" (p. 54).

Legitimate peripheral participation (LPP) in a community of practice

A community of practice helps a cohort of teachers reflect their practices through mutual collaboration (Maher & Jacob, 2006). Maher and Jacob insisted that emotional and intellectual scaffolding from peers enabled reflective thinking of participants' practices along with contextual situations such as classrooms, students, and schools. In this light, O'Donnell and Tobbell (2007) clarified two critical aspects of successful communities of practices: participation and legitimacy. Individuals' peripheral participation at their early learning state would be the beginning of developing a community. On top of it, the participation

should gain legitimacy from peers in a manner of positive assessment on their practices or contribution. In other words, it would take training time for beginners to develop their full participation into valued contribution, as their efforts gain peers' recognition through a series of assessment. Waiting for such positive assessment is alternatively understood as practicing legitimate peripheral participation (LPP). The primary concept of LPP is to govern degrees of participation among newcomers or novice participants (Hasrati, 2005). In communities of practice, learning by practicing is a sole method for development, while seniors or masters manage any risks that might be caused.

The main features of this are that novice members are given enough credibility to be considered as 'legitimate' members of their target communities and are given 'less demanding' practices to perform to learn the craft of their 'masters'. (p. 557)

Socially-recognized legitimacy

In conventional communities of practice, legitimate access is securely restricted by masters or social systems such as divisions of labor in a social milieu (Lave & Wenger, 1991). So far, the legitimacy in a community of practice commences with public (social) interactions between participants, promotes legitimacy of specific participants through the evaluative filter of contribution, and finally differentiates the most contributing participants or masters from other novices. Of note is that the differentiating concept between masters and novices is mostly fixated by the time variable in traditional apprenticeship.

In the online community of practice, however, promoting a master or a contributing participant is more likely defined by a series of perceived legitimate activities such as commenting and retweeting personally relevant opinions. In a current online community, a person collects his/her legitimacy by means of such social recognition. In the most recent study of community models, Smith (2010) highlights that Twitter users develop legitimacy through user-initiated interactions: the socially-recognized (or public-defined) legitimacy. This study interprets the term *public-defined* in Smith's (2010) statement as being *socially-recognized*, in that this smaller research design focuses on the community of practice for 30 participants.

Twitter user engagement in this study provides understanding of a socially distributed model of public relations, in which individuals with little recognized stake in an organization initiate and fulfill public relations responsibilities through online interactivity. In this social model, public relations-related activities are initiated by an online public, facilitated by communication technology, and based on user interactivity (or the

searching, retrieval, and distribution of information online). ... [Its] social public relations are based on user-initiation and comprise three concepts: viral interaction, public-defined legitimacy, and social stake. (Smith, 2010, p. 333)

RESEARCH QUESTION

The recent research regarding communities of practice reveals that a facilitative structure from teacher educators is not compulsory as much as it used to be believed (Nicholson & Bond, 2003). Because of teachers' increased technological knowledge (Nonis, Bronack, & Heaton, 2000), voluntary *roletaking* (Reiman, 1999), or construction of an informal social community (Russell & Daugherty, 2001) referred to as a "Cocktail Party" (Nonis et al., 2000), a community of practice emerges to be not only an effective environment for professional development but also an effort-efficient intervention for participants and teacher educators.

It seems typical of apprenticeship that apprentices learn mostly in relation with other apprentices. There is anecdotal evidence (Butler personal communication; Hass n.d.) that where the circulation of knowledge among peers and near-peers is possible, it spreads exceedingly rapidly and effectively. (Lave & Wenger, 1991, p. 93)

In a teacher training program wherein pedagogical content knowledge and school practices are integrated, experienced knowledge is critical for pre-service teachers who are thus instructed to consistently interact with university professors, peer teachers, and mentor teachers. The main assumption in this study is that developing an online community of practice would share the duties of teacher educators among pre-service teachers who provide necessary information and encourage reflections. As an effective community of practice increases experienced and autonomous participants with reasonable scaffolding from teacher educators, identifying characteristics of the certain participants with higher legitimacy and socially-recognized contribution is critical for developing an online community of practice.

Many previous studies about a community of practice, especially delivered through online systems, measured individuals' peripheral participation by counting numbers of blog posts or comments (Yang, 2009). Such periphery appeared in a traditional community for higher education in terms of recognition of physical location of university campus, accessibility to their central (educational) services, early academic practices, and dialogic participation in a learning process (O'Donnell & Tobbell, 2007). However, measuring the legitimacy has

been a difficult task due to the methodological limitation, as Smith (2010) commented:

Though it may be difficult to judge perceived legitimacy in a content analysis of Twitter posts, the retweeting of others' posts demonstrates basic credibility and lends measurable legitimacy to the opinions communicated. (p. 333)

Although some studies on social network services have reported the positive influences of a community during teacher training courses (Hsu & Ching, 2011) or teacher internships (Wright, 2010), they could not provide a reliable and valid measurement of legitimacy so as to distinguish contributing participants and their graduate shift from a novice to a master in a community of practice. Likewise, Sivan (2000) used a similar term *leadership* among participants and addressed the challenges that the researchers faced, stating "We must admit that currently we cannot fully analyze the issues of leadership within virtual communities" (p 66). Although little is known about how a passive listener becomes a full contributor, all types of participation are likely to contribute to developing a community of practice. A preceding study claims that even "silent participants" who do not play an active role as a leader should also be appreciated, as they extend dissemination of information by listening to the dialogues (Falk, Lochhead, Jacobs, Mooney, & Drayton, 1999). Hence, this research aims to examine pre-service teachers' conversations in a community of practice developed on Twitter and to explicitly identify different characters of participants. In specific, the following two research questions are resolved:

- (1) What variables measure participation and legitimacy in the community of practice?
- (2) What characteristics do the participants hold in terms of participation and legitimacy?

METHODOLOGY

The course

To reinforce teacher-training facilities in Turkey, the faculties of education were reconstructed between 1994 and 1998 within the framework of the "HEC World Bank National Education Development Project: Pre-Service Teacher Training" project. Since 1998, the faculties of education have used a common program in Turkey. In compliance with this program, *School Experience*, as a compulsory course, has been put into effect to support teacher candidates to get accustomed to a school environment with lengthened time allowed (Egrilmez & Egrilmez, 2010).

In this study, each week in the course consisted of pre-service teachers' observations and their reflected comments about dynamic teaching and learning environments through 1-hour seminars at the faculty of education and 4-hour practices at primary schools. During the seminar, pre-service teachers and teacher educators discussed various educational topics detailed in the second column of Table 1: asking questions, class management, evaluation of students' assignments, using text books, group works, preparation of worksheets, alternative assessment methods, using simulations, planning science course, and portfolio preparation.

Table 1. Research plan integrated with the pre-service teacher course "School Experience"

Week	Topics	Online collaborative reflection
1	Starting the internship in assigned schools	In-class workshop of using Twitter and its advantages regarding teacher's collaborative reflection (see Appendix 1)
2	Preparation of the semester program	In-class demo of how to access Twitter via Mobile network (see Appendix 2)
3	School day for teachers in the school	In-class demo of how to use a Twitter client on a PC
4	School day for a primary student in the school	
5	Teaching methods used in the school	
6	Class management	
7	Asking questions	
8	Evaluation of students' assignments	Online supports offered by the two teacher trainers promoting the environmental, social, motivational, and expectance factors
9	Using text books	
10	Group works	
11	Worksheet preparation- portfolios	
12	Alternative assessment methods	
13	Using simulations	
14	Planning science course	

In addition, an online collaborative reflections were implemented in each seminar session shown in the third column. During the first three weeks, there were in-class workshops and demonstration for posting their reflective comments and sharing them on Twitter. During the later weeks the two instructors ubiquitously supported participants' collaborative reflections. According to Nonis et al (2000), an effective online discussion should comprise facilitative structures such as an environmental factor

with professional relevance, social factor allowing mini-discussions, motivational factor transiting the ownership to participants, and expectance factor from instructors. Implementing such supportive factors on the Twitter community, the two course instructors assisted the pre-service teachers in reading, sharing, and responding messages posted by 28 pre-service teachers.

Data analysis

Participates' textual conversation were collected by a real-time software coded with the Perl language in a Unix system over the 14 weeks. For each participant, a number of posted messages was measured as the *participation variable* in the online community of practice. Likewise, the number of citations defined as the publically defined legitimacy was counted as the *legitimacy variable*. Because the participation and legitimacy variables measure heterogeneous characteristics, and formulate different means and standard deviations, the *z*-score transformation is applied: $z\text{-score} = (\text{value} - \text{mean}) / \text{standard deviation}$. Both converted variables present the same mean of zero and the same standard deviation of one.

FINDINGS

Number of citations as a measurement of socially-recognized legitimacy

As shown in Figure 2, each participant posted 67.5 messages on average ($SD_m = 39.9$) during the 14 weeks. Considering that the requirement was 3 weekly messages totaling 42 for each participant, this higher participation was 161% of what the instructors expected. These messages contained Internet addresses to link statements, questions, answers, and chained group conversations among peer participants. In addition, a participant received 42.5 citations recognized by the peers on average ($SD_c = 32.4$). In terms of the socially-recognized legitimacy, it was inferred that a user who received more replies and more recognition from his/her peers tended to write more messages of information and contributed more to the community of practice. Correlation analysis between numbers of messages and recognized citations revealed $r = .69$, $N = 30$. According to the citation variable, 28 pre-service teachers were coded between *ST1* indicating the least cited student teacher and *ST28* indicating the most cited student. Along with the student identification, the main instructor was represented as *TE1* and the assistant instructor as *TE2*.

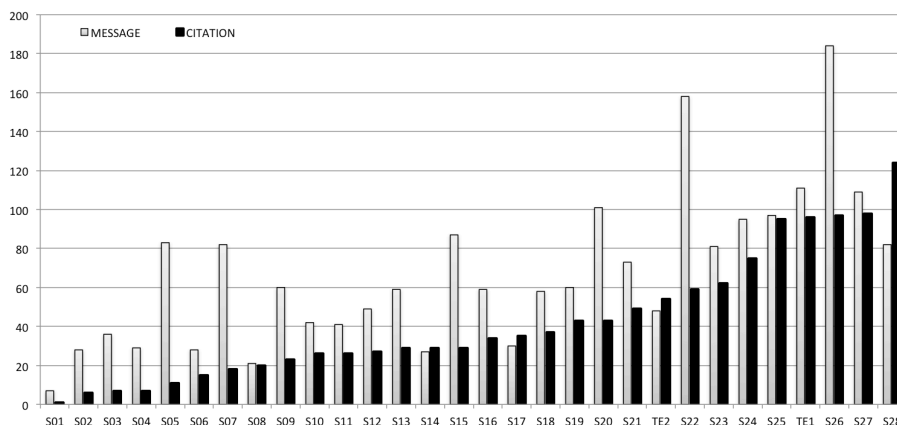


Figure 2. Number of posted messages and citations among all participants ($M_m = 67.5$; $M_c = 42.5$; $r = .69$; $N = 30$)

Another evidence of the significance about measuring citations as socially-recognized legitimacy was identified from 213 chained conversations. Approximately 63% of the entire messages were posted in a form of interactive replies to other participants. Figure 3 presents the size of each chained conversation. For example, there were four seed messages that initiated chained conversations consisted of the most 20 replies. Of note is that this chained conversation occurs in a form of *branch shapes* with the timeline feature in Twitter. That is, in real life conversations, a spoken speech could never be heard later with external participants. However, Twitter messages are preserved in a chronological order for more liberal asynchronous interactions. This feature enables any later participants to initiate his/her branch of conversation with different aspects of a seed message. For example, the below chained conversation begins by S28 with her uploaded photo taken from her internship school. S28 asks whether or not there exists any equipment missing in the science laboratory. S23 replies that she cannot see any. S28 returns and adds her opinion that during her school days she did not experience much lab classes. Referring to both students by indicating @S28 and @S23, TE1 (the course instructor) points out that an emergency shower is missing. In a parallel chained conversation, S23 replies on the last message posted by S28, resulting in two different branches stem from the seed message.

- DATE: 16/10/12 18:20
- USER: S28
- MESSAGE: Do you see anything missing in the photo of a school laboratory that I visited today? If you can find any, what is it? [URL to the school image]

- DATE: 16/10/12 19:36
- USER: S23
- MESSAGE: @S28 There does not seem to be many missing items in the laboratory photo.

- DATE: 16/10/12 19:42
- USER: S28
- MESSAGE: @S23 We did not see much things missing. I used to have science classes in a normal classroom.

- DATE: 16/10/12 19:44
- USER: TE1
- MESSAGE: @S28 @S23 There is no emergent shower against chemical accident!

- DATE: 16/10/12 19:47
- USER: S23
- MESSAGE: @S28 During my internship, the science labs were locked and we did not have a chance to visit one.

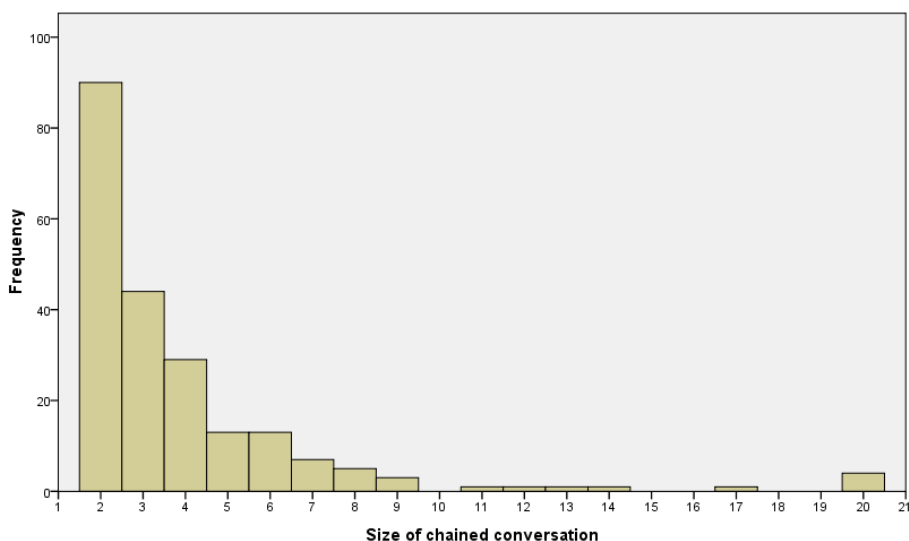


Figure 3. Histogram for presenting size of chained conversation (Mode = 2, $M_s = 3.92$, $SD_s = 3.2$, $N_s = 213$)

Throughout this branch-shape conversation, 3 citations are offered for S28, 2 for S23, and none for TE1, which is in line with the amount of contribution to this collaboration. S28 deserves the most amount of recognition because she initiates the conversation. S23 answers the seed message and reassures it by conversing with S28. Lastly, although TE1 answers the seed message as well, no one continues from his message contributing no expansion of this conversation. Along with the asynchronous interactions, another significant aspect of these branch-shape conversations is identified that S23 continues her contribution even after the course instructor gives his conclusive remark on the seed message.

Types of participation in the community of practice

Regarding these advantageous aspects, a number of citations is set as a measurement of socially-recognized legitimacy. Figure 4 shows a z-score distribution containing numbers of recognized citations and posted messages. Because a z-score fixates zero for its mean and one for its standard deviation, the two different variables could be compared from the origin as a mean for both. Another advantageous feature of using a z-score is that, if a transformed value is bigger than +2 or smaller than -2, this score is regarded as an extreme with the unlikely possibility of 95% ($N = 30$) (Gravetter & Wallnau, 2007).

According to Figure 4, S22 and S25 posted extreme numbers of messages over the mean, as their z-scores are beyond 2.0. All the other students are placed between -2.0 and +2.0 for both citation and message variables. As the correlation is measured to be $r = .69$ ($N = 30$), there is a trend that most of the data points form a straight line penetrating the origin, the quadrant 1, and quadrant 3. However, there still exist 2 participants in the quadrant 2 and 3 in the quadrant 4. In the quadrant 1, 9 students and the course instructor (TE1) are featured with their abundant numbers of messages posted and citations received from other peers. It could be inferred that these participants made the most contribution in terms of the two criteria (1) that they posted enough information and educational materials, and (2) that their contribution was socially recognized to be valuable, since many peers made citations from their messages. In this study, these active and recognized participants in the quadrant 1 are labeled as *contributors*. In the quadrant 2, there are the assistant instructor (TE2) who supported participants' use of Twitter and S19. Although these two participants posted messages less than the mean, their messages were recognized and cited more than the mean. As TE2's role did not include involving in the school internship among the Turkish-speaking pre-service teachers, these participants are labeled as *advisors*. In the quadrant 3, the most number of participants are identified. The 15 pre-service teachers

were not more eager to post messages, and their contribution was not valuable enough for attracting the peers' recognized citations. However, their role should not be degraded, as they were the very peers who provided citations on other's messages. These less-active but critical participants are labeled as *audiences*. Lastly, three participants are placed in the unusual context wherein their efforts of posting more messages was less recognized than the mean. According to Falk et al. (1999), they are labeled as *silent participants*.

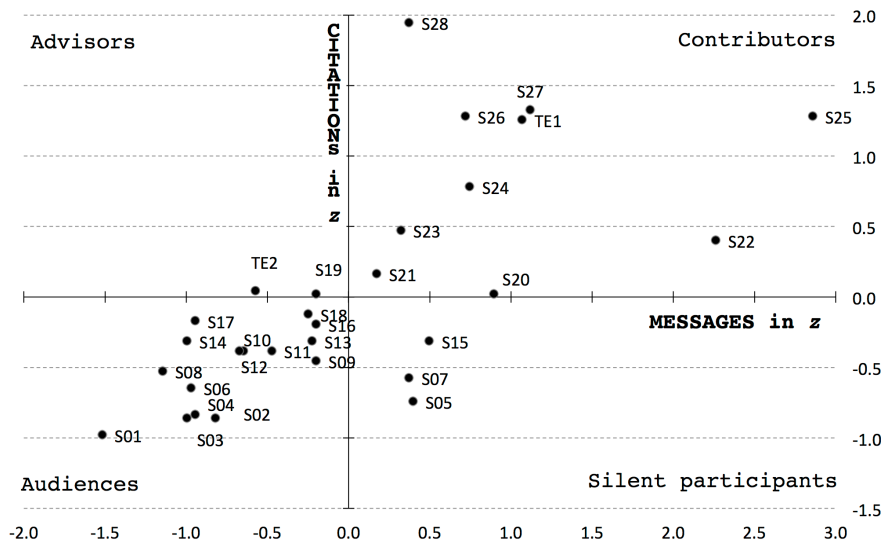


Figure 4. Four quadrants in the message-citation distribution (z-score transformation; $N = 30$)

DISCUSSION

Socially-recognized legitimacy: Citations

As a key to decide a success or risk of a community of practice, legitimacy of a participant has been conceptually discussed in the abundant theoretical literature. Achieving legitimacy is interpreted as gaining credibility from peers (Hasrati, 2005), enlarging divisions of labor in a social milieu (Lave & Wenger, 1991), collecting reinforcement by colleague teachers in the progress model of collaborative reflection (Kim, Lavonen, Juuti, Holbrook, & Rannikmäe, 2013), increasing social recognition (Smith, 2010), and demonstrating leadership (sivan, 2000). Although Smith assumed that counting a number of retweets would be the method, measuring legitimacy in a dynamic community of practice has not been attempted among teacher educators. In addition, his unfeasible

assumption might not be the solution in a smaller size community of practice, because participants enjoy conversing with other people adding citations. They do not retweet much, while leaving their personal comments or praises to other users. Therefore, the significance of this study is that it measures participants' socially-recognized legitimacy in a community of practice by means of analyzing one of the Twitter's features: citations marked with the at sign "@".

LPP among silent participants

Another empirical conclusion of this study is that characteristics of the three silent participants are explained by the theory of legitimate peripheral participation (LPP) with relevance and validity. Their numbers of messages were beyond the mean, indicating that they spent enormous efforts for the community. However, they were not socially recognized enough among the peers. In traditional communities for apprenticeship such as midwives, quartermasters, tailors, butchers, or nondrinking alcoholics, the time variable is the most critical for masters or seniors to render higher-rank tasks to a novice participant. In the recent community of practice organized online, legitimacy is received when numerous peers appreciate a user's participation; it is socially recognized. Therefore, it can be inferred that messages posted by the three silent participants were not relevant, informative, timely, or understandable to their peer evaluators. However, according to Falk et al. (1999), their participation should not be degraded, because they have strong motivation to be recognized as a full contributor. In this light, these silent participants were practicing their legitimate peripheral participation in a sense that they were allowed to post as many messages as they wished and that the dissemination was strictly controlled by their peers. Messages without any comment or retweet disappear soon in the Twitter timeline and in a community of practice, which disables any related collaborative reflection such as the reinforcement or stimulation (Kim et al., 2013).

Further research questions could stem from examining such dynamic interactions. A longer-period study should be prepared for identifying silent participants and tracking them to be a full contributor. By the time, the current method of converting the message and citation counts into *z*-scores should be enhanced, because it always transforms the mean of a variable into zero regardless of its absolute achievement level. Succeeding studies about communities of practice on Twitter should resolve these technical limitations.

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APPENDICES

Appendix 1: Day 1 - Twitter quick start

ONLINE DISCUSSION GROUP FOR SCHOOL TEACHING EXPERIENCE

Aim

The discussion group on <http://twitter.com/search/%239e2> aims to promote pre-service teacher's professional development by posting, commenting, and questioning theories and practices in education.

How to

Basically, adding the code **#9e2** (NumberSign-9-e-2) is the only technical requirement. Post your ideas about learning theories, teaching practice (school experience), ICT integrated teaching, etc. For beginners in the Twitter, please refer to the six examples below:

Example messages

How well the scientific inquiry works in a real classroom is my big doubt.

⇒ Wrong. No code. This tweet will not be shown in the discussion group.

#9e2 I monitored grade 11 math. Very strict classroom management was the key to a success.

⇒ Correct. This tweet will be shown in the discussion group.

#9e2 I liked this class. The teacher did well with the kids.

⇒ Not recommended. Tweets need to be specific and informative.

#te2 Learning community for pre-service teacher would be effective, according to the Snow-Gerono (2005). Read more at <http://bit.ly/ijOGan>

⇒ #te2 is wrong. Unfortunately, this tweet will not be shown in the discussion group.

Assignment

- Please leave your name and ID on http://_____.
- Write more than 3 messages (tweets) per week during this course.
- Be ware of adding #9e2 for each message.

Appendix 2: Day 2 - Twitter via SMS

TWITTER VIA SMS

For Smart Phone users, please install your app and enjoy the mobile Twitter. Other users can read and send Twitters via SMS.

Step 1

After signing in to Twitter, go to Setting > Mobile

Enter your country, phone number, and carrier (only *Vodafone* or *Turkcell*; sorry for *Avea*).

Step 2

Send a SMS from your cellphone.

number: 2444 for *Vodafone* (2555 for *Turkcell*)

text: GO

Step 3 (Optional)

Go to Setting > Mobile again.

Uncheck “Let others find me by phone number.”, if you wish to hide your number on Twitter.

Step 4

As shown below, go to Home > Following > Some favorite users > Turn on mobile Notification.



Step 5

During your school experience, please share your idea to the course students vis SMS. As always, please don't forget entering the code **#9e2** at the beginning.