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Understanding Social Nature of an Online Community of Practice for Learning to Teach

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ABSTRACT

This study is aimed to explore the social nature of membership in an online community of practice (NETwork, Nurturing Elementary Teachers' work) whose purpose is to support pre-service and in-service teachers with a collaborative virtual space for learning how to teach. Path analysis was employed to explore the relationships among social constructs: perceived ease of use and usefulness, social ability, sense of community, satisfaction with NETwork experience, and effectiveness of NETwork for Teaching. The results show members' satisfaction was the only direct factor impacting members' perceptions of effectiveness; several social constructs have direct impact on members' satisfaction; and technology acceptance influences members' social ability, sense of community, and learning satisfaction.

Keywords

Teacher online learning community, Sense of community, Social ability, Technology acceptance, Online learning satisfaction

Introduction

The rapid development of the Internet has led to expansion and enhancement of online learning in higher education (Allen & Seaman, 2010). Recent years, researchers have been exploring alternative forms to traditional course-based learning. One such form that has potential in the field of teacher education is the use of online communities of practice (CoP). Researchers in teacher education have particular interest in CoP as a method for diminishing the gaps and disconnect between the stages of teachers' professional development. Supporting a professional continuum of learning that spans pre-service teacher education, induction of beginning teachers, and continued professional development is a key challenge of teacher education (Feiman-Nemser, 2001). Since 1990s, teachers' professional development has attempted to move beyond simply supporting teachers' knowledge and skill acquisition by changing the training format from one-shot professional development to long-term professional development (Vescio, Ross, & Adams, 2006). The establishment of professional learning communities (PLCs) based upon a CoP framework (Wenger, 1998) has been recognized as an effective model to support the reform of teacher practice and teaching reflection (Hollins, McIntyre, DeBose, Hollins, & Towner, 2004; Strahan, 2003; Andrews & Lewis, 2002).

However, participating in the PLCs required teachers to travel to particular locations and coordinate tight schedules for meetings. Taking time to meet is problematic because teachers indicate that teachers' daily teaching schedules occupy most of their time (Scribner, 2003). Improved ease of access and capabilities of network technologies offers the potential to support PLCs online where teachers can participate at anytime and anywhere. Some cases of applying online systems to support the continuum of teachers' professional development have been found effective but not easy to sustain. (Tsai, Laffey, & Hanuscin, 2010; Job-Sluder & Barab, 2004; Gray & Tatar, 2004; Steele, 2002; Desimone, Porter, Garet, Suk Yoon, & Birmnan, 2002). These studies indicated difficulties to sustain members' feelings of a sense of ownership, connections, trust, commitment to the community, and a sharing culture (Tsai, et al., 2010; Barab, Makinster, & Scheckler, 2004; Schlager & Fusco, 2004) which were crucial social factors impacting members' interaction and retention (Carr, 2000; Chyung, 2001). To understand how to better sustain teachers' interaction and participation in an online CoP, this study investigated the interdependent relationships among the social factors of the online learning community, NETwork.

Theoretical perspectives

Community of practice

Shaffer and Amundsen (1993) define the term: community as "a dynamic whole that emerges when a group of people participate in common practices; depend upon one another; make decisions together; identify themselves as

part of something larger than the sum of their individual relationships; and commit themselves for the long term to their own, one another's, and the group's well-being" (Shaffer & Amundsen, 1993, p. 10). A form of CoP that has a major focus on improving practice and supporting the learning of members is also called a learning community. To distinguish learning communities from other groups, Woodruff (1999) suggested four elements, including function, identity, discursive participation, and shared values, as primary elements that unify a community.

A form of CoPs that use the Internet as the primary mechanism for communication, participation, and sharing is called an online community. Preece (2000) described online communities as consisting of people, shared purpose, policies, and computer systems which diminish members' concerns of location and time. Wenger (1998) defined CoP as groups of people who join together with a common purpose and share a common practice. Members of CoP integrate practice, meaning, identity, and community as components of learning and knowing in their interaction within CoP. Lave and Wenger (1991) said "activities, tasks, functions, and understandings do not exist in isolation; they are part of broader systems of relations in which they have meaning. These systems of relations arise out of and are reproduced and developed within social communities, which are in part systems of relations among persons" (p. 53). Communities are places where practitioners can share interests and resources, engage in joint activities, and work toward the same goals. Individual's growth depends not only on members' individual inputs but also the shared values and knowledge reproduced in the interaction. Learning and membership in a community are intertwined as members' identities change gradually from peripheral participation to more core roles as they gain more knowledge of practice. The changes in members identities, indicating how they perceive who they are and how other members think about them, is a result of their participation and engagement in online learning and interaction (Wenger, 1996). Members' learning, identity changes, and relationships with others are influenced by their feelings and levels of participation and vice versa.

Social factors influencing interaction

When online PLCs operate through computer-mediated communication (CMC) tools and systems, how to facilitate and foster online social interaction within the CoP becomes a critical factor for the success of teachers' professional development in the online learning community (Gess-Newsome, Blocher, Clark, Menasco, & Willis, 2003). Researchers found when people interact through online learning environments, the nature of the tools and the social constructs established around the contexts influence members' participation and interaction (Picciano, 2002; Rovai, 2002a). The usages of CMC tools have shown to influence students' participation and interaction in online learning (Collins & Zane, 1996). Similarly, Hara and Kling (2000) discovered that communication and technical difficulties experienced by students in online learning environments frustrated them and impeded interaction. This is critical because levels and types of interaction influence members' sense of community (SOC) and participation (Lally & Barrett, 1999).

Previous studies reported that without sufficient social interaction, students experience a sense of isolation even though they do appreciate the flexibility and convenience of the virtual learning space (Rovai & Wighting, 2005; Cereijo, Young, & Wilhelm, 2001; Curry, 2000). Students' feelings of isolation were found to be a primary reason for higher dropout rates in distance education (Carr, 2000). A lack of social interaction was a factor that depressed students' satisfaction in online learning (Arbaugh, 2000). Students' perceptions of their interaction and sense of presence were found to have positive relationships with their perceived performance in an online environment (Picciano, 2002). To be more specific, researchers in teacher education discovered that participants' interaction and participation in CoPs were associated with the effectiveness of their learning, collaboration, and how they can apply what they learn (Job-Sluder & Barab, 2004; Gray & Tatar, 2004; Schlager & Fusco, 2004). The following sections identify previous studies that help form a model of how people's SOC, social ability (SA), and technology acceptance are primary constructs impacting social interaction and participation of CoP.

Sense of Community (SOC). SOC and SA have been identified as two critical factors influencing members' level of online participation and social interaction (Lin, Lin, Liu, Huan, Shen, & Laffey, 2006; Rovai, 2003; Picciano, 2002; Carroll, 2001). McMillan and Chavis (1986) defined SOC as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and shared faith that members' needs will be met through their commitment to be together" (p. 9). SOC is one of the factors that can make an online community a learning community (Blanchard, 2000; Haythornthwaite, Kazmer, Robins, & Shoemaker, 2000). Prior research reported learners benefit from being a member of a community by feeling a sense of belonging and having others to ask for

support (Wellman & Gulia, 1999). Communities have greater flow of information among members, availability of supports, commitment to group goals, and higher members' collaboration and satisfaction when people experience a stronger SOC (Scott, 2004; Wellman, 1999; Dede, 1996; Bruffee, 1993; Tinto, 1993). Similar to the results from studies of online courses, SOC has been shown to be a factor in sustaining social interaction in virtual teacher communities (Job-Sluder & Barab, 2004; Steele, 2002).

Social Ability (SA). SA is defined as "a person's capacity to associate with fellows and to use the members, resources and tools of the social context to achieve something of value" (Social Computing Research Group (SCRG), 2006, p.2). Social presence (SP) and social navigation (SN) are underlying factors of social ability in online learning environments (Laffey, Lin, Lin, 2006; Yang, Tsai, Cho, Kim, & Laffey, 2006). In online learning studies, SP "as an attribute of computer-mediated activity is derived from media studies about how effectively media (TV, etc.) convey the sense that mediated participants were really present" (Laffey et al., 2006, p. 166). SN is defined as "a construct representing being aware of what others are doing as a primary guide for one's own actions" (Laffey et al., 2006, p. 166). Prior research has found positive relationships between students' perceived SP and assignment scores (Picciano, 2002). Additionally, what members do or how they act in an online environment are found to be based upon what others have done, where others are, and what they have looked at (Gutwin & Greenberg, 1998; Dourish & Bellotti, 1992).

Technology Acceptance. Social constructs of online learning are highly associated with the affordance of technology in the online learning environment. The CMC tools influence how members socialize with others and appropriate tools when interacting and participating online. With the intention of understanding how usage of CMC tools impacts members' social interaction, researchers have examined people's perception of how they use and how they feel about the information and functions conveyed by the CMC tools (Davis, 1989). The Technology Acceptance Model (TAM) is a frequently used framework for exploring people's technology usage behaviors (Davis, 1989). Since people's intention of using technologies influences their attitude about using the tools and their perception of how useful the tools are, two primary constructs, perceived usefulness and perceived ease of use, have been identified as determinants of people's technology acceptance (Mathieson, 1991; Davis,1989). By adapting TAM to examine students' online learning experience, Lin (2005) showed how students' intention of using technologies impacted students' appropriation behavior. Also, previous study, which explored the relationships among perceived ease of use (PEU), perceived usefulness (PU), SA, and SOC in online courses, found that PEU directly influences SA and PU positively impacts SOC (Tsai et al., 2008a). However, it is not clear if these relationships found in online courses exist in the same way in a teacher CoP.

Relationships among social constructs of CoP

Since SOC and SA have been recognized as influential factors determining levels of participation and interaction in online learning environments, studies of online courses have examined how these particular social constructs influence students' learning satisfaction, course grade, and participation. Because the social constructs are interdependent and intertwined, it makes their contribution difficult to understand without considering the relationships among them. There are rare studies examining the relationships among social constructs as a whole. In a study which established a unified model to explain the relationship among social constructs in online courses, Lin et al. (2006) found that SA was a significant predictor for students' online learning satisfaction and students' perceptions of using tools in an online context influence not only their learning satisfaction but also how they used the tools to better achieve learning goals. In another study examining both SA and SOC simultaneously (Tsai, Yang, & Laffey, 2008a), researchers found SOC could be a mediator for the relationship between SA and learning satisfaction, and SA was not a direct predictor for learning satisfaction. When Lin et al. (2006) examined the relationship between SA and learning satisfaction, social connectedness was included as a factor of SA. It is not clear how the relationship between SA and learning satisfaction are influenced by the social connectedness which has a similar meaning to SOC. These two studies examined the relationships between SA and other social constructs, but they did not examine the sub-relationships among SA's sub-constructs and other social constructs. While there is reason to believe that social constructs influence online learning, more research examining all the factors simultaneously is needed to understand the relationships among these key social constructs and online learning outcomes.

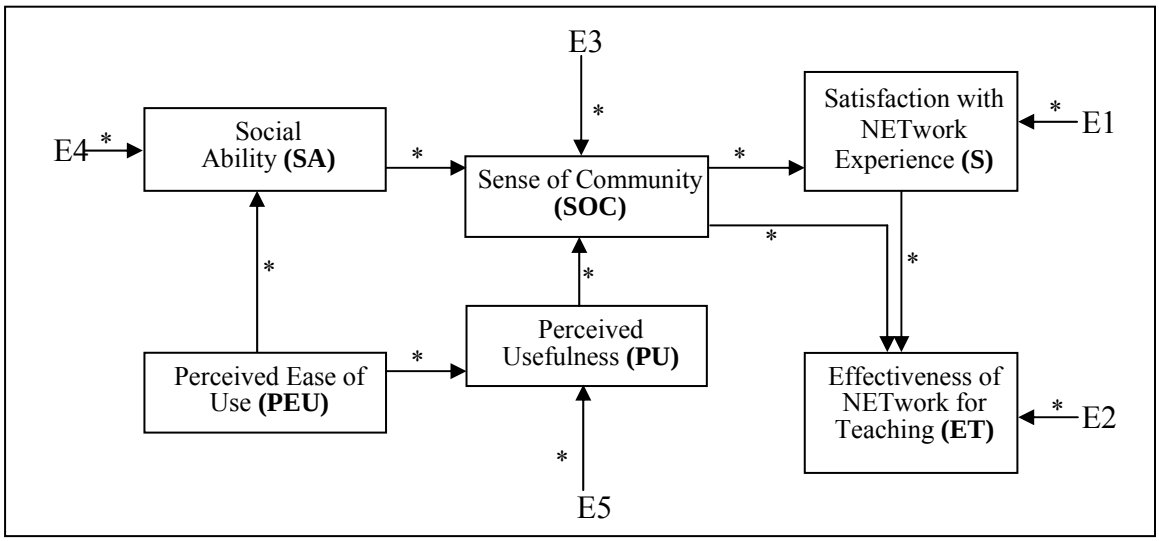
Previous studies have developed reliable instruments to measure SOC and SA in online course contexts but have not been tested in an online CoP. To better understand the social nature of a CoP, there is a need to explore how SOC and SA influence teachers' social interaction and effectiveness of participating in the online teacher CoP. Thus, this study examined not only the relationships among key social constructs but also relationships among members' perception of technology acceptance, SA, and SOC.

Research questions

The purpose of this study was to understand the social nature of an online learning community of practice. To understand the social nature, the relationships among social constructs were examined via path analysis. The proposed path model (Figure 1) of how well the social constructs of the online learning community explain the effectiveness of professional development in a community was adapted from Tsai et al. (2008a). Below are the two research questions for this study.

(1) How well does the proposed path model explain the relationships among the social constructs of online learning (e.g., SOC, SA, PEU, and PU) and explain community outcomes/effects (satisfaction with NETwork experience (S) and effectiveness of NETwork for Teaching (ET))?

(2) How do members' perceptions of the sub constructs of social ability influence other social constructs, and how are they impacted by other social constructs?



[1] The ⟶ represents direct relationship, "E" represents residual error)

Figure 1. Proposed Path Model

Research method

Research context and participants

An online teacher community, NETwork, has been in place using the Sakai 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. The community was established via recruiting members from the field experience courses in the teacher education program. The key features of NETwork include (a) communication tools: synchronous and asynchronous tools, files sharing space, and some notification and social awareness tools; and (b) learning tasks: asynchronous topic discussions, synchronous chat discussion sessions, and teaching resources or lesson plans sharing.

In addition to professors of the teacher education, members of Network include pre-service teacher/old members (POs) who took the field experience courses in Fall 2006 semester, pre-service teacher/new members (PNs) who was taking the courses in Spring 2007 semester, in-service teacher/old members (IOs) who joined the community since Fall 2006, and in-service teacher/new member (INs) who joined the community since Spring 2007. The professors served as a facilitator to guide the discussion and provide relevant resources of teaching. Based on the knowledge and skills learned, the pre-service teachers served as a learner role to discuss how to teach science as well as gain practical experience from what in-service teachers shared about their school teaching. However, NETwork is not just a CoP within an online course. While it did integrate some activities (e.g. topic discussion of teaching methods and resource sharing) for PNs while undertaking their field experience courses, the primary goal of Network is to establish connections that go beyond the pre-service classroom in time and place. Most of the NETwork activities (e.g., topic discussion focusing on K-12 science teaching, synchronous chat discussion session with in-service teachers, and lesson plan and resource sharing) were not necessarily related to what PNs were doing in their courses. There were a total of 92 student members in NETwork. Table 1 presents the demographic information of 66 members who participated in the final survey.

Table 1. Demographic Information for 66 Participants

Demographic Information		Number of Participants	Percentage (%)
Gender	Male	6	9.1
	Female	60	90.0
Age	Under 20	7	10.6
	21-25	55	83.3
	26-30	3	4.5
	>30	0	0
	missing data	1	1.5
Membership	Old member (since Fall06)	36	54.5
	New member (since Spring07)	30	45.5
Teaching Status	Pre-service teacher (Old member)	30	45.5
	Pre-service teacher (New member)	30	45.5
	In-service teacher (Old member)	6	9.1
	In-service teacher (New member)	0	0
Participation of NETwork Discussion	participator	42	63.6
	non-participator	24	36.0
Previous Online Learning Experience	In Sakai	46	69.7
	In Blackboard	48	72.7
	In other systems	2	3.0
	Missing data	14	21.2
Messages Posted in Discussion Board (weekly)	1ess than 2 postings	37	56.1
	3-5 postings	24	36.4
	6-8 postings	4	6.1
	8-10 postings	1	1.5
Hours Login(weekly)	1ess than 1 hour	38	57.6
	1-5 hours	28	42.4
	6-10 hours	0	0
	>10 hours	0	0

Instruments

Below are the constructs included in the survey. The items for assessing the social constructs were adapted from previous studies. For the social constructs items, participants were asked to rate their agreement with the items on a 7-point Likert-type Scale where 1 represented strongly disagree and 7 meant strongly agree.

Technology Acceptance. The 10 items of these constructs were adapted from an online learning experience survey (Yang et al., 2006) based upon Davis's (1989) technology acceptance instrument. The Cronbach α reliability of PEU and PU assessed in the previous study were .96 and .98 (Tsai, Kim, Liu, Goggins, Kumalasari, & Laffey, 2008).

SOC. The 20 items for SOC were adapted from Rovai's Classroom Community Scale (Rovai, 2002) to measure SOC in an online learning environment. The Cronbach α reliability of connectedness subscale and learning subscale are reported as .92 and .87 (Rovai, 2002).

SA. The 18 items of social ability were adapted from a 30-item instrument of online learning experience (Yang et al., 2006). Advances to the original 20-item instrumentation, Yang et al. (2006) found students perceived instructor's social presence and peers' social presence differently. Based upon this result, this study examined social presence with instructors (instructor role: professors and mentors, 6 items) and social presence with peers (peer role: pre- and in- service teachers, 6 items) separately. The Cronbach α reliability of SN, social presence with instructor (SPi), and social presence with peers (SPp) were .88, .93, and .91 (Yang et al., 2006).

S. 9 items to measure members' satisfaction with NETwork experience were modified to meet the context of this study from a previous online learning experience study (Laffey et al., 2006; Yang et al., 2006). The Cronbach α reliability of overall satisfaction of online learning were .92 and .87 for learning satisfaction and .89 for course evaluation (Tsai et al., 2008).

ET. The 10 items about how members perceive the value of participating in NETwork were developed by the author to address how members feel about their teaching knowledge, skills, and confidence after participating in NETwork. Two expert reviews were conducted for developing these items. The expert with expertise in science education reviewed the items to ensure the questions could address members' feeling of their improvement/change of the content and pedagogical knowledge in science teaching. After that, the expert with expertise in social computing reviewed the questions to ensure questions were realistic and meaningful to measure members' changes after participating in an online learning community.

Data collection and analysis

To address the research questions a final survey collected at the end of the semester was employed. An invitation with a link to a consent form and online survey was sent to the 92 members, and 66 members (72%) completed the survey. Additionally, path analysis which visualizes the intertwined relationships was employed to analyze the final survey data to quantify the relationships among the social constructs of online experiences in NETwork. To further understand how sub constructs of social ability are related to other social constructs, two further path analyses were conducted to assess how members' technology acceptance influences the sub constructs of SA and how the sub constructs of social ability impact members' SOC and satisfaction of participating in NETwork.

Results

Preliminary analysis

Prior to the path analysis, the assumptions of normality, linearity, multicollinearity, and homoscedesticity were examined and found to be satisfactory. There were no univariate or multivariate outliers found and no cases were excluded. Descriptive statistics and Cronbach's alpha reliability estimates for the social constructs are presented in Table 2. All social constructs showed satisfactory reliability with Cronbach's alpha values greater than .80 (Nunnally, 1978).

Table 2. Descriptive Statistics and Reliability (N=66)

Variables	M	SD	Reliability (# of items)
Sense of Community (SOC)	4.89	.96	.92(20)
Social Ability (SA)	4.93	1.19	.96(18)
Social Presence with Peer (SPp)	5.07	1.32	.92(6)
Social Presence with Instructor (SPi)	4.90	1.34	.91(6)
Social Navigation (SN)	4.83	1.31	.91(6)

Perceived Ease of Use (PEU)	5.14	1.46	.96(4)
Perceived Usefulness (PU)	4.79	1.45	.93(4)
Satisfaction with NETwork experience (S)	4.72	1.61	.95(8)
Site Evaluation (SE)	4.90	1.46	.83(4)
Learning Satisfaction (LS)	4.54	1.87	.97(4)
Effectiveness of NETwork for Teaching (ET)	4.83	1.66	.97(8)

Note. 7 point Likert-type Scale where 1 represented strongly disagree and 7 meant strongly agree were used.

Table 3 presents a correlation matrix of all the social constructs. The results present how social constructs are co-related and provide a basis for making decisions of including or dropping constructs for testing the path model.

Table 3. Correlations among Social Constructs (N=66)

Variables	SOC	SA	SPp	SPi	SN	PEU	PU	S	SE	LS	ET
Sense of community (SOC)	-										
Social ability (SA)	.814**	-									
Social Presence with Peer (SPp)	.733**	.920**	-								
Social Presence with Instructor (SPi)	.743**	.910**	.783**	-							
Social Navigation (SN)	.730**	.879**	.707**	.679**	-						
Perceived ease of use (PEU)	.715**	.720**	.688**	.721**	.539**	-					
Perceived usefulness (PU)	.725**	.741**	.653**	.726**	.627**	.865**	-				
Satisfaction (S)	.771**	.784**	.668**	.733**	.722**	.742**	.810**	-			
Site Evaluation (SE)	.702**	.716**	.630**	.700**	.608**	.720**	.761**	.959**	-		
Learning Satisfaction (LS)	.782**	.792**	.660**	.717**	.769**	.718**	.802**	.975**	.872**	-	
Effectiveness of NETwork for Teaching **(ET)**	.683**	.722**	.571**	.691**	.694**	.635**	.759**	.900**	.842**	.894**	-

Note. ** $p < .01$, * $p < .05$

Examination of the proposed path model

In the path analysis, the Wald test for dropping parameters was employed, and paths were dropped if they were not statistically significant ($z < 1.96$, $p < .05$) and the chi-square (χ^2) change was smaller than 3.84 ($\chi^2(0) = 3.84$; Kline, 2005) or if the relationship did not make sense based on theoretical perspectives. During the process of Wald tests, 5 paths were dropped because of not achieving significance. A final path model with best model fit is presented in Figure 2. According to the criteria for a good model fit (non-significant χ^2 value, CFI and TLI >.95, SRMR<.10, and RMSEA<.06) suggested by Hu and Bentler (1999), most of the criteria were met, suggesting a good model fit. Although the chi-square value for the final path model was 15.76 ($p < .05$) indicating a poor fit, the comparative fit index (CFI) was .99, the Tucker-Lewis Index (TLI) was .96, and the standardized root mean square residual (SRMR) was .05, which also indicated the data fit the model well. Also, the standardized root mean square error of approximation (RMSEA) was .13 which did not meet the criteria of a good fit, but the confidence interval of RMSEA was found to be between .00 and .24 which included .05 and indicated a good fit. Because the achieved statistically significant chi-square value (indicating less than a good fit) could be due to the small sample size of this study, an alternative index of fit was used to further examine the model fit. According to Byrne (2001), it suggests that if a χ^2/df ratio less than 5, the model is considered to be indicative of a good model fit (Hayduk, 1987). The χ^2/df ratio of this model is 2.25 (15.76/ 7 = 2.25), indicating a good model fit. Thus, overall the data fit the model well. Table 4 presents the fit indices of goodness for this over-identified model.

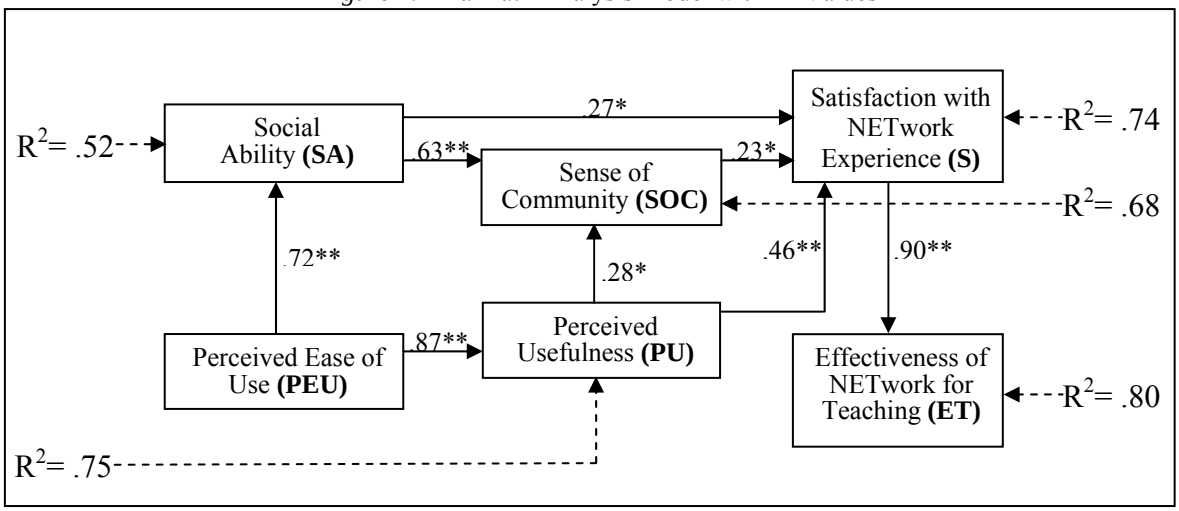
In the final path model, the correlation coefficients of the direct paths range from .23 to .90 and are statistically significant at $p < .05$ or .001. The R^2s means indicate that approximately 80% of the variance of ET is explained by members' S in the NETwork community. Members' perceptions of SOC, SA, and the PU explain approximately 72% of the variance of members' S. Also, SA and PU account for 68% of the variance in members' SOC. Lastly, members' perceptions of PEU directly accounted for about 52% of variance of members' SA and approximately 75% of variance of PU.

Table 4. Model Fit Indices

Model	χ^2	P	CFI	TLI	SRMR	RMSEA	RMSEA
Criteria	N/A	>.05	>.95	>.95	< .10	< .06	90% C. I.
Results of the Final Model	15.76	.03	.98	.96	.05	.14	.04 ~ .23

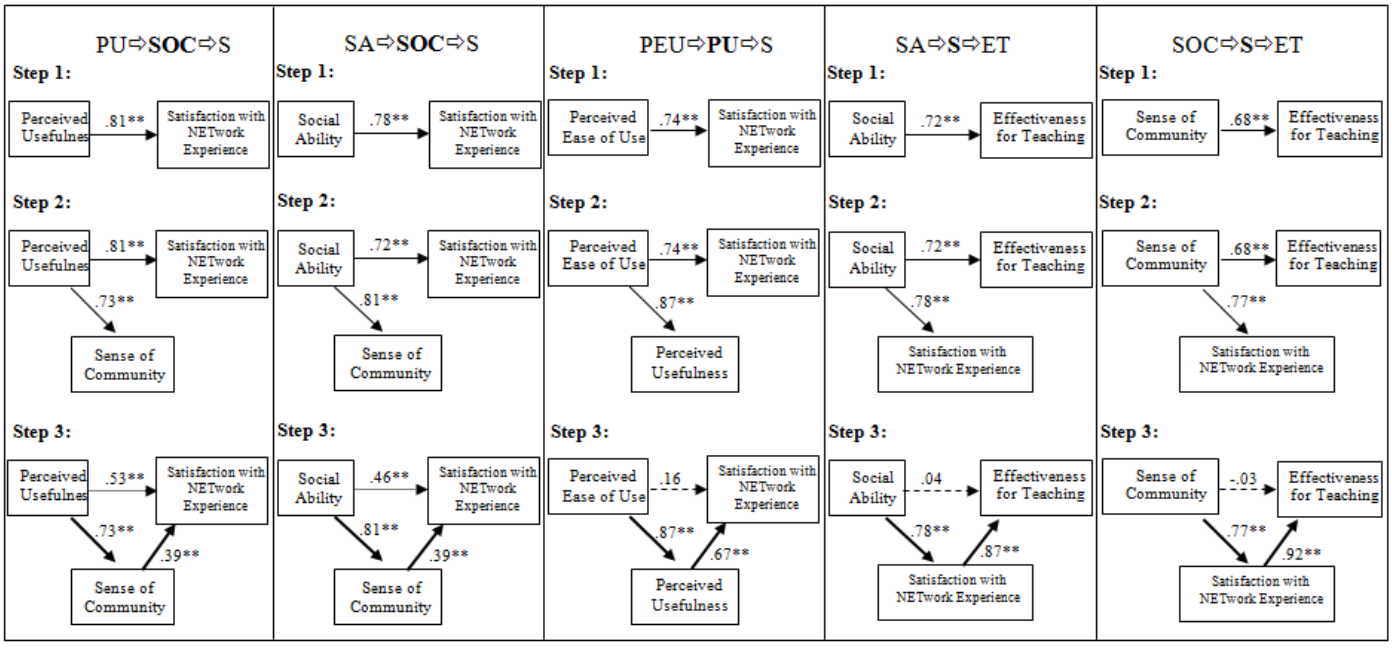
Note. N=66 (Hu & Bentler, 1999)

Figure 2. Final Path Analysis Model with R^2 Values



[1] * represents z > 1.96, p < .05; ** represents z > 3.29, p < .001 statistically significant; ⟶ represents significant path, - - -▸ represents variance explained)

Figure 3. Mediator Identification



[1] * represents z > 1.96, p < 0.05; ** represents z > 3.29, p < 0.001 statistically significant; - - - -▸ represents non-significant path, ⟶ represents significant path without decreasing strength; ·····▸ represents weaken path with significant value

Members' perceptions of SOC did not have a direct impact on their perception of ET as had been expected and included in the initial path model. Also, members' perception of S was the only influential factor to how they perceived the ET. In the proposed path model, SA had been expected to influence S via the mediation of SOC. However, in the final model, S was directly explained by SA.

Additionally, the mediating relationships among the variables in the final path model were examined. According to Frazier, Tix, and Barron (2004), a mediator is defined as a variable that accounts for the relation between a predictor and a dependent variable. Five potential mediating relationships, including PU⇨SOC⇨S, PEU⇨PU⇨S, SA⇨S⇨ET, and SOC⇨S⇨ET, were identified. Based on the examining steps presented in Frazier, Tix, and Barron (2004), a full mediator is identified when the relationship between a predictor and a dependent variable becomes non-significant after adding direct relationship between the mediating variable and the dependent variable. After the examination, PU was found to be a full mediator for the relationship between PEU and S, as well as S was a full mediator for both the relationships between SOC and ET and SA and ET. Additionally, members' perception of SOC was found to be a partial mediator for the relationship between PU and S. The procedures for establishing the full mediating relationships are illustrated in Figure 3.

Examination of SA sub-constructs

To further examine the relationships based on relationships (i.e. SA⇨SOC, SA⇨S, PEU⇨SA) identified in the final path model, SA was replaced with its sub-constructs, including SN, SPi, and SPp. Due to the small sample size, the examinations were conducted separately to meet the required minimum sample size (at least 5 cases per parameter). The relationships among SA's sub-constructs, PEU, and PU were examined as the first set. Later, a second analysis for SA's sub-constructs, SOC, and S was undertaken.

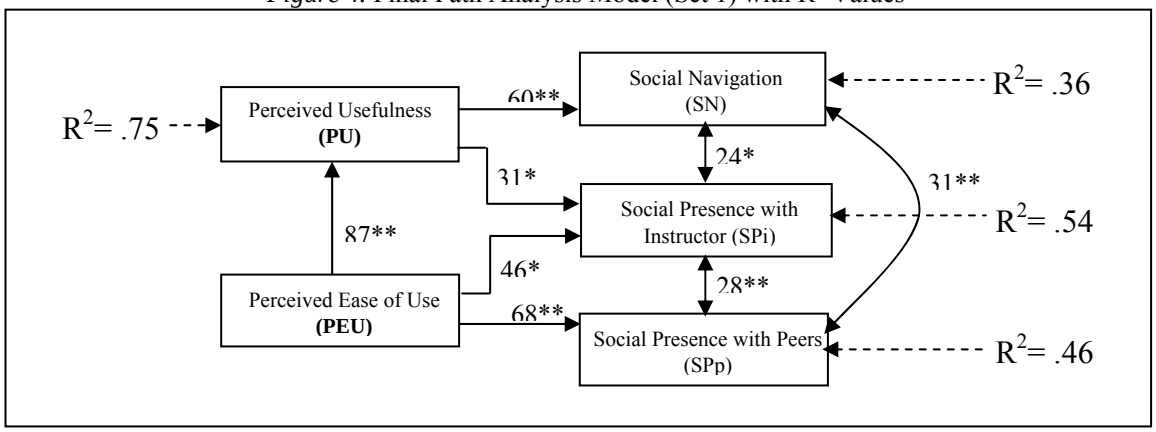
First Set Examination. In the path analysis for the first examination, two non-significant paths (PEU⇨SN & PU⇨SPp) were dropped. A final path model presented in Figure 4 was achieved. According to Hu and Bentler (1999), the indices reported in Table 5 suggest a good model fit.

Table 5. Model Fit Indices (Set 1)

Model	χ^2	P	CFI	TLI	SRMR	RMSEA	RMSEA 90% C. I.
Criteria	N/A	>.05	>.95	>.95	< .10	< .06	
Results of the Final Model	2.05	.36	1.00	1.00	.04	.02	.00 ~ .25

Note. N=66 (Hu & Bentler, 1999)

Figure 4. Final Path Analysis Model (Set 1) with R^2 Values

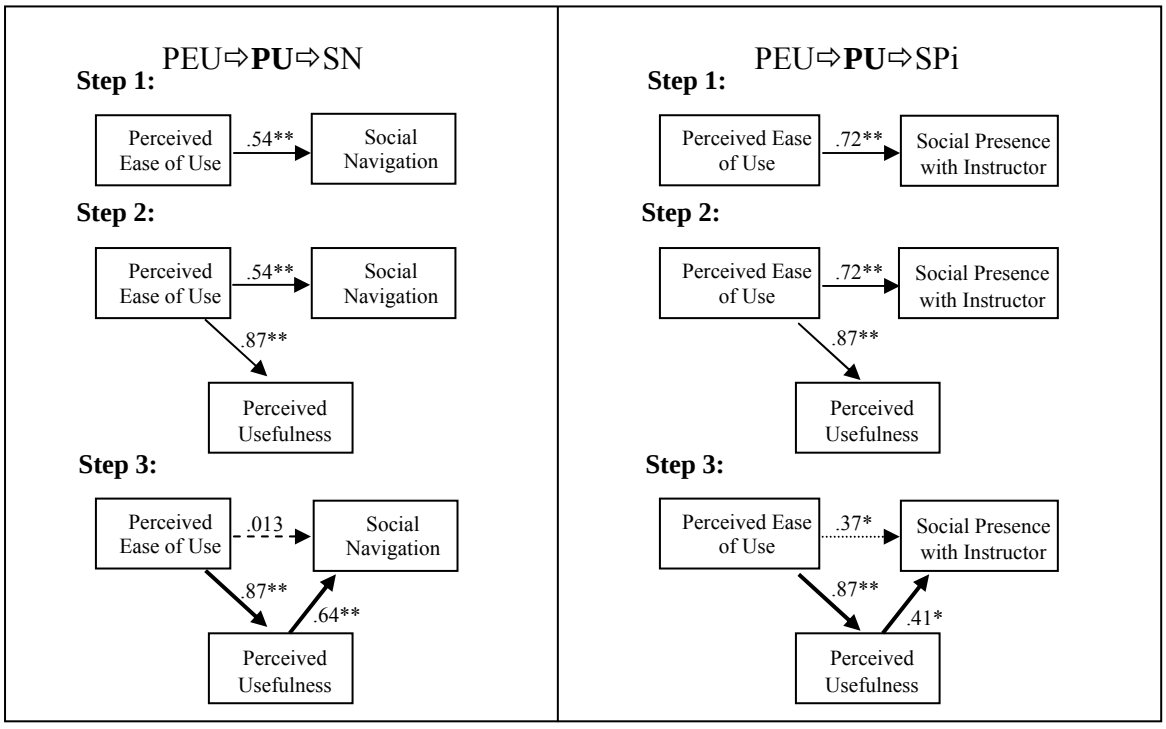


[1] * represents z > 1.96, $p < .05$; ** z > 3.29, $p < .001$ statistically significant; ⟶ represent significant direct path, ⟷ represents significant correlation paths, - - - - ▸ represents variance explained

In the final path model of set 1, the correlation coefficients of the direct paths range from .24 to .87 and are statistically significant at p<.05 or .001. The R^2s means showed approximately 87% of the variance of PU was explained by PEU. Also, PEU and PU explain approximately 54% of the variance of SPi. Members' perception of PU accounted for 36% of the variance of SN, and PEU explained 46% of the variance of SPp.

Additionally, two possible full mediating relationships among the variables in the set 1 final path model were examined (Figure 5). PU was identified as a full mediator for the relationship between perceived PEU and SN. When adding the direct path between PU and SN, the value of the direct path from PEU to SN not only dropped but also became non-significant. However, PU was found to only partially mediate the relationships between PEU and SPi. After adding the direct path between PU and SPi, the path value between PEU and SPi dropped but remained significant.

Figure 5. Mediator Identification

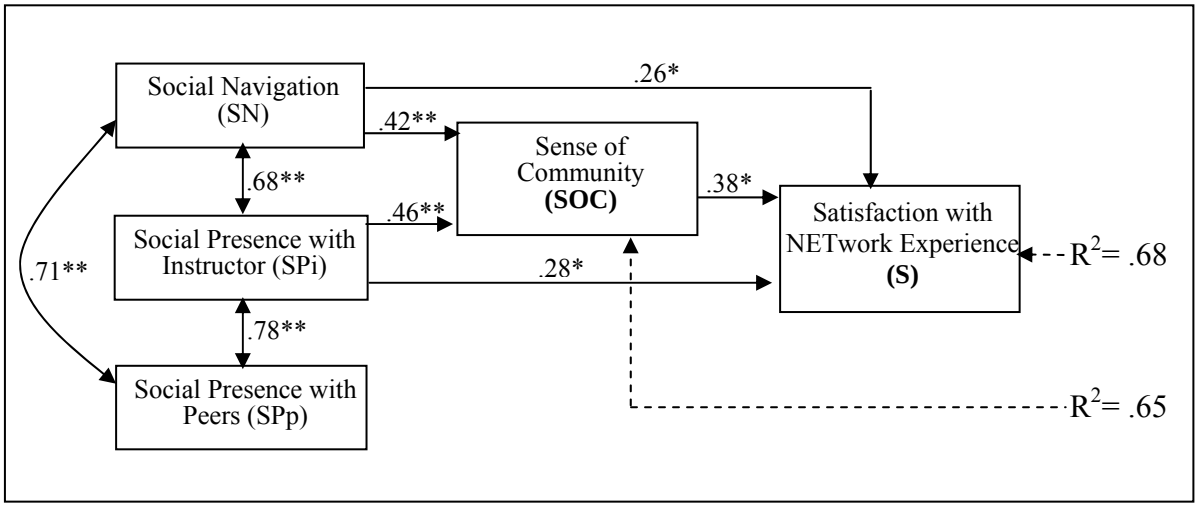


[1] * represents z > 1.96, *p* < .05; ** represents z > 3.29, *p* < .001 statistically significant; ⋯▸ represents weaken path with significant value, - - - ▸ represents non-significant path, ——▸ represents significant path without decreasing strength)

Second Set Examination. For the second set of constructs, the path analysis results were used to discard two non-significant paths (SPp⇨S & SPp⇨SOC). Although the standardized root mean square error of approximation (RMSEA) was .11 and did not meet the criteria of good fit, the confidence interval of RMSEA was found between .00 and .29 including .05. These findings suggest a marginal fit of the model. The other indices for the goodness of the model fit presented in Table 7 indicate a good model fit for this over-identified model. Overall the data fits the model well. To visualize the relationships among the SA sub-constructs, the final path model is presented the Figure 6.

In the final path model, the correlation coefficients of the direct paths range from .26 to .78 and are statistically significant at p < .05 or .001. The R^2s means showed SN, SOC, and SPi explain approximately 68% of the variance of S. Also, SN and SPi explain approximately 65% of the variance of SOC. The correlation between the SA sub-constructs ranged from .68 to .78, which indicated a high correlation among the SA sub-constructs.

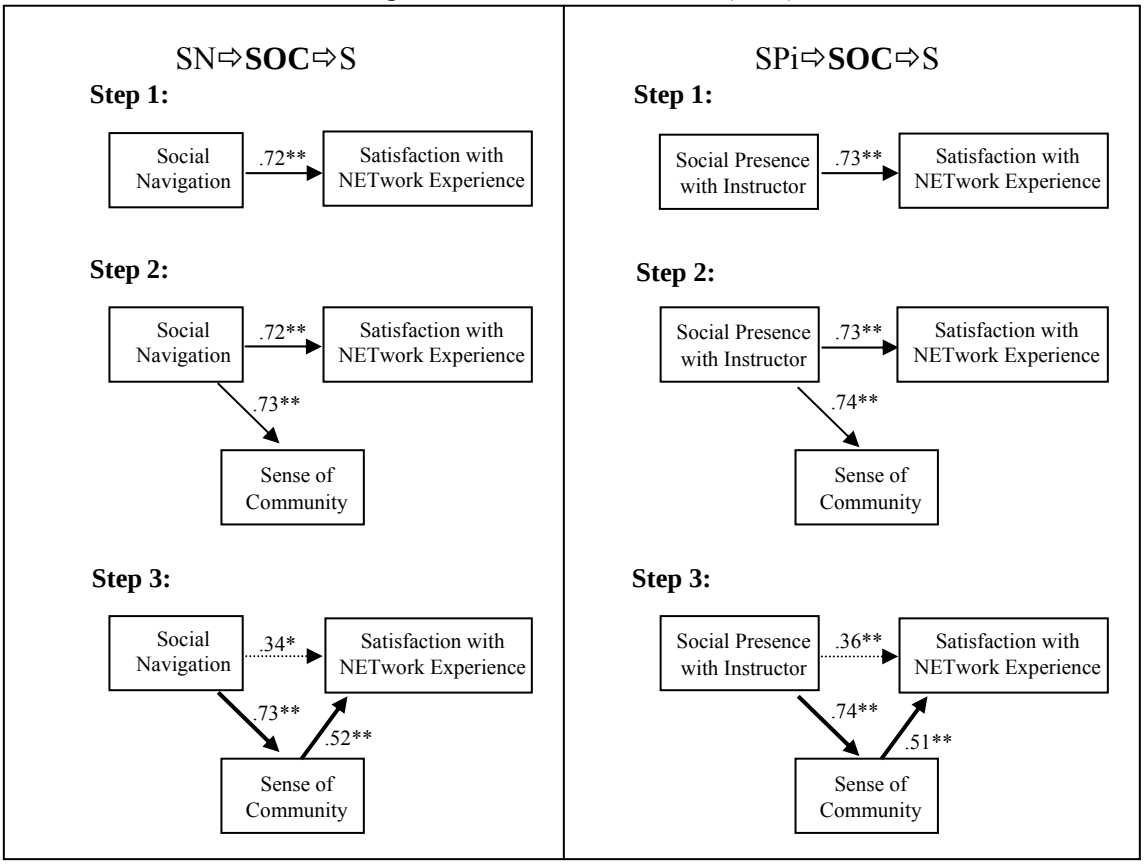
Figure 6. Final Path Analysis Model (Set 2)with R^2 Values



[1] * represents z < 1.96, p < .05; ** represents z < 3.29, p < .001 statistically significant; ⟶ represents significant direct path, ⟷ represents significant correlation paths, - - - ▸ represents variance explained)

Additionally, two possible full mediating relationships among the variables in the set 2 final path model were examined (Figure 7). SOC was found to only partially mediate the relationships between SN and SPi to S. When adding the direct path between SOC and S, the value of the direct path from SN to S remained significant, as well as the path value between SPi and S. Thus, SOC is failed to serve as a full mediator in this path model.

Figure 7. Mediator Identification (Set 2)



[1] * represents z > 1.96, *p* < .05; ** represents z > 3.29, *p* < .001statistically significant; ⋯▸ represents weaken path with significant value, ⟶ represents significant path without decreasing strength

Discussion

Differing from prior studies (Tsai et al., 2008; Lin et al., 2006) that utilized statistical models to visualize the relationships among social constructs of online learning in courses, an additional variable, ET, was extension in this study. Members' S was found to be the only direct factor impacting ET, which means members felt the effectiveness of NETwork for their teaching only when they felt satisfied with learning in NETwork. Additionally, S was a mediator for the relationships of SA to ET and SOC to ET, which means members' SA and SOC influenced ET indirectly. These mediating relationships are new discoveries in the final path model and extend previous models.

Additionally, SA, SOC, and PU directly impact S, meaning members with higher SA and SOC felt much more satisfied with their learning experience, as well as members who felt the Sakai tools were useful for their learning and interaction were much more satisfied with their learning experience. SA and PU account for significant variation in SOC, indicating members had higher SOC when they felt the usefulness of Sakai tools to facilitate their learning and to socially interact with others in NETwork. This result supports the insight that social interaction can be supported by CMC tools if the tools are utilized effectively and members feel the usefulness of the tools for their learning (Tu & Corry, 2003; Lavooy & Newlin, 2003; Tu & McIsaac, 2002).

Further, PEU directly influences SA and PU, meaning that members needed to feel the ease of use of Sakai tools before they can perceive the usefulness of Sakai tools and utilize them to socially interact with others. PU was a mediator for the relationships between PEU and S, indicating PEU contributes to S when they also feel the usefulness of the Sakai tool. This finding is consistent with Hillman, Willis, and Gunawardena (1994) that argued users' learning is obstructed if they cannot interact easily through the medium/tools. Thus, ease of use of the tools is one of the most basic requirements for establishing an online learning community.

According to Tsai et al. (2008) and Line et al. (2006) that reported SOC fully mediates the relationships between SA and satisfaction in online courses, it was expected that SA would not directly impact S when considering SOC and other social constructs simultaneously. However, this study found a direct relationship between SA and S exists even when adding sense of community in the model and failed to confirm SOC's fully mediating role for the relationship between SA and S. Additionally, SOC was only a partial mediator for the relationship between PU and S in the present study, which is inconsistent with the findings of Tsai et al. (2008). These inconsistencies might result from the different contexts in this study (an online learning community) and that of Tsai et al. (2008) (online courses).

Going beyond prior studies, this study provided further examination of the interdependent relationships among SA sub-constructs (SN, SPi, and SPp) and other primary social constructs (e.g., SOC, SA, PEU, and PU). The results indicate that PU was significantly associated with SN and SPi. Prior studies (Tsai et al., 2008; Lin et al., 2006) and this study showed no significant relationship between PU and the main construct, SA; however, in the examination of SA sub-constructs, significant relationships of PU to SN and PU to SPi were found. This indicates members who perceived the usefulness of Sakai tools had a better sense of instructors' social presence and appreciated being able to use what others did as a guide for their own actions. Additionally, PU was found to fully mediate the relationship between PEU and SN. It is possible that a direct influence from PU to SA was not identified in the final path model in this study and that of Tsai et al. (2008). Thus, the direct relationship from PU to SA is suggested for a further examination.

Further, SN and SPi were found to directly influence SOC and S, while SPp did not have any direct impact on SOC and S. Similar to the final path model, SOC was not a full mediator for the relationship between SA and S. SOC was only a partial mediator for the relationships between SA sub-constructs and S (i.e., SN⇨S and SPi⇨S). After adding SOC in the mediator identification models, these two relationships (SN⇨S and SPi⇨S) weakened but remained significant. In addition to the study of Tsai et al. (2008), which examined the relationships among SOC, S, and SA as a whole, this study provides new insights for understanding how different SA sub-constructs influence SOC and S within a CoP experience.

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