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Abstract

Purpose – The purpose of this paper is to examine whether social networking site (SNS) communities benefit from collective knowledge and collaboration, which represent a portfolio of knowledge transfer on SNSs.

Design/methodology/approach – A survey was conducted on a large scale through an online questionnaire. Structural equation modeling was employed to analyze data collected from 674 experienced SNS users.

Findings – The results indicate that all three exogenous variables, presented as user characteristics and integrated into SNS user characteristics, were positively related to the knowledge transfer portfolio, namely, to collective knowledge and collaboration, and these variables had significant moderating effects on SNS users' community cohesiveness. Early SNS adoption was more likely than late SNS adoption to moderate the relationship between collective knowledge and community cohesiveness and that between collective collaboration and community cohesiveness.

Practical implications – The findings provide useful insights for SNS operators to enhance the process of collaborative knowledge transfer. They may also be used to obtain better insights into important factors that require closer attention during SNS use.

Originality/value – The present study provides a systematic analysis of SNS use by considering a new research model and investigating the effects of SNS-based knowledge transfer on user outcomes based on three major characteristics of SNS users. The results are expected to provide a major foundation for further SNS research and a better understanding of the relationships between SNS user characteristics, knowledge transfer, and community cohesiveness.

Keywords Community cohesiveness, Collective knowledge, Collective collaboration, Social networking site

Paper type Research paper

Introduction

The emergence and popularity of social networking sites (SNSs) in recent years have revolutionized the internet environment, expanding it into a virtual community (Kim *et al.*, 2015; Ransbotham and Kane, 2011). Recent years have witnessed increasing numbers of individuals using SNSs not only as a critical channel for sharing information with their members but also as a major channel of knowledge transfer (Burns *et al.*, 2011; Ransbotham and Kane, 2011; Vivacqua and Borges, 2012).

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According to Sexton and Barrett (2004), knowledge transfer refers to the movement of knowledge through certain channels from one individual or unit to another (Cress and Held, 2013). A central issue in acquiring knowledge is its appropriate transfer beyond the context and content of acquired knowledge (Kimmerle *et al.*, 2010). Accordingly, effective knowledge transfer involves not only some information transmission but also absorption and use following the transmission (Slaughter and Kirsch, 2006). SNSs can be a useful channel for knowledge transfer (Bonabeau, 2009; Ransbotham and Kane, 2011; Wang and Zhang, 2012; Shi *et al.*, 2014), that is, the transfer of knowledge (e.g. a user's skill or experience) from SNS users (e.g. Twitter followers, Youtube viewers, and Facebook users) to the whole community through available social media channels such as Facebook.com and Wikipedia.org (Vivacqua and Borges, 2012; Gwynne and Gobble, 2012). Because knowledge transfer is not only an individual's achievement but also a community-related issue, the idea of combining knowledge transfer with community cohesiveness could be fruitfully applied in the context of SNSs (Ransbotham and Kane, 2011; Vivacqua and Borges, 2012). Community cohesiveness based on SNSs is rooted in a broader set of collective knowledge transfer (Ransbotham and Kane, 2011). Community cohesiveness may be the appropriate theoretical background for examining the effect of knowledge transfer in an SNS context because the virtual community on SNSs is the medium through which an individual's knowledge is converted into collective knowledge and collaboration (Cress and Held, 2013) as well as into a cohesive community, and therefore members value their membership and strive to maintain positive social relationships with other members (Ransbotham and Kane, 2011). Despite the need for a comprehensive understanding of knowledge transfer on SNSs, few studies have empirically examined this topic in the context of information systems. In addition, there is no suitable model that describes knowledge transfer on SNSs or theory that can explain the effect of SNS-based knowledge transfer on the community cohesiveness of SNSs (Ransbotham and Kane, 2011; Wang and Zhang, 2012). In this regard, the following research questions are addressed:

RQ1. What are the major characteristics of users who influence knowledge transfer on SNSs?

RQ2. Does SNS-based knowledge transfer influence user community cohesiveness?

RQ3. Does the level of SNS use moderate the relationship between SNS-based knowledge transfer and community cohesiveness?

To address the research questions and provide the structure and foundation for the research model, the study adopts a knowledge transfer framework (Slaughter and Kirsch, 2006) consisting of organizational design characteristics, knowledge transfer portfolios, and software process performance. They investigates whether the knowledge transfer portfolio affects the performance of software development process and provides some valuable insights into the knowledge transfer framework applicable to research on SNS, which serves as the basis for constructing the research model. For instance, participation, openness, and sharing are three distinct features of Web 2.0 technologies (Pasek *et al.*, 2009; Ertmer *et al.*, 2011), and they enable SNS users to form online communities, facilitate participation among community members, and encourage the sharing of user-generated content (Vivacqua and Borges, 2012). Given that SNSs are Web 2.0 technological artifacts (Pasek *et al.*, 2009; Ertmer *et al.*, 2011; Kane *et al.*, 2014), the three features of Web 2.0 technologies are regarded as major user characteristics of SNSs in the proposed research model. Our study also includes knowledge transfer as a mediator of

the relationship between user characteristics and SNS outcomes in the research model. Previous studies have found that knowledge transfer mediates effects of various variables such as accumulated knowledge, knowledge creation, and knowledge retention on client firms' productivity and community-based peer production (Chang and Gurbaxani, 2012; Ransbotham and Kane, 2011). The present study focuses mainly on two types of knowledge transfer, namely, collective knowledge (Sigurbjornsson and Zwol, 2008; Kimmerle *et al.*, 2010; Ertmer *et al.*, 2011; Vivacqua and Borges, 2012; Cress and Held, 2013) and collective collaboration (Oliver and Roos, 2007; Ertmer *et al.*, 2011; Ransbotham and Kane, 2011), because they are likely to be influenced by SNS users' characteristics included in the model and they tend to influence the community cohesiveness of SNSs (Ertmer *et al.*, 2011).

To test the model, structural equation modeling was employed to analyze data collected from 674 experienced SNS users. The results provide support for the theoretical model and verify that collective knowledge and collaboration mediate the relationship between SNS user characteristics and community cohesiveness. This study extends the literature on SNS community behavior by examining whether SNS users' features are related to SNS community cohesiveness. In addition, the study extends SNS research by examining the mediating role of knowledge transfer factors (collective knowledge and collaboration) in the relationship between SNS user features and community cohesiveness.

The rest of this paper is organized as follows: second section discusses the theoretical framework and hypotheses. Third section presents the results for the hypotheses, and fourth section concludes with some limitations and contributions to research and practice.

Theory and hypothesis development

Virtual communities on SNSs provide virtual environments in which users join together based on common interests, communicate, interact, discuss, and share one another's opinions, ideas, resources, information, experiences, and explanations (Cress and Held, 2013). In particular, SNSs facilitate person-to-person relationships through the sharing of information and knowledge, which are individually seen, as well as through the application of information created by other users (Kwon and Wen, 2010; Boyd and Ellison, 2008). In this regard, Pasek *et al.* (2009) examined three factors influencing online social networking: participation (civic engagement), sharing (political knowledge), and openness (interpersonal trust). They extrapolated that those who intentionally use the internet for information tend to make positive use of SNSs. This indicates varying patterns of participation, sharing, and openness (Susarla *et al.*, 2012). Because they provided mixed results for the effects of these factors for the SNSs tested (Facebook and MySpace), the present study examines the specific relationships between the three factors and SNS-based knowledge transfer to determine the ideal combination for community cohesiveness. The study employs participation, openness, and sharing for SNS user characteristics (Boyd and Ellison, 2008; Heinrichs *et al.*, 2011; Wolff and Kim, 2012).

On the other hand, the term "knowledge" has been defined in various research fields (Hall and Graham, 2004; Bonabeau, 2009; Yu *et al.*, 2010). The collection of all accessible and relevant knowledge in a special topic is often mentioned as the basic idea behind knowledge management. SNSs represent the social aggregation emerging from a network when enough users engage in some public discussion long enough with sufficient human feelings to form networks of personal relationships and knowledge

transfer online (Hall and Graham, 2004; Kane *et al.*, 2014). Knowledge transfer is an outcome of this process (Gwynne and Gobble, 2012; Vivacqua and Borges, 2012; Wang and Zhang, 2012), and this leads to new content, which in turn fosters new ideas (Wang and Zhang, 2012). As a result, what emerges from this knowledge transfer is the dynamic flow of individually implicit and collectively explicit knowledge (Chang and Lo, 2012).

Knowledge creation, sharing, and use on SNSs represent collective processes and communication between participants (Ransbotham and Kane, 2011; Vivacqua and Borges, 2012). Although the term "knowledge transfer" typically refers to the sharing of knowledge with others, previous studies have defined it in diverse ways depending on their objective and focus (Bock *et al.*, 2005; Sue *et al.*, 2010; Wang and Zhang, 2012). Previous researchers have tended to address knowledge transfer on an individual-to-individual basis instead of taking a macroscopic approach (Srivastava *et al.*, 2006; Liu *et al.*, 2010) and generally defined knowledge transfer as a process or activity by which the knowledge of an individual is transferred to other individuals (Peters *et al.*, 2010). In addition, knowledge transfer has been referred to as the emergence of some intelligent behavior through interactions between individuals within a group or to as mass collaboration (Liu *et al.*, 2010; Malone *et al.*, 2010). Previous studies have conceptualized mass collaboration based on a large number of individuals who generally have different interests and possess a diverse range of knowledge and expertise, employing widely distributed computational and communications technologies to achieve shared outcomes through loose voluntary relationships (Ransbotham and Kane, 2011). According to Lykourentzou *et al.* (2010), online social networks enhance the flow of information, and therefore individuals in such networks gain information on opportunities and choices that otherwise would not be available to them. Networking benefits may be related more to the creation or consideration of new relationships between an individual's existing information and knowledge than to the acquisition of new information (Lykourentzou *et al.*, 2010; Peña-López, 2012). In other words, the value of online networking may lie not only in gaining new information but also in relating new information to existing knowledge for the creation of something new (Sandoval-Almazan and Gil-Garcia, 2012). In this regard, connections made through social media have the ability to facilitate SNS users' knowledge transfer (Chai and Kim, 2012; Chang and Lo, 2012).

Knowledge transfer is a key factor to consider with respect to SNSs and their community value (Chang and Lo, 2012; Ransbotham and Kane, 2011). It is widely expected that the easier the knowledge transfer, the less the required time (Hall and Graham, 2004) and effort and the more likely the transfer and its success. SNS-based knowledge transfer can help bring people together by facilitating interactions between individuals from different social groups that may not normally interact with one another (Ransbotham and Kane, 2011; Wang and Zhang, 2012). SNSs offer various possibilities, including increased social activity, improved community cohesion, and a stronger society attachment (Wang and Zhang, 2012). The potential of SNS-based collective knowledge can be especially pertinent in enhancing community cohesion (Cress and Held, 2013). Community cohesiveness can be strengthened by executing knowledge transfer through increased anonymity and impersonality in SNS communities (Balmaceda *et al.*, 2014; Fu *et al.*, 2008).

Among various concepts of knowledge transfer, that at the individual level is generally regarded as an important topic in the SNS context (Yu *et al.*, 2010). In this regard, with different aspects of knowledge transfer between SNS users taken into

account, knowledge transfer on SNSs is composed of two dyadic factors: collective knowledge, which take place as a by-product of people's interaction with a shared digital artifact (Sigurbjornsson and Zwol, 2008; Cress and Held, 2013), and collective collaboration, which reflects a process-oriented perspective (Oliver and Roos, 2007; Ertmer *et al.*, 2011; Ransbotham and Kane, 2011). More specifically, collective knowledge targets explicit information and knowledge occurring through some exchange between human cognition and a shared digital artifact (Wang and Zhang, 2012), whereas collective collaboration reflects explicit as well as tacit knowledge from a process-oriented perspective (Sandoval-Almazan and Gil-Garcia 2012).

Based on these theoretical building blocks, this study develops several hypotheses that flesh out the relationships between SNS user characteristics (participation, openness, and sharing), knowledge transfer (collective knowledge and collaboration), and outcomes (community cohesiveness). Figure 1 shows the research model with these relationships.

SNS user characteristics and knowledge transfer

Participation. The core focus of Web 2.0 is user participation (Bennett *et al.*, 2012). In the Web 2.0 environment, users are the main agents for information consumption, and at the same time, they are the major participants in collective information creation (Slaughter and Kirsch, 2006; Ransbotham and Kane, 2011). Social individuals tend to be interested in current events and social issues and thus are likely to participate actively in social agendas because of their broad social connections (Wolff and Kim, 2012). SNSs allow for personal profiles, facilitate sharing and communication through connections formed through relationships between users, and provide web-based services that support interactions between users (Boyd and Ellison, 2008; Rishika *et al.*, 2013). The SNS model reflects a service based on participation and personal connections that bridge the gap between offline and online social networking (Valenzuela *et al.*, 2012). In addition, the higher the level of an SNS user's participation, the more likely he or she is to acquire project information and thus successfully engage in collaborative efforts

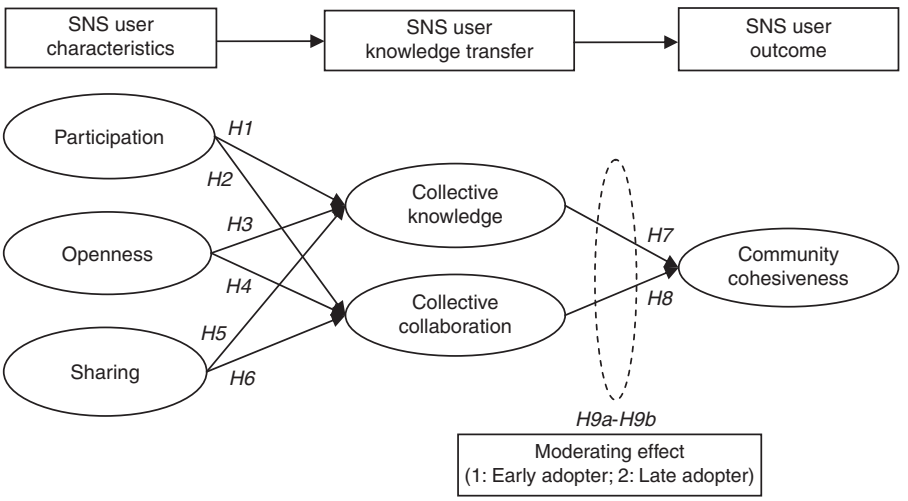


Figure 1.
Research model

(Burns *et al.*, 2011; Ertmer *et al.*, 2011). Recent years have witnessed the explosive growth of social networking and participation, and participation in social networking may occur for its intrinsic rewards through the generation of collective knowledge (Ransbotham and Kane, 2011; Wang and Zhang, 2012). Active SNS participation enables users to exchange friendship networks and knowledge, and induces community-based collaboration toward common goals (Ransbotham and Kane, 2011). In this regard, the following hypotheses are proposed:

H1. SNS users' participation has a positive effect on their collective knowledge.

H2. SNS users' participation has a positive effect on their collective collaboration.

Openness. SNS users' use motives tend to be influenced by their openness in comparison with that of other users (Valenzuela *et al.*, 2012; Wolff and Kim, 2012). Wolff and Kim (2012) found that openness has considerable influence on individuals' networking behavior, which is an important part of SNSs (Richards, 2009). Therefore, SNS users are more active than non-SNS users in forming collective knowledge through openness, such as acquiring information on recent social issues and connections with influential figures (Yu *et al.*, 2010; Kimmerle *et al.*, 2010). In addition, those individuals showing a high degree of openness are more likely to contribute their time and talent to collective collaboration (Richards, 2009; Yu *et al.*, 2010). In this sense, Youtube-based media knowledge may be based on the activity of users and thus may depend heavily on their online openness or what is known as interpersonal openness (Susarla *et al.*, 2012; Westerman *et al.*, 2012). Further, Youtube viewers with their revealed identity leave their comments or express their attitudes with "likes" or "dislikes" (Susarla *et al.*, 2012). In this way, they initiate collective collaboration with online members, making Youtube the most watched media channel online (Susarla *et al.*, 2012; Vivacqua and Borges, 2012). In this regard, the following hypotheses are proposed:

H3. SNS users' openness has a positive effect on their collective knowledge.

H4. SNS users' openness has a positive effect on their collective collaboration.

Sharing. Sharing among SNS users refers to their information-sharing behavior (Heinrichs *et al.*, 2011; Wang *et al.*, 2014; Westerman *et al.*, 2012). SNSs can induce user addition because of their features facilitating sharing and communication, among others, have become an integral part of users' daily lives. SNS users can strengthen their collective knowledge by sharing their knowledge and information (Vivacqua and Borges, 2012). Technological developments or performance improvements depend not on individual knowledge but on collective knowledge, which can be achieved through SNS users' collective ideas and information sharing (Ransbotham and Kane, 2011). In addition, information and knowledge sharing among SNS users can have considerable influence on their collective collaboration through their active cooperation and exchange (Hsu, 2015; Rishika *et al.*, 2013; Zhang *et al.*, 2009). This suggests that sharing information and knowledge on SNSs can be a major motive for collective collaboration (Peters *et al.*, 2010; Valenzuela *et al.*, 2012). In this regard, the following hypotheses are proposed:

H5. Sharing among SNS users has a positive effect on their collective knowledge.

H6. Sharing among SNS users has a positive effect on their collective collaboration.

SNS user knowledge transfer and community cohesiveness

Collective knowledge. Knowledge is increasingly viewed as a collective process, and collective knowledge is a shared activity that can be implemented only by interactive users belonging to a community of action and understanding (Bonabeau, 2009; Susarla *et al.*, 2012; Vivacqua and Borges, 2012). Collective knowledge pays attention to the consequences of knowledge indivisibility and the role of complementarities between localized bits of knowledge possessed by each user (Kimmerle *et al.*, 2010). This perspective characterizes both the generation and dissemination of knowledge in the system and values the contribution of external knowledge to the production of new knowledge (Gwynne and Gobble, 2012). Classic examples of collective knowledge include Wikipedia, product reviews for consumer products, and collaborative filtering for recommending books and music (Peña-López, 2012). SNS users can benefit from spiral collective knowledge based on SNSs to achieve their goals, and this intellectual application can have considerable influence on their attitudes toward community cohesiveness (Lykourentzou *et al.*, 2010). In this regard, the following hypotheses are proposed:

H7. SNS users' collective knowledge has a positive effect on their community cohesiveness.

Collective collaboration. Given SNSs as a channel for facilitating openness, participation, and sharing, not only the generation and sharing of users' content and knowledge but also social production from collective collaboration represents an important mechanism underlying knowledge formation and transfer (Ransbotham and Kane, 2011; Kane *et al.*, 2014). As demonstrated by Wikipedia.org, one of the most representative examples, social production derived from SNS-based collective collaboration can be an important driver of knowledge creation (Vivacqua and Borges, 2012; Wang and Zhang, 2012). Wikipedia clearly demonstrates how a group of ordinary individuals can dominate a particular area previously monopolized by experts (Malone *et al.*, 2010; Wang and Zhang, 2012). Because most individuals tend to be specialists in certain areas, they can generate practical and useful knowledge through SNS-based collective collaboration and thus realize more creative and value-added outcomes (Ertmer *et al.*, 2011; Kane *et al.*, 2014). SNSs provide a more efficient platform than traditional media, allowing more individuals to express their ideas or to contribute their specific knowledge to various tasks and projects and thus enhancing their community cohesiveness (Ransbotham and Kane, 2011). In this regard, the following hypotheses are proposed:

H8. SNS users' collective collaboration has a positive effect on their community cohesiveness.

Moderating effect of SNS adoption

Previous studies of mobile banking (Laukkanen and Pasanen, 2008) and smartphones (Verkasalo, 2011) have demonstrated clear differences in efficiency between early and late adopters. Lee and Mendelson (2007) found that some behavioral differences between early and late adopters can be explained by differences in their personality traits. This study divides SNS users into early and late adopters based on survey responses to analyze whether the level of an individual's SNS adoption moderates the effects of his or her collective knowledge and

collaboration on community cohesiveness. In this regard, the following hypotheses are proposed:

H9a. The effect of SNS users' collective knowledge on community cohesiveness varies according to the level of their SNS adoption.

H9b. The effect of SNS users' collective collaboration on community cohesiveness varies according to the level of their SNS adoption.

Research methodology

Measurement

This study's questionnaire was composed of three sections: general information on the survey, SNS use, and questionnaire items. The initial version of the questionnaire was subjected to a review by SNS researchers/practitioners and graduate/undergraduate students at a university in Korea who were active SNS users through informal interviews. Based on the results, any ambiguous or unclearly explained items were identified and revised. Then a pilot test was conducted for better clarity of the instructions and items in the questionnaire by employing 50 SNS users from a Korean firm. According to the pilot study, the reliability and validity of the scales (Nunnally, 1978) were assessed to verify the suitability of the questionnaire for an empirical analysis in the SNS context.

Data collection

A survey of experienced SNS users was conducted over a four-month period from January 6, 2015 to May 2, 2015. To maximize the corresponding response rate, the SNS-generated online survey function of CyWorld, Facebook, and Twitter accounts was employed. The questionnaire addressed the respondents' experiences with specific SNS sites such as Facebook, Twitter, Wikipedia, and CyWorld. Altogether, 758 responses were obtained. Here incomplete responses (61) and inexperienced SNS users (23) were excluded to obtain a final sample of 674 responses for the empirical analysis. To assess non-response bias, a *t*-test was conducted using the level of education and age for the first and last 20 respondents. The results indicate no significant differences in these variables between the two groups at the 0.05 level.

Table I shows the demographic characteristics of the final sample. A majority of the respondents were in their 30s, had a university degree, and were employed. The results for the demographic characteristics indicate that the respondents generally had a good understanding of SNS use, satisfying the goal of obtaining a sample of experienced SNS users.

Table II shows the respondents' SNS use. They were most likely to use CyWorld (24.2 percent), followed by Facebook (22.0 percent) and Twitter (16.8 percent). In terms of their daily SNS use, over 70 percent spent more than 30 minutes a day on SNSs. In terms of the length of their SNS use, approximately 15 percent were SNS users for one year, two years, three years, or less than four years, indicating a relatively even distribution. In terms of the number of daily visits, 33.2 percent visited once, and 28.7 percent, twice. Finally, 29.2 and 70.8 percent of the respondents were early and late SNS adopters, respectively.

Data analysis and results

Measurement model validation

Both validity and reliability were determined to evaluate our research model. The reliability of constructs was evaluated by calculating Cronbach's α, composite

Category	Frequency	Composition (%)	Category	Frequency	Composition (%)
Gender			*Age*		
Male	396	58.8	Under 19	60	8.9
Female	278	41.2	20-25	133	19.7
Total	674	100.0	26-30	121	18.0
			31-35	146	21.7
			36-40	123	18.2
			Over 41	91	13.5
			Total	674	100.0
Education			*Occupation*		
Some high school	20	3.0	Enterprisers (Including self-employed)	56	8.3
High school degree	39	5.8	Officials	68	10.1
Some college	54	7.9	Company employees (office)	186	27.6
Bachelor's degree	458	68.0	Company employees (technical)	128	19.0
Graduate school	15	2.2	Professionals	107	15.9
Master's degree	83	12.3	Students	101	15.0
Other	6	0.9	Housewife	6	0.9
Total	674	100.0	Others	22	3.3
Annual income ($)					
Less than $11,000	155	23.0	Total	674	100.0
$11,001-33,000	186	27.6			
$33,001-66,000	239	35.5			
More than $66,001	94	13.9			

Table I. Demographic characteristics of respondents

reliability (CR), and the average variance extracted (AVE) (Fornell and Larcker, 1981). For a construct to possess good reliability, Cronbach's α should be larger than 0.7, CR should be at least 0.6, and the AVE should exceed 0.5 (Fornell and Larcker, 1981). As given in Tables III and V, all values exceed the generally accepted values, indicating good reliability. Content validity and construct validity are often used to measure validity. The variables in this study were derived from existing literature, thus exhibiting strong content validity. Construct validity was examined by investigating discriminant validity and convergent validity. We applied principal components analysis to test the convergent validity of each construct. All of the factor loadings for the items exceed the recommended level of 0.6 and are significant at $p < 0.001$. Thus, all constructs in the model have adequate convergent validity.

Discriminant validity was examined using criteria suggested by Fornell and Larcker (1981). Each construct has a higher loading on its corresponding construct than its cross-loadings on other constructs, thus providing evidence of discriminant validity (Table IV). In summary, the measurement model demonstrates adequate reliability, convergent validity, and discriminant validity.

To assess how well the model represents the data, we employed AMOS 16.0 to evaluate "Goodness of Fit" Indices. As given in Table V, $\chi^2/df = 1.91$, RMR = 0.036, RMSEA = 0.061, GFI = 0.899, AGFI = 0.875, CFI = 0.920, NFI = 0.892, and IFI = 0.920

Category	Frequency	Composition (%)	Category	Frequency	Composition (%)
Types of SNSs used			*Amount of time spent on SNSs (daily)*		
CyWorld	413	24.2	Less than 15 minutes	180	26.7
Facebook	375	22.0	Less than 30 minutes	187	27.7
Twitter	287	16.8	Less than an hour	192	28.5
YouTube	236	13.9	Less than 2 hours	80	11.9
Wikipedia	212	12.4	More than 2 hours	35	5.2
LinkedIn	118	6.9	Total	674	100.0
Other	65	3.8			
Multiple responses (Total)	1,706 (674)	100.0			
Length of SNS use			*Number of visits (daily)*		
Less than a year	99	14.7	Occasionally	69	10.2
Less than 2 years	96	14.2	Once	225	33.4
Less than 3 years	103	15.3	Twice	197	29.2
Less than 4 years	106	15.7	Three times	93	13.8
More than 4 years	270	40.1	More than three times	90	13.4
Total	674	100.0	Total	674	100
			SNS adoption		
			Early adopter	197	29.2
			Late adopter	477	70.8
			Total	674	100.0

Table II.
SNS use by respondents

are all within the commonly accepted thresholds suggested in the literature (Fornell and Larcker, 1981). These indices provide satisfactory results for hypothesis testing.

The results of hypothesis testing are presented in Table VI. All of the paths are significant in the expected direction. Our results indicate that participation are strongly associated with collective knowledge ($\beta = 0.222$, $t = 6.439$, $p < 0.001$) and collective collaboration ($\beta = 0.204$, $t = 6.752$, $p < 0.001$). Thus, *H1* and *H2* are supported. The effects of openness on collective knowledge ($\beta = 0.449$, $t = 7.941$, $p < 0.001$) and collective knowledge ($\beta = 0.124$, $t = 2.214$, $p < 0.05$) are significant. Hence, *H3* and *H4* are supported. Our results also show that sharing exerts substantial effects on collective knowledge ($\beta = 0.323$, $t = 7.886$, $p < 0.001$) and collective collaboration ($\beta = 0.287$, $t = 6.312$, $p < 0.001$), thus validating *H5* and *H6*. The impacts of collective knowledge ($\beta = 0.603$, $t = 11.296$, $p < 0.001$) and collective collaboration ($\beta = 0.253$, $t = 5.359$, $p < 0.001$) are positively associated with community cohesiveness, thus supporting *H7* and *H8* (Figure 2).

In addition, the moderating effects of the timing of SNS adoption were examined using the method in Kim and Kim (2008): the difference in the χ^2 between constrained and unconstrained models. This difference was tested for *H9a* and *H9b*. First, there was a significant difference in the effect of collective knowledge on SNS users' community cohesiveness between early and late SNS adoption ($\Delta\chi 2 = 4.817$, $p < 0.01$), providing support for *H9a*. Second, there was a significant difference in the effect of collective collaboration on SNS users' community cohesiveness between early and late SNS adoption ($\Delta\chi 2 = 5.492$, $p < 0.01$), providing support for *H9b* (Table VII).

Latent factor	SRW	Error	Construct reliability	Variance extracted
Participation				
PA2	0.737	0.509	0.854	0.594
PA3	0.707	0.427		
PA4	0.793	0.352		
PA5	0.820	0.316		
Openness				
OP1	0.787	0.282	0.850	0.588
OP2	0.723	0.376		
OP4	0.752	0.32		
OP5	0.641	0.506		
Sharing				
KS1	0.775	0.25	0.905	0.703
KS2	0.810	0.236		
KS3	0.782	0.27		
KS4	0.781	0.289		
Collective knowledge				
CI2	0.744	0.358	0.859	0.604
CI3	0.713	0.339		
CI4	0.748	0.379		
CI5	0.723	0.327		
Collective collaboration				
CC2	0.796	0.287	0.877	0.643
CC3	0.856	0.207		
CC4	0.734	0.352		
CC6	0.658	0.453		
Community cohesiveness				
UPE2	0.720	0.412	0.897	0.593
UPE3	0.740	0.351		
UPE4	0.785	0.302		
UPE5	0.726	0.306		
UPE6	0.673	0.361		
UPE7	0.659	0.389		

Table III.
Construct reliability and the average variance extracted

Latent factor	PA	OP	KS	CI	CC	UPE
Participation (PA)	0.771*					
Openness (OP)	0.464	0.767*				
Sharing (KS)	0.287	0.573	0.839*			
Collective knowledge (CI)	0.541	0.698	0.637	0.778*		
Collective collaboration (CC)	0.448	0.427	0.474	0.612	0.802*	
Community cohesiveness (UPE)	0.444	0.678	0.557	0.666	0.552	0.770*

Table IV.
Factor correlation coefficients

Discussion

Individuals who adopt SNSs may use them not only as a critical channel for sharing information with their members but also as a major channel of knowledge transfer. However, no previous empirical studies have examined the effect of SNS-based knowledge transfer on the community cohesiveness of SNSs. In this regard, the present

Latent factor	Estimate	SE	CR	Loading	Cronbach's α
Participation					
PA2	0.966	0.049	19.657	0.791	0.848
PA3	0.812	0.043	18.747	0.705	
PA4	0.958	0.045	21.276	0.830	
PA5	1.000			0.807	
Openness					
OP1	1.140	0.071	16.145	0.749	0.812
OP2	1.080	0.071	15.228	0.726	
OP4	1.084	0.069	15.654	0.745	
OP5	1.000			0.691	
Sharing					
KS1	0.915	0.045	20.434	0.746	0.866
KS2	0.999	0.047	21.409	0.807	
KS3	0.972	0.047	20.632	0.792	
KS4	1.000			0.758	
Collective knowledge					
CI2	1.017	0.057	17.718	0.680	0.822
CI3	1.001	0.059	17.034	0.696	
CI4	1.050	0.059	17.815	0.750	
CI5	1.000			0.651	
Collective collaboration					
CC2	1.199	0.070	17.177	0.764	0.843
CC3	1.284	0.071	17.969	0.860	
CC4	1.092	0.068	16.149	0.741	
CC6	1.000			0.643	
Community cohesiveness					
UPE2	1.000			0.650	0.863
UPE3	1.024	0.057	18.006	0.698	
UPE4	1.086	0.057	19.044	0.761	
UPE5	0.899	0.051	17.667	0.752	
UPE6	0.834	0.051	16.387	0.662	
UPE7	0.871	0.054	16.062	0.654	

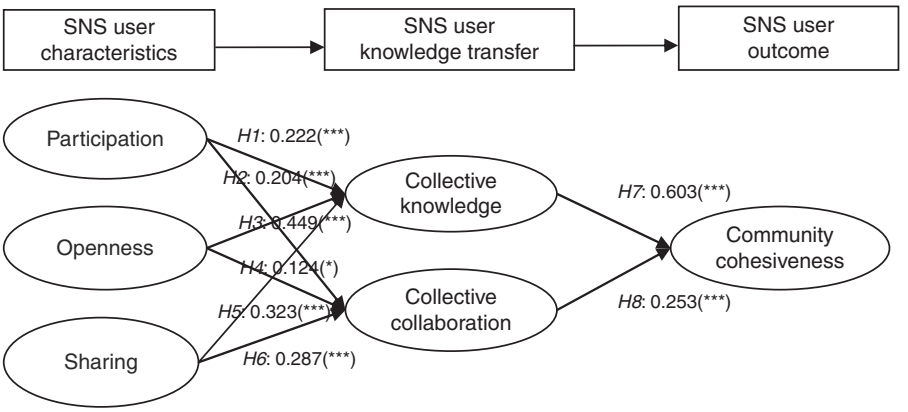
Table V.
Evaluation of the measurement model

Notes: Model fit χ^2=998.566; df=523; p=0.000; RMR=0.036; GFI=0.899; AGFI=0.875; CFI=0.920; NFI=0.892; IFI=0.920; RMSEA=0.061

Hypotheses and paths	Estimate	SE	CR	p
H1: Participation → Collective knowledge	0.222	0.034	6.439	***
H2: Participation → Collective collaboration	0.204	0.030	6.752	***
H3: Openness → Collective knowledge	0.449	0.057	7.941	***
H4: Openness → Collective collaboration	0.124	0.056	2.214	0.027*
H5: Sharing → Collective knowledge	0.323	0.041	7.886	***
H6: Sharing → Collective collaboration	0.287	0.045	6.312	***
H7: Collective knowledge → Community cohesiveness	0.603	0.053	11.296	***
H8: Collective collaboration → Community cohesiveness	0.253	0.047	5.359	***

Table VI.
Results of the hypothesis test

Notes: *p<0.05; ***p<0.001



Notes: *$p<0.05$; **$p<0.01$; ***$p<0.001$

Figure 2.
Test of structural model

Hypotheses	Category	Early adoption (197)	Late adoption (477)	$\Delta\chi^2$	Results
H9a: Collective knowledge → Community cohesiveness	Estimate	0.691	0.490	4.817**	Adopted
	SE	0.098	0.062		
	CR	7.037	7.894		
H9b: Collective collaboration → Community cohesiveness	Estimate	0.142	0.332	5.492**	Adopted
	SE	0.072	0.060		
	CR	1.961	5.572		

Notes: Δ = Equal constrained model−Unconstrained model. **$p < 0.01$

Table VII.
Moderating effects

study provides a systematic analysis of SNS use by considering a new research model and investigating the effects of SNS-based knowledge transfer on user outcomes based on three major characteristics of SNS users. The present results provide further evidence that all the three exogenous variables, presented as user characteristics and integrated into SNS user characteristics, are positively related to the knowledge transfer portfolio, namely, to collective knowledge and collaboration, and these variables have significant moderating effects on SNS users' community cohesiveness. The results can be summarized as follows.

First, participation has significant effects on collective knowledge and collaboration, indicating that it is a critical factor in the formation of collective knowledge as well as in the process of collective collaboration. This result is in line with prior studies (Burns *et al.*, 2011; Ertmer *et al.*, 2011), which argued that individuals showing high level of participation are more likely to acquire project information and thus successfully engage in collaborative efforts. This finding also implies that SNSs are highly user driven. That is, SNSs largely emphasize individuals' active participation and information sharing. Active SNS participation enables users to exchange friendship networks and knowledge, and induces community-based collaboration toward common goals. Thus, it is crucial to promote individuals' participation by providing users with a more compelling experience (e.g. personalized services that better meet users' needs). Furthermore, participation has a

greater effect on collective knowledge than on collective collaboration, providing support for the notion that SNS users are likely to add their specific knowledge to the "wisdom of the crowd." This finding is in accordance with the result of research conducted by Wang *et al.* (2014), which argued that SNS users' participation may be especially relevant for collective knowledge in a voluntary context. However, the impact of participation on collective collaboration may be more significant for compulsory behaviors (e.g. in the workplace).

Consistent with previous research that showed a link between openness and Youtube-based knowledge transfer (Susarla *et al.*, 2012), openness is found to directly influence collective knowledge and collaboration, indicating that it plays a significant role in the formation of collective knowledge as well as in the process of collective collaboration and providing support for the notion that SNS users are likely to contribute their ideas and work together with others on SNSs. In this sense, SNS-based knowledge transfer is probably based on the activity of users and thus depends heavily on their online openness. Given that openness emerges as a stable individual characteristic, it is crucial to identify and retain individuals who have a high level of openness because they are more likely to form collective knowledge and initiate collective collaboration with online SNS users.

In contrast to previous studies (Pasek *et al.*, 2009; Wang *et al.*, 2014), sharing is confirmed to have significant positive effects on collective knowledge and collaboration, providing support for the notion that uploading and sharing information and knowledge can enhance collective knowledge, and sharing is a crucial factor in collective collaboration. This finding is important because previous studies mainly employed sharing as a determinant of SNS adoption, while neglecting its considerable influence on the two types of SNS knowledge transfer. This result indicates that in order to promote SNS knowledge transfer, we could consider adopting measures, such as appropriate reward systems, to encourage individuals to share their knowledge and information on a SNS platform.

In addition, the effects of collective knowledge and collaboration on community cohesiveness are verified to be significant. This result is consistent with previous studies in SNS literature that tested the relationship between knowledge transfer and community value (Cress and Held, 2013; Lykourentzou *et al.*, 2010; Ransbotham and Kane, 2011; Wang and Zhang, 2012). For instance, Wang and Zhang (2012) demonstrated that SNS-based knowledge transfer can offer various possibilities, including increased social activity, improved community cohesion, and a stronger society attachment. Our finding suggests that knowledge transfer activities such as collective knowledge and collaboration play important roles in the formation of SNS users' community cohesiveness. According to this finding, SNS users can benefit from spiral collective knowledge and collaboration based on SNSs to achieve their goals, and this intellectual application can have considerable influence on their attitudes toward SNS communities and thus enhancing their community cohesiveness.

Finally, the present study validates the prediction that the timing of SNS adoption has significant moderating effects on the relationships of collective knowledge and collaboration to community cohesiveness. The result suggests that early SNS adopters are more likely to influence the effects of collective knowledge and collaboration on community cohesiveness. This finding is in line with previous studies (Laukkanen and Pasanen, 2008; Verkasalo, 2011), which have demonstrated clear differences in efficiency between early and late adopters in other contexts (e.g. mobile banking,

smartphones). Our result further reveals a moderating effect on the relationship between SNS-based knowledge transfer and community cohesiveness, providing theoretical foundation for future research on these moderating effects.

Contributions to research and practice

Previous studies have demonstrated the positive effect of the SNS platform on individual achievement, but little is known about the mechanism underlying this effect. The study fills this knowledge void and makes several important contributions to the literature.

First, the study contributes to the SNS literature by thoroughly examining three major characteristics of SNS users, namely, participation, openness, and sharing. Previous studies of SNS use have focused on various research subjects (Baker and White, 2010), but no study has empirically examined the effects of user characteristics represented by participation, openness, and sharing on knowledge transfer on SNSs (Heinrichs *et al.*, 2011; Boyd and Ellison, 2008; Wolff and Kim, 2012). The results empirically verify the significant effects of these factors on collective knowledge and collaboration. By examining these three characteristics of SNS users, this study provides a theoretical background for the relationships between SNS users' characteristics and knowledge transfer.

Second, the results verify collective knowledge and collaboration as major mediators of SNS-based knowledge transfer. Knowledge transfer on SNSs provides useful insights and better awareness for further research. That is, linking individuals' characteristics to community cohesion through knowledge transfer demonstrates the importance of knowledge transfer variables as mediating factors in the SNS context in that the ultimate goal of SNSs is to manipulate and benefit from outcomes of the SNS community. This study makes an important contribution to the IS literature by highlighting how SNS users employ a set of mechanisms to transfer collective knowledge and collaboration for community cohesiveness.

Third, the study examines the moderating effect of knowledge transfer on SNS community outcomes. Based on previous research, the sample was divided into two groups (early and late adopters). According to the results, the respondents' knowledge transfer for SNS user outcomes (early and late adoption) had significant moderating effects on the relationships of collective knowledge and collaboration to community cohesiveness. These results suggest that early SNS adopters are more likely to influence the effects of collective knowledge and collaboration on community cohesiveness. In this regard, SNS users' knowledge transfer theoretically explains how and why collective knowledge and collaboration are relevant to their effects on SNS community cohesiveness.

Fourth, this study makes an important theoretical contribution by providing new insights into SNS community cohesiveness. Despite the increasing use of SNSs, many SNS-based community sites fail to generate worthwhile outcomes such as community cohesiveness. The nature of factors affecting the community cohesiveness of SNSs seems to be different from that of traditional offline ones. In terms of this characteristic, the results provide empirical evidence that collective knowledge and collaboration are distinct factors facilitating the community cohesiveness of SNSs. This suggests a theoretical anchor for identifying factors influencing SNS-based community cohesiveness.

The study also makes practical contributions. First, the results indicate that all three user characteristics (participation, openness, and sharing) had significant effects on knowledge transfer (collective knowledge and collaboration). In this regard, these results have some important practical implications. The results indicate a need for a more

holistic approach to SNS users' characteristics that span their impact on the community as a whole. That is, the results provide those responsible for the development and provision of SNSs for commercial and community service purposes with some important guidelines on what kinds of user characteristics can be attracted and retained.

Second, the representative examples that demonstrate the effects of SNS-based collective knowledge on community cohesiveness include Wikipedia.com, Facebook.com, and Twitter.com. The empirical results verify a positive relationship between knowledge transfer and community cohesiveness. Indeed, SNS providers should carefully consider the effects of SNS-based collective knowledge and collaboration on the whole community. SNS providers should ensure that their SNS functions smoothly facilitate the exchange of users' knowledge and information during the knowledge transfer process.

Finally, the results provide a better understanding of some practical application for SNS developers and providers. The importance of community cohesiveness highlights a need for SNS developers and providers to carefully manipulate collective collaboration and knowledge directly as well as SNS users' characteristics indirectly. The results suggest that SNS operators should focus not only on providing knowledge transfer functions that facilitate the cohesiveness of the SNS community but also on managing users' features that can enhance the process of collaborative knowledge transfer. In sum, public and private organizations can use the results to obtain better insights into important factors that require closer attention during SNS use.

Limitations and future research

This study has some limitations. First, in the classification of SNS users, there was no differentiation between wired and wireless internet users. However, because of the rapidly increasing number of individuals accessing SNSs through their smartphones, future research should consider mobile SNS users' features. Second, in addition to the three characteristics of SNS users considered in this study, future research should focus on other factors that may influence collective knowledge and collaboration. Finally, future research should take a more multidimensional approach by targeting an issue from various perspectives such as psychology, society, and economics. Despite these limitations, the results provide not only a valuable theoretical foundation for future research but also some practical guidelines for developing and applying new business strategies that incorporate the characteristics of SNS users, the knowledge transfer portfolio, and community cohesiveness.

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Appendix. Questionnaire items

Participation (Rishika *et al.*, 2013)

- I use SNSs to participate in discussions.
- I use SNSs to spread news.
- I use SNSs to respond to others' requests.
- I use SNSs to interact with other participants in the virtual community.
- I use SNSs to establish my own place in my group.

Openness (Wolff and Kim, 2012)

- I use SNSs to voice my ideas.
- I use SNSs to be exposed to new concepts.
- I use SNSs to reveal myself to others.
- I use SNSs to disclose valuable information to others.
- I use SNSs to gain trust of others.

Sharing (Heinrichs *et al.*, 2011)

- I use SNSs to convey specific information.
- I use SNSs to share knowledge.
- I use SNSs to pool ideas with others.
- I use SNSs to deliver general views.

Collective knowledge (Cress and Held, 2013)

- I obtain a diverse range of knowledge from others on SNSs.
- I receive more accurate conclusions from others on SNSs.
- I improve my understanding through others' information on SNSs.
- I overcome my cognitive bias through discussions with others on SNSs.
- I reach enhanced intellectual outcomes with others' help on SNSs.
- I increase my level of intelligence through others' experience on SNSs.

Collective collaboration (Cress and Held, 2013)

- I learn teamwork with others on SNSs.
- I strengthen my ability to cooperate with others on SNSs.
- I help others as a team member on SNSs.
- I try to cooperate productively on SNSs.
- I widen my social network through SNSs.
- I perform non-personal tasks through the help of others on SNSs.

Community cohesiveness (Ransbotham and Kane, 2011)

- As an SNS user, I feel a sense of common belonging to the SNS community.
- As an SNS user, I feel positive about other users.
- As an SNS user, I respect the views of other users.
- As an SNS user, I recognize the common interests shared with others.
- As an SNS user, I experience interpersonal relationships with other users.
- As an SNS user, I feel attracted to other users.
- As an SNS user, I see myself and other users as part of a whole.

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