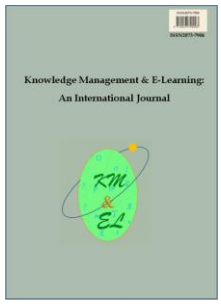
Knowledge Management & E-Learning



ISSN 2073-7904

Competencies affecting knowledge sharing in virtual learning teams

Ruzanna Topchyan
University of Phoenix Online, USA

Recommended citation:
Topchyan, R. (2015). Competencies affecting knowledge sharing in virtual learning teams. *Knowledge Management & E-Learning, 7*(2), 316–333.

Knowledge Management & E-Learning, 7(2), 316–333

Competencies affecting knowledge sharing in virtual learning teams

Ruzanna Topchyan*

Faculty of Research
University of Phoenix Online, USA
E-mail: rtopchya@email.phoenix.edu

*Corresponding author

Abstract: This study is designed to identify which competencies have predictive relationship with knowledge sharing in virtual learning team in distance education. The study was conducted with 1,355 distance education students at undergraduate and graduate levels. This study suggests that loyalty, integrity, cooperativeness and trust have statistically significant predictive relationship with knowledge sharing. The results of the study have implications for instructional designers and instructors to design learning environments and to provide instruction in virtual classrooms by taking into consideration the impact of the identified variables on knowledge sharing.

Keywords: Computer supported collaborative learning; Virtual learning teams; Competencies; Knowledge sharing

Biographical notes: Dr. Ruzanna Topchyan is a research faculty at the University of Phoenix Online. She received her Ph.D. in Instructional Design, Development & Evaluation from Syracuse University. Her current research interests include computer supported collaborative learning, human behavior in computer mediated interaction, small group learning in physical and virtual environments, organizational development, assessment of learning and program evaluation using evaluation logic models.

1. Introduction

In recent years, distance education instructional models operating within the paradigm of computer supported collaborative learning (CSCL) have begun to use virtual learning teams (VLTs). VLTs make it possible to bring student-centered instructional methodologies into virtual classrooms and to create learning environments that have the potential to foster learners' knowledge sharing behavior and at the same time develop their interpersonal and collaborative skills. The corporate world expects to hire university graduates who are capable "to create, acquire, integrate and use knowledge" (Staples & Webster, 2008, p. 618). They should possess not only a strong knowledge base, but also highly developed skills (competencies) in social communication and cooperativeness and much more, as well as flexibility to work with others in a variety of contexts (McLoughlin & Luca, 2002).

In this study, a VLT is defined as a team made up of geographically dispersed members who meet only electronically (through a course management system); they do not have face-to-face meetings. The definition of knowledge sharing is adopted from

Ford (2004) and slightly adapted to fit the VLT context. Thus, knowledge sharing in this study is defined as a behavior in which VLT individual members voluntarily impart their expertise, insight, or understanding to other individual members in the VLT or to the entire team with the intention that others on the team may have that knowledge in common with themselves. Competencies in this study are defined as knowledge skills, attitudes and personality traits that allow distance education students to successfully collaborate on VLTs.

The purpose of this study is to identify which competencies for working on virtual teams affect knowledge sharing behavior in VLTs in distance education. This study intends to fill the gap in our understanding of knowledge sharing in distance education and to provide information that can have practical value for educators in designing learning environments that can foster the development of the identified competencies, which in its turn will enhance knowledge sharing in VLTs.

2. Background

2.1. Benefits of knowledge sharing in VLTs

Knowledge sharing plays a key role in "upgrading the competitiveness of a team" (Zhuge, 2002, p. 23). Shared mental model theory suggests that knowledge sharing contributes to the development of mental models and/or shared understanding in teams, which results in more accurate and efficient performance, better quality and timeliness of output, more efficient communication among team members, and higher levels of accuracy of expectations and predictions; knowledge sharing fosters trust, high morale, collective efficacy, and satisfaction in teams (Cannon-Bowers & Salas, 2001). Shared understanding of reality, which is developed when relevant knowledge is being collectively organized (Hinds & Weisband, 2003), minimizes the need for further negotiation (Klimoski & Mohammed, 1994), for questioning, and optimizes team performance (Bolstad & Endsley, 1999). Interaction contributes to the development of individual cognition. Learners develop cognition and learn better when they provide explanations to others and engage in cognitive elaboration (Springer, Stanne, & Donovan, 1999). Choi, Land, and Turgeon (2005) note that the articulation of understanding, opinions, and perspectives allows learners to identify their cognitive conflicts. Reflecting on new knowledge, and justifying and defending positions, allows learners to co-construct knowledge in a social context. In that process, learners reevaluate their thoughts and externalize their knowledge by transforming internal processes into public processes. While doing so, they develop metacognitive knowledge, which is (a) "knowledge of their cognition," (b) "knowledge about the specific cognitive demands of varied learning tasks," and (c) procedural knowledge of when and where to use acquired strategies" (p. 484). Dillenbourg, Baker, Blaye, and O'Malley (1996) stress the importance of active participation in activities, because it supports learners' "conceptual understanding" and the emergence of new metacognitive beliefs (p. 16). Costa and O'Leary (1992) note that through cooperative learning individuals develop cocognition; they cooperatively develop intellect, concepts, visions, and operational definitions of intelligent behavior, which allow them to reflect upon their own performance while in groups.

2.2. Empirical research on knowledge sharing

In recent years, a number of studies have been conducted on knowledge sharing in virtual teams in different contexts (mostly organizational). Some of these studies, together with the antecedents that they used, are presented in Table 1 below.

Table 1
Sample empirical studies on knowledge sharing

Researcher	**Predictor**
Mueller (2014)	Cultural antecedents (i.e. time, structure, output, orientation, and openness)
Pinjani & Palvia (2013)	Diversity, mutual trust
Papadopoulos, Stamati, & Nopparuch (2012)	Self-efficacy, perceived enjoyment, certain personal outcome expectations, and individual attitudes towards knowledge sharing
Casimir, Ng, & Cheng (2012)	Intention to share
Wu (2011)	Subjective norms, expected contributions, expected loss, distinctiveness, altruism, reinforcement, expected relationships, sharing interference
Ma & Yuen (2011)	Perceived online attachment motivation, perceived online relationship commitment
Matzler and Mueller (2011)	Goal orientations (i.e. learning goal orientation; performance goal orientation)
Li (2010)	Organizational factors: performance, expectancy, compatibility based on work practice, knowledge sharing culture, time pressure; and cultural factors: language, different logic, and different level of perceived credibility for knowledge sharing
Chen, Chen, & Kinshuk (2009)	Social network times, attitudes, web-specific self-efficacy subjective norms,
Zboralski (2009)	Motivation to participate in communities of practice, importance of the community leader, management support
He (2009)	Trust, mutual influence, conflict, leadership, cohesion, quality,
Matzler, Renzl, Muller, Herting, & Mooradian (2008)	Personality traits: agreeableness, conscientiousness, and openness to experience
Forstenlechner & Lettice (2007)	Career prospects, authority, provision of charge codes, recognition among peers, and online incentives
Ardichvili, Maurer, Li, Wentling, & Stuedermann (2006)	Cultural factors: degree of collectivism, competitiveness, importance of saving face, in-group orientation, attention paid to power and hierarchy, and culture-specific preferences for communication modes
Liao (2006)	Power of teachers: reward, punishment, and legitimacy; interaction: learners' perceived degree of interaction with other learners
Ford (2004)	Attitudes, subjective norms, intention

While the above and other studies might have used some of the antecedents interesting to this study, none of them seemed to have used them in the exactly same combination and in distance education as this study did.

2.3. Theoretical framework

Previous studies on knowledge sharing used a number of theories. Lin, Hung, and Chen (2009) used Bandura's (1986) model of triadic reciprocal causation in their study for looking at knowledge sharing (see Fig. 1).

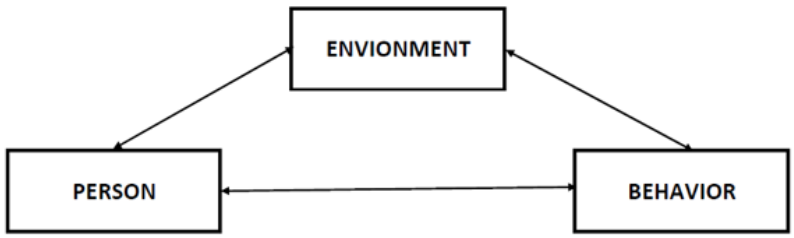


Fig. 1. Model of triadic reciprocal causation. Adapted from Bandura (1986)

This model seemed pertinent for the purposes of this study because this study explored the relationship between person and behavior. This study measured the one-directional relationship between *person* and *behavior*. Person category in this study is presented through competencies for working on virtual teams and namely: loyalty, integrity, conscientiousness, communication, cooperativeness, learning motivation, creativity, persistence, independence, interpersonal trust and intercultural communication skills. The behavior is knowledge sharing.

2.4. Competencies

Competencies are defined by many (Birkett, 1993; Roe, 2002; Boam & Sparrow, 1992). However, there is a lack of uniformity across disciplines and continents in regard to competency definitions. The fact that competencies are also considered "learnable" (Stevens & Campion, 1994), and that they are an under-researched area in virtual teams (Martins, Gilson, & Maynard, 2004) creates the rationale for exploring them. Yang (2007) emphasizes that there is a bidirectional relationship between competencies and knowledge sharing, stating that "knowledge sharing occurs when an individual is willing to assist as well as to learn from others in the development of new competencies" (p. 84).

In organizational research, competency frameworks have been suggested for conducting team member selection (Blackburn, Furst, & Rosen, 2003; Ellingson & Wiethoff, 2002). Empirical studies conducted by Stevens and Campion (1994) and Hertel, Konradt, and Voss (2006) designed and validated competency frameworks to be used for selecting employees for physical and virtual teams respectively. Hertel, Konradt, and Voss (2006) operationalized the construct of virtual team competencies as (a) task work competencies (i.e. loyalty, integrity, conscientiousness), (b) teamwork competencies (i.e. cooperativeness, communication), and (c) telecooperation competencies (i.e. self-management, interpersonal trust, intercultural skills).

Task Work Competencies. Previous research (Schmidt, Ones, & Viswesvaran, 1994) argues that loyalty, integrity, and conscientiousness are the three attributes that "cover the general aspects of reliability of a person" (p. 483). Schmidt and Hunter (1998)

write that integrity tests are used in industry to select employees who are less likely to exhibit negative behaviors (e.g. drinking, using drugs on jobs, getting into fights, stealing from the employer). The above stated three concepts are equally important for VLTs because VLTs often times face challenges, and if VLT members have loyalty to their team, they will develop positive attitude and will successfully overcome all the obstacles toward effective collaboration. Integrity will help VLT members become good team players, have high ethics in team interactions and to create cohesion in teams. Conscientiousness will help them be efficient, organized and easy-going which will benefit the entire team.

Teamwork Competencies. Teamwork competencies suggested by Hertel, Konradt, and Voss (2006) are communication and cooperativeness. Effective teams engage in informal, relaxed, and comfortable communication (Argyris, 1966; Likert, 1961; McGregor, 1960), in which participants are open and supportive of one another's ideas, feelings, and perspectives (Likert, 1961). The communication is event-oriented rather than person-oriented (Gibb, 1961). In this communication everyone has equal opportunity to speak, and topics are not monopolized (Wiemann & Backlund, 1980). Individuals take responsibility for their statements (Stevens & Campion, 1994). Cooperativeness is especially important for virtual collaboration because the lack of common context in computer-mediated communication can create misunderstanding and increase the risk that someone will feel neglected (Hertel, Konradt, & Voss, 2006, p. 483). Miscommunication in VLTs create a host of problems for effective cooperation. VLT members with developed communication and cooperativeness skills are a real asset for their VLT.

Telecooperation Competencies. For virtual teams, who collaborate under restrictions imposed by the virtual environment, Hertel, Konradt, and Voss (2006) suggested four aspects to cover self-management: (a) persistence, (c) learning motivation, (c) creativity, and (d) independence (p. 483). Persistence is important for accomplishing tasks involving technology-mediated interactions. VLT members might face technology-related and other barriers towards completing the tasks right away, but if they are persistent, they will learn through trial and error and from feedback of their team members and their instructors. Other than this, their persistence should be obvious to other VLT members so that healthy working relationships are created. VLT members should be capable of motivating themselves to continue working on the task—in other words, persist in learning. Learning motivation in VLTs relates to course content, to team involvement, and to task completion methods and strategies, which might be different from the ones that VLT members previously encountered. Creativity allows VLT members to discover and develop new concepts and to find original and innovative solutions to tasks. Independence relates to team members' self-efficacy as Hertel, Konradt, and Voss (2006) maintain. Self-efficacy is the "judgment about one's ability to accomplish the task as well as one's confidence in one's skills to perform the task" (Pintrich, Smith, Garcia, & McKeachie, 1991, p. 13). Self-efficacy is important for VLTs in distance education because the unavailability of face-to-face interaction creates an even stronger need to be confident in one's capabilities to perform. Interpersonal trust is the "expectancy of team members that their efforts will be reciprocated and not exploited by other team members" (Hertel, Konradt, & Orlikowski, 2004, p. 8). In distance education, where face-to-face interactions are nonexistent, trust is especially important because computer-mediated communication can create misunderstandings and can escalate the fear of exploitation (Jarvenpaa & Leidner, 1999). However, because on virtual teams it is impossible to monitor other team members (Aubert & Kesley, 2003), the only thing that individuals can do is to trust one another. The effectiveness of VLTs, then, depends on the capability of team members to deliver the promised work. Each

individual team member has to trust that other team members will deliver their share of the work in a timely manner and with appropriate quality. Intercultural skills are especially important in the current period when education and work often occur on a global level. Virtual team members can find themselves cooperating and collaborating with partners from other countries and cultural backgrounds (Duarte & Snyder, 2001; Ellingson & Wiethoff, 2002), as well as with people from different educational, occupational, and functional backgrounds (Hertel, Konradt, & Voss, 2006). The same can be stated about distance education students. Thus, in this study VLT competencies will be measured along the eleven dimensions suggested by Hertel, Konradt, and Voss (2006).

3. Methodology

3.1. Research design

This study has been designed as a correlational study. The study was conducted with distance education students at a major online university. The data were collected on students' perceptions, one time, through an electronic survey questionnaire. The study used split sample design methodology to identify and to validate the knowledge sharing model, and the total sample for final conclusions. The split sample consisted of approximately 50% of the total sample. The dependent variable in the study was knowledge sharing. The independent variables in the study were: loyalty, integrity, conscientiousness, communication, cooperativeness, learning motivation, creativity, persistence, independence, interpersonal trust and intercultural communication skills.

3.2. Research questions

The primary research question in this study is: *Which competencies affect VLT members' knowledge sharing behavior in distance education?* In order to answer this question, answers to the questions below were sought.

1. Does loyalty affect knowledge sharing in VLTs?
2. Does integrity affect knowledge sharing in VLTs?
3. Does conscientiousness affect knowledge sharing in VLTs?
4. Does communication affect knowledge sharing in VLTs?
5. Does cooperativeness affect knowledge sharing in VLTs?
6. Does learning motivation affect knowledge sharing in VLTs?
7. Does creativity affect knowledge sharing in VLTs?
8. Does persistence affect knowledge sharing in VLTs?
9. Does interpersonal trust affect knowledge sharing in VLTs?
10. Does self-efficacy affect knowledge sharing in VLTs?
11. Does intercultural communication affect knowledge sharing in VLTs?

3.3. Participants

One thousand three hundred seventy-three students enrolled in a major distance education university in 2011 participated in the study. The sample was selected through stratified random sampling. Four criteria were used to select the sample: (a) gender (both males

and females were invited to participate), (b) academic level (undergraduate and graduate) (c) area of study (all areas of studies were invited to participate), and (d) prior experience with at least one VLT at the point of completing the survey. The number of total sample changed to 1,355 after initial data cleaning procedures.

3.4. Measures

Measure of knowledge sharing. The instrument consisted of 14 items adopted from the 42-item scale suggested by Johnson et al. (2007) and slightly adapted for the use in an academic context. On the original instrument of 42 items, those 14 items loaded on three factors: (a) general task and team knowledge (7 items), (b) knowledge of team dynamics and interactions (5 items), and (c) team resources and team environment (2 items). One item (item 15), on course-related knowledge, was added as sharing of "your course related information" and categorized under Resource and Environment. Johnson et al. (2007) utilized a 5-point Likert scale ranging from 5 = "strongly agree" to 1 = "strongly disagree." Based on the idea of knowledge sharing and hoarding discussed by Ford (2004), a 5-point Likert scale was created in which 5 = "shared everything I knew or had," 4 = "shared more than withheld," 3 = "shared and withheld about equally," 2 = "withheld more than shared," and 1 = "withheld everything or nearly everything that I knew or had." Johnson et al. (2007) reported a Cronbach's alpha of .82 for the complete instrument.

Measure of competencies. As stated earlier, the Virtual Team Competency Inventory (VTCI) suggested by Hertel, Konradt, and Voss (2006) assesses three areas of competence: task work, teamwork, and telecooperation. The task work competency model is a three-factor (loyalty, integrity, conscientiousness) model with 11 indicators loaded on the three factors. The teamwork competency model is a two-factor model comprised of four indicators that measure communication skills and four indicators that measure cooperativeness. The telecooperation competency model has six factors (creativity, learning motivation, persistence, interpersonal trust, independence or self-efficacy, and intercultural competencies) with 20 items loaded on the six factors. VTCI uses a 6-point Likert scale in which 1 = "not at all true," 2 = "not true," 3 = "middle rate/marginal," 4 = "true," 5 = "very true," and 0 = "question not applicable to my team." Because the unit of analysis in this study was the individual rather than the team, the instrument was used with a 5-point Likert scale; the sixth point, "question not applicable to my team," was excluded. The scale reliability coefficient reported for the instrument by Hertel, Konradt, and Voss (2006) is a Chronbach's alpha of .92. VTCI was initial designed for virtual teams in corporate setting. Topchyan and Zhang (2014) validated VTCI with the total sample used in this study using exploratory structural equation modeling technology (ESEM) and reported that the eleven-factor model showed reasonable fit to the data: CFI=.902, RMSEA=.042, and SRMR=.043, although TLI (.883) was slightly below the acceptable range of .90. The scale reliability analysis on the VTCI 34-item measurement yielded a Chronbach's alpha of .974.

3.5. Analyses

In this study, the following analyses were performed: (i) sample demographic profile analysis; (ii) exploratory factor analysis on knowledge sharing; (iii) correlation analysis on knowledge sharing, (iv) scale reliability analysis on knowledge sharing, and (v) multiple regression analysis. Analyses were performed using IBM SPSS Statistics 21.

4. Findings

4.1. Sample demographic profile

Table 2 below presents the demographic profile of the sample.

Table 2
Sample demographic profile

Demographic Features	Acad Level		Gender		Age		Ethnicity		Study Area	
	N	%%	N	%%	N	%%	N	%%	N	%%
Undergraduate	624	45								
Graduate	648	47								
Female			983	72						
Male			377	27						
Under 21					3	2				
21-23					25	1.8				
24–34					392	29				
35–44					465	34				
45–54					350	26				
55–64					116	8.4				
65 and over					10	7				
American Indian of Alaska Native							16	1.2		
Asian							29	2.1		
Black or African American							239	17		
Hispanic/Latino							88	6.4		
Native Hawaiian or Pacific Islander							11	8		
White (Non-Hispanic)							946	69		
Arts and humanities									8	0.6
Business									311	22.6
Computer and IT									155	11.3
Education									367	26.7
Engineering									1	0.1
Health and nursing									206	15
Law									170	12.4
Public affairs									7	0.5
Science									11	0.8
Missing Values	102	7.4	14	1	13	0.9	45	3.3	138	10

4.2. Exploratory factor analysis on knowledge sharing

A principal Axis Factor (PAF) with a Varimax (orthogonal) rotation of 15 Likert-scale questions on knowledge sharing, 14 of which were selected from the 42-item

measurement developed by Johnson et al. (2007), was performed with 1355 research participants. The 42 items in Johnson et al. (2007) are linked to the five emergent factors of shared mental models: (i) general task and team knowledge, (ii) general task and communication skills, (iii) attitude toward teammates and task, (iv) team dynamics and interactions, and (v) team resources and working environment. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy of knowledge sharing suggested that the sample was non-factorable (KMO = .968).

Table 3
Orthogonally rotated component loadings for 15 knowledge sharing items

Component	1
general ideas (KS1)	.790
task component relationships (KS2)	.833
problem interpretation (KS3)	.813
task goal (KS4)	.849
specific strategies (KS5)	.890
task completion general process (KS6)	.888
understanding of roles & responsibilities (KS7)	.846
where to get information (KS8)	.836
interaction patterns (KS9)	.831
team issues (KS10)	.798
information exchange (KS11)	.885
learning environment (KS12)	.890
safe environment (KS13)	.869
environmental constraints (KS14)	.874
course related information (KS15)	.804
Eigenvalue	10.76
Number of test measures	15

The results of an orthogonal rotation of the solution are shown in Table 3 above. When loadings less than 0.30 were excluded, the analysis yielded a one-factor solution with a simple structure (factor loadings=>.30). The internal consistency of the scale was examined by using a scale reliability analysis which yielded a Chronbach's alpha of .974. The inter-item correlation matrix below, suggested that items are well correlated.

4.3. Multiple regression analysis

A multiple regression analysis using the backward elimination method on approximately 50% of the sample, Sample A (N=683) was used to identify which competencies have statistically significant predictive relationship with knowledge sharing. Competencies entered into regression analysis were: loyalty, integrity, conscientiousness, communication, cooperativeness, creativity, learning motivation, persistence, interpersonal trust, independence or self-efficacy, and intercultural competencies. The prediction model consisting of six predictors (loyalty, integrity, cooperativeness, learning motivation, persistence and trust) was obtained in six steps. Basic descriptive statistics and regression coefficients are shown in Table 4 and Table 5.

Table 4
Correlation matrix for knowledge sharing 15 items

	KS1	KS2	KS3	KS4	KS5	KS6	KS7	KS8	KS9	KS10	KS11	KS12	KS13	KS14	KS15
KS1	1	.817**	.713**	.716**	.723**	.699**	.664**	.642**	.589**	.549**	.677**	.653**	.656**	.646**	.663**
KS2	.817**	1	.775**	.709**	.750**	.727**	.713**	.682**	.664**	.630**	.699**	.694**	.689**	.690**	.655**
KS3	.713**	.775**	1	.724**	.742**	.739**	.668**	.679**	.615**	.616**	.714**	.683**	.662**	.672**	.663**
KS4	.716**	.709**	.724**	1	.822**	.782**	.720**	.680**	.671**	.632**	.740**	.741**	.714**	.713**	.688**
KS5	.723**	.750**	.742**	.822**	1	.872**	.756**	.739**	.694**	.674**	.765**	.775**	.735**	.727**	.731**
KS6	.699**	.727**	.739**	.782**	.872**	1	.773**	.759**	.721**	.671**	.747**	.777**	.738**	.752**	.727**
KS7	.664**	.713**	.668**	.720**	.756**	.773**	1	.746**	.750**	.707**	.748**	.727**	.701**	.707**	.648**
KS8	.642**	.682**	.679**	.680**	.739**	.759**	.746**	1	.735**	.678**	.741**	.719**	.695**	.719**	.698**
KS9	.589**	.664**	.615**	.671**	.694**	.721**	.750**	.735**	1	.800**	.726**	.748**	.754**	.768**	.618**
KS10	.549**	.630**	.616**	.632**	.674**	.671**	.707**	.678**	.800**	1	.742**	.726**	.719**	.737**	.602**
KS11	.677**	.699**	.714**	.740**	.765**	.747**	.748**	.741**	.726**	.742**	1	.833**	.799**	.793**	.721**
KS12	.653**	.694**	.683**	.741**	.775**	.777**	.727**	.719**	.748**	.726**	.833**	1	.849**	.835**	.737**
KS13	.656**	.689**	.662**	.714**	.735**	.738**	.701**	.695**	.754**	.719**	.799**	.849**	1	.867**	.694**
KS14	.646**	.690**	.672**	.713**	.727**	.752**	.707**	.719**	.768**	.737**	.793**	.835**	.867**	1	.706**
KS15	.663**	.655**	.663**	.688**	.731**	.727**	.648**	.698**	.618**	.602**	.721**	.737**	.694**	.706**	1

Table 5
Knowledge sharing related to virtual team competencies (N=683)

	Zero-Order r									
Variable	Loya	Integr	Coop	Lrn	Pers	Trust	β	Std. Error	*b*	*sig*
Loya	1	.499**	.367**	.425**	.397**	.346**	.942	.267	.157	.000
Integr	.499**	1	.386**	.295**	.398**	.240**	.580	.194	.127	.003
Coop	.367**	.386**	1	.400**	.431**	.294**	.672	.168	.167	.000
Lrn	.425**	.295**	.400**	1	.538**	.198**	-.418	.206	-.089	.043
Pers	.397**	.398**	.431**	.538**	1	.237**	.385	.259	.066	.138
Trust	.346**	.240**	.294**	.198**	.237**	1	.589	.185	.121	.002
					Intercept		27.91	3.484		
Mean	12.67	16.83	15.30	11.77	12.70	10.87				
Std. Deviation	1.67	2.20	2.49	2.13	1.73	2.06				

Note: **. Correlation is significant at the 0.01 level (2-tailed). R^2 = .171, $\triangle R^2$ =.162, p<.001. The following abbreviations are used: Loya=Loyalty; Integr=Integrity; Coop=Cooperativeness; Lrn=Learning Motivation; Pers=Persistence.

The ANOVA table showed that the regression is statistically significant $F(6,676) = 23.228$, p<.001. This means that taken together in some optimally weighted combination, loyalty, integrity, cooperativeness, learning motivation, persistence and

trust predict or explain knowledge sharing to a statistically significant degree. The model accounted for approximately 17% of the variance in knowledge sharing (R^2 = .171, $_{\triangle} R^2$ =.162). Knowledge sharing was predicted primarily by higher levels of loyalty and cooperativeness, somewhat lower levels of integrity and trust. Learning motivation showed negative relationship with knowledge sharing which means that when learning motivation increases in team members their knowledge sharing behavior will decrease. This is a somewhat surprising relationship and needs to be explored further. This exploration is beyond the scope of this study. Additionally, persistence showed non-significant relationship with knowledge sharing (p = .138).

Detecting outliers. The next step in the analysis was to detect the possible outliers so that the model could be improved. Toward that end, following the recommendations in Field (2009), a number of criteria were considered, namely, Cook's distance, leverage, Mahalanobis distance, the absolute value of DFBeta, and the values of standardized residuals. Outlier analysis is presented in Table 6 below.

Table 6
Outlier analysis

	Min	Max
Standardized Residual	-4.2411	2.00648
Mahalanobis Distance	.34768	38.40675
Centered Leverage Value	.00051	.05631
Cook's Distance	.00000	.04105
Standardized DFBETA Intercept	-.24238	.20183

Cook's distance and DFBeta did not show values above the absolute value of 1. The cut-off value of centered leverage was calculated using the formula suggested by Stevens (2002) (3(k+1)/n), which in the case of 6 independent variables and N=683 equals to .03075. Fifteen cases (2.2%) exceeded the calculated values of centered leverage. 7 cases (1%) were found to exceed the calculated value of Mahalanobis distance of 25.21 suggested by Barnett and Lewis (1978) for a sample size of 500 and 5 predictors at p=.05. 15 cases (2.2%) were found to exceed the absolute value of 2.58 which is the cut-off value of standardized residuals. The examination of cases whose standardized residuals exceeded 2.58 suggested that those respondents chose either to provide negative responses to the different variables or near negative, because the summed scores on all the variables to which they responded were rather low. For this reason, this study assumed that this group of respondents did not represent the population from which the sample had been drawn. Step-by-step elimination of the cases exceeding the cutoff values of standardized residuals and centered leverage, also excluded cases with Mahalanobis distance beyond the accepted value. This decreased the sample size to 653.

Analysis on Filtered Sample A. The regression analysis was repeated on the filtered Sample A (N=653). The analysis of the six-predictor regression model with the filtered Sample A yielded a somewhat improved model. The ANOVA table showed that the regression is statistically significant: $F(6, 646) = 26.039$, $p<.001$, The predictors accounted for approximately 20% of the variance in knowledge sharing (R^2 = .195, $_{\triangle} R^2$ =.187). The results of the analysis on the filtered Sample A showed that learning

motivation and persistence have non-significant relationship with knowledge sharing. Standardized and unstandardized coefficients are presented in Table 7 below.

Table 7
Standardized and unstandardized coefficients

	B	Std. Error	*b*	Sig
(Constant)	29.965	3.112		.000
Loya	.817	.248	.149	.001
Integr	.654	.176	.162	.000
Coop	.644	.161	.174	.000
Learn	-.213	.185	-.052	.251
Pers	.223	.239	.044	.351
Trust	.501	.172	.111	.004

Note: R^2 = .195, $_{\triangle}R^2$ =.187, p<.001

4.4. Model cross-validation

To cross-validate the regression model, a multiple regression analysis was performed on the second half of the sample (Sample B, N=672). The ANOVA table showed that the regression was statistically significant: $F(6, 665) = 19.939$. The predictors accounted for approximately 15% of variance in knowledge sharing. R^2 = .152, $_{\triangle}R^2$ =.145, p<.001. The unstandardized and standardized coefficients of the predictors are presented in Table 8.

Table 8
Standardized and unstandardized coefficients

	B	Std. Error	Beta	Sig.
(Constant)	22.935	4.332		.000
Loya	.426	.308	.061	.167
Integr	.568	.243	.100	.020
Coop	.599	.220	.126	.007
Learn	-.472	.241	-.086	.050
Pers	.878	.333	.126	.009
Trust	1.164	.215	.204	.000

Note: R^2 = .152, $_{\triangle}R^2$ =.145, p<.001

The analysis suggested significant relationship between knowledge sharing and all the predictors except loyalty and learning motivation.

Detecting Outliers. The next step in the analysis was to detect the possible outliers in the same pattern as above so that the model could be improved. Cook's distance and DFBeta did not show values above the absolute value of 1 in this model either. The value of centered leverage was calculated as .03125. Outlier analysis is presented in Table 9.

Table 9
Outlier analysis

	Min	Max
Standardized Residual	-5.08962	1.93071
Mahalanobis Distance	.50117	31.47355
Centered Leverage Value	.00075	.04691
Cook's Distance	.00000	.06474
Of Standardized DFBETA Intercept	-.15803	.20713

Nine cases (1.3%) showed leverage values above .03125. 4 cases (.6%) showed Mahalanobis values exceeding the absolute value of 25.21. 18 cases (2.7%) showed standardized residual values above the cut-off level of the absolute value of 2.58. The cases exceeding the cut-off values have been step-by-step eliminated from the model. Step-by-step removing the outliers changed the sample size to N=646.

Analysis on Filtered Sample B. The regression analysis was repeated on the filtered Sample B (N=646). The ANOVA table showed that the regression is statistically significant: F(6,639) = 23.795. The model somewhat improved. Now it explained approximately 18% of variability in knowledge sharing: R^2 = .183, $_{\triangle}R^2$ =.175, p<.001. The standardized and unstandardized coefficients are presented in Table 10.

Table 10
Standardized and unstandardized coefficients

	B	Std. Error	Beta	Sig.
(Constant)	24.801	3.701		.000
Loya	.617	.270	.103	.022
Integr	.679	.208	.139	.001
Coop	.539	.189	.132	.004
Learn	-.376	.210	-.080	.074
Pers	.751	.290	.128	.010
Trust	.819	.187	.165	.000

Note: R^2 = .183, $_{\triangle}R^2$ =.175, p<.001

The analysis on the filtered Sample B suggested that all the predictors except learning motivation have statistically significant relationship with knowledge sharing.

Regression coefficient comparability analysis. The hypothesis about the comparability of the two regression coefficients was tested. The null hypothesis (i.e. $b_1 = b_2$) was tested using the formula below, suggested by Paternoster, Brame, Maxerolle, and Piquero (1998) for studies with sample sizes over 500(large samples).

$$Z = \frac{b_1 - b_2}{\sqrt{SEb_1^2 + SEb_2^2}}$$

To calculate the z-value, *b* values in each regression model were summed up, thus resulting in a total b_1 value for the regression model with Sample A and a total b_2 value

for the regression model with Sample B. The same was done for the standard errors of *b* in both models. The calculation yielded an absolute z-value of .000151 for the regression model, which confirmed that we cannot reject the null hypothesis that $b_1 = b_2$. In other words, from this result we cannot conclude that knowledge sharing in Sample A differs significantly from that in Sample B at p<.05 because the calculated z-value falls within the accepted values of z suggested by Brown (2006). Further, the z-values for the identified antecedents were also calculated. The results are presented in Table 11.

Table 11
Z-Values on predictors

	Z-value
Loya	.125
Integr	.084
Coop	.169
Learn	.100
Pers	-.224
Trust	-.213

The calculation of z-values on individual predictors also confirmed that the null hypothesis $b_1 = b_2$ should not be rejected.

4.5. Analysis with filtered total sample

And the last, but not the least, the regression analysis was repeated with the total sample of 1355. After removing the outliers from the total sample, the sample size changed to N=1303. Table 12 below presents the results of the regression analysis performed on the filtered total sample of 1303. As Table 11 suggests, six antecedents in the knowledge sharing model show statistically significant predictive relationship with knowledge sharing. The ANOVA table showed that the regression is statistically significant: $F(6,1296)= 49.247$. The predictors explain approximately 19% of the variance in knowledge sharing: $R^2 = .186$, $_{\triangle}R^2 =.182$, $p<.001$. This is moderate effect.

Table 12
Standardized and unstandardized coefficients

	B	Std. Error	Beta	Sig.
(Constant)	27.143	2.416		.000
Loya	.742	.184	.127	.000
Integr	.627	.136	.139	.000
Coop	.602	.123	.154	.000
Learn	-.323	.140	-072	.021
Pers	.543	.182	.099	.003
Trust	.666	.127	.140	.000

Note: $R^2 = .186$, $_{\triangle}R^2 =.182$, p<.001

Thus, the different analyses suggested that a knowledge sharing model that can be generalized with all the three samples can be presented comprised of four antecedents:

loyalty, integrity, cooperativeness and trust. Learning motivation did not seem to fit into the model well because it did not show statistically significant relationship with knowledge sharing when analyzed with Sample A and Sample B. Persistence, on the other hand, did not show statistically significant relationship with knowledge sharing when analyzed with filtered Sample A.

5. Conclusions and suggestions

This study contributes to the research on knowledge sharing by exploring a combination of antecedents in a knowledge sharing model that has not been explored in previous research. It also contributes to the line of research on small group learning because it sheds light on how some aspects of person relate to team dynamics. While doing so, it introduces the discussion of knowledge sharing in distance education context. Further, it extends research on virtual team competencies, an area that needs further research.

This study also contributes to the theory. Corley and Gioia (2011) provide a general definition of theory as "a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs" (p. 12). The present study used an inductive approach and suggested a knowledge sharing model in which the relationship between the constructs was validated through empirical research.

Further, this study contributes to practice. The findings in this study can be used by practitioners to design learning environments conducive to learning. Students can be oriented to the confirmed competencies so that their knowledge sharing behavior is enhanced. Therefore, activities can be designed to facilitate better understanding and appreciation of loyalty, integrity, cooperativeness, and trust in computer-supported collaborative learning before learners engage in tasks related to their actual online course content. The activity should highlight the link between competencies and knowledge sharing behavior, particularly the benefits that VLTs will gain if those competencies are used, and the losses that they may face if they are not used.

This study has a number of limitations: (i) it was conducted in one university only and at one point in time; (ii) it gathered data on individual VLT members' perceptions of the constructs of interest; (iii) different participant categories were unequally represented in the study, (iv) the data were collected through an electronic survey posted on a commercial website that participants could access from anywhere and on which the researcher did not have control and so on.

However, with all the above limitations, the study made an important step towards adding to the understanding of knowledge management in distance education to which knowledge sharing is a component. This study can guide further research efforts in this area and while not all the competencies entered into the regression analysis were confirmed in the model, other competencies for working on VLTs could also be identified that might relate to knowledge sharing in VLTs. Further research should continue to explore the relationship of competencies to knowledge sharing, and identify other competency frameworks that will allow further exploring the predictors whose impact on knowledge sharing was not generalized or the ones that were excluded from the analysis.

References

Ardichvili, A., Maurer, M., Li, W., Wentling, T., & Stuedemann, R. (2006). Cultural influences on knowledge sharing through online communities of practice. *Journal of Knowledge Management, 10*(1), 94–107.

Argyris, C. (1966). Interpersonal barriers to decision making. *Harvard Business Review, 44*, 84–97.

Aubert, B. A., Kesley, B. L. (2003). Further understanding of trust and performance in virtual teams. *Small Group Research, 34*(5), 575–618.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barnett, V., & Lewis, T. (1978). *Outliers in statistical data*. John Wiley & Sons.

Birkett, W. P. (1993). *Competency based standards for professional accountants in Australia and New Zealand*. Sydney: Institute of Chartered Accountants in Australia and the New Zealand Society of Accountants.

Blackburn, R., Furst, S. A., & Rosen, B. (2003). Building a winning, virtual team. In C. Gibson & S. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 95–120). San Francisco: Jossey-Bass.

Boam, R., & Sparrow, P. (1992). *Designing and achieving competency*. London: McGraw-Hill.

Bolstad, C. A., & Endsley, M. R. (1999, September). Shared mental models and shared displays: An empirical evaluation of team performance. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (pp. 213–217). Sage.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research: Methodology in the social sciences*. New York, NY: Guilford Press.

Cannon-Bowers, J. A., & Salas, E. (2001). Reflections on shared cognition. *Journal of Organizational Behavior, 22*, 195–202.

Casimir, G., Ng, Y. N. K., & Cheng, C. L. P. (2012). Using IT to share knowledge and the TRA. *Journal of Knowledge Management, 16*(3), 461–479.

Chen, I. Y. L., Chen, N. S., & Kinshuk (2009). Examining the factors influencing participants' knowledge sharing behavior in virtual learning communities. *Educational Technology & Society, 12*(1), 134–148.

Choi, I., Land, S. M., & Turgeon, A. J. (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. *Instructional Science, 33*(5/6), 483–511.

Corley, K. G., & Gioia, D. A. (2011). Building theory about theory building: What constitutes a theoretical contribution? *Academy of Management Review, 36*(1), 12–32.

Costa, A. L., & O'Leary, P. W. (1992). Co-cognition: The cooperative development of the intellect. In N. Davidson & T. Worsham (Eds.), *Enhancing thinking through cooperative learning* (pp. 41–65). New York: Columbia University Teachers College.

Dillenbourg, P., Baker, M. J., Blaye, A., & O'Malley, C (1996). The evolution of research on collaborative learning. In E. Spada & P. Reiman (Eds.), *Learning in humans and machines: Towards an interdisciplinary learning science* (pp. 189–211). Oxford: Elsevier.

Duarte, D. L., & Snyder, N. T. (2001). *Mastering virtual teams*. San Francisco, CA: Jossey-Bass.

Ellingson, J. E., & Wiethoff, C. (2002). From traditional to virtual: Staffing the organization of the future today. In R. L. Henemann & D. B. Greenberger (Eds.), *Human resource management in virtual organizations* (pp. 141–177). Greenwich, CT: Information Age Publishing.

Field, A. (2009. *Discovering statistics using SPSS*. Sage publications.

Ford, D. P. (2004). *Knowledge sharing: Seeking to understand intentions and actual*

sharing. Doctoral dissertation. Available from ProQuest Dissertations and Theses database. (UMI NQ99942)

Forstenlechner, I., & Lettice, F. (2007). Cultural differences in motivating global knowledge workers. *Equal Opportunities International, 26*(8), 823–833.

Gibb, J. R. (1961). Defensive communication. *Journal of Communication, 11*(3), 141–148.

He, J. (2009). *Examining factors that affect knowledge sharing and students' attitude towards their learning experience within virtual teams*. Doctoral dissertation. Available from ProQuest Dissertations and Theses database. (DAI-A 71/03)

Hertel, G., Konradt, U., & Orlikowski, B. (2004). Managing distance by interdependence: Goal setting, task interdependence, and team-based rewards in virtual teams. *European Journal of Work and Organizational Psychology, 13*, 1–28.

Hertel, G., Konradt, U., & Voss, K. (2006). Competencies for virtual teamwork: Development and validation of a web-based selection tool for members of distributed teams. *European Journal of Work and Organizational Psychology, 15*(4), 477–504.

Hinds, P. J., & Weisband, S. P. (2003). Knowledge sharing and shared understanding in virtual teams. In C. Gibson & S. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 21–36). San Francisco, CA: Jossey-Bass.

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science, 10*(6), 791–815.

Johnson, T. E., Lee, Y., Lee, M., O'Connor, D. L., Khalil, M. K., & Huang, X. (2007). Measuring sharedness of team-related knowledge: Design and validation of a shared mental model (SMM) instrument. *Human Resource Development International, 10*(4), 437–454.

Klimoski, R., & Mohammed, S. (1994). Team mental models: Construct or metaphor? *Journal of Management, 20*(2), 403–437.

Li, W. (2010). Virtual knowledge sharing in cross-cultural context. *Journal of Knowledge Management, 14*(1), 38–50.

Liao, L. F. (2006). The impact of teacher's powers to knowledge sharing behavior and learning satisfaction in distance-learning environment. *Journal of Information, Technology and Society, 2*(3), 1–14.

Likert, R. (1961). *New patterns of management*. New York: McGraw-Hill.

Lin, M. J. J., Hung, S. W., & Chen, C. J. (2009). Fostering the determinants of knowledge sharing in professional virtual communities. *Computers in Human Behavior, 25*, 929–939.

Ma, W. W. K., & Yuen, A. H. K. (2011). Understanding online knowledge sharing: An interpersonal relationship perspective. *Computers & Education, 56*(1), 210–219.

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here? *Journal of management, 30*(6), 805–835.

Matzler, K., & Mueller, J. (2011). Antecedents of knowledge sharing–Examining the influence of learning and performance orientation. *Journal of Economic Psychology, 32*(3), 317–329.

Matzler, K., Renzl, B., Muller, J., Herting, S., & Mooradian, T. A. (2008). Personality traits and knowledge sharing. *Journal of Economic Psychology, 29*, 301–313.

McGregor, D. (1960). *The human side of enterprise*. New York: McGraw-Hill.

McLoughlin, C., & Luca, J. (2002). A learner-centered approach to developing team skills through web-based learning and assessment. *British Journal of Educational Technology, 33*(5), 571–582.

Mueller, J. (2014). A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams. *European Management Journal, 32*(2), 190–202.

Papadopoulos, T., Stamati, T., & Nopparuch, P. (2013). Exploring the determinants of knowledge sharing via employee weblogs. *International Journal of Information*

Management, 33(1), 133–146.
Paternoster, R., Brame, R., Mazerolle, P., & Piquero, A. (1998). Using the correct statistical test for the equality of regression coefficients. *Criminology, 36*, 859–866.
Pinjani, P., & Palvia, P. (2013). Trust and knowledge sharing in diverse global virtual teams. *Information & Management, 50*(4), 144–153.
Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Washington, DC: Office of Educational Research and Improvement.
Roe, R. A. (2002). What makes a competent psychologist? *The European Psychologist, 7*, 192–202.
Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin, 124*, 262–274.
Schmidt, F. L., Ones, D. S., & Viswesvaran, C. (1994). *The personality characteristic of integrity predicts job training success*. Paper presented at the 6th Annual Convention of the American Psychological Society. Washington, DC.
Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small group learning on undergraduates in science, mathematics, engineering and technology: A meta-analysis. *Review of Educational Research, 69*(1), 21–51.
Staples, D. S., & Webster, J. (2008). Exploring the effects of trust, task interdependence and virtualness on knowledge sharing in teams. *Information Systems Journal, 18*, 617–640.
Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences* (4th ed.) (Chapter 3). Hillsdale, NJ: Erlbaum.
Stevens, M. J., & Campion, M. A. (1994). The knowledge, skills and ability requirements for teamwork: Implications for human resources management. *Journal of Management, 20*(2), 503–530.
Topchyan, R., & Zhang, J. (2014). Validation of virtual learning team competencies for individual students in a distance education setting. *The American Journal of Distance Education, 28*(4), 264–279.
Wiemann, J. M., & Backlund, P. (1980). Current theory and research in communicative competence. *Review of Educational Research, 50*(1), 185–199.
Wu, H. H. (2011). A model for knowledge sharing in web-based learning environments. *The International Journal of Organizational Innovation, 3*(4), 82–94.
Yang, J. (2007). The impact of knowledge sharing on organizational learning and effectiveness. *Journal of Knowledge Management, 11*(2), 83–90.
Zboralski, K. (2009). Antecedents of knowledge sharing in communities of practice. *Journal of Knowledge Management, 13*(3), 90–101.
Zhuge, H. (2002). A knowledge flow model for peer-to-peer team knowledge sharing and management. *Expert Systems with Applications, 23*, 23–30.