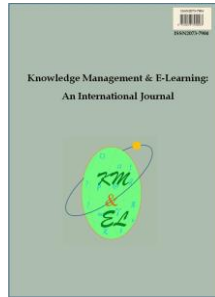

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Does social presence relate to knowledge sharing in virtual learning teams?

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Abstract: The purpose of this study was to identify whether social presence relates to knowledge sharing in virtual learning teams in distance education. The participants in the study were 1355 students engaged in distance education programs. Both split sample and the total sample were used for different analyses. The findings of the study confirmed social presence as a two-dimensional construct, which involves interactive responses and cohesive-affective responses. Only interactive responses were found to relate to knowledge sharing. The results of the study can be used by instructional designers and instructors to design instructional environments that encourage effective social interaction towards knowledge sharing.

Keywords: Distance education; Virtual learning teams; Knowledge sharing; Social presence

Biographical notes: Dr. Ruzanna Topchyan is a Lead Faculty Area Chair (Research) 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; program evaluation using evaluation logic models; technology in higher education; workplace learning; adult learning; human performance; E-Learning design and evaluation, and technology enhanced learning. She has published papers in *The American Journal of Distance Education* and *Knowledge Management & E-Learning: An International Journal*.

1. Introduction

In recent years, working collaboratively with others has been a prominent focus in organizational research because of an increase in situations where people learn and work together. Responding to the need for highly developed collaboration skills, a number of educational institutions started using virtual learning teams (VLTs) in their instructional models. VLTs create opportunities for students with different levels of knowledge and expertise to work together and engage into knowledge sharing and co-construction. However, while educators consider VLTs to be conducive to knowledge sharing, students experience with VLTs differ—partly because it accentuates their struggle to work

productively with others. Learners' reluctance to share their knowledge with others might stem from a number of factors, including low levels of social presence created in VLTs.

In this study, a *virtual learning team (VLT)* is defined as “a team where students meet only electronically, are geographically dispersed, and do not have the opportunity to meet the other members in person or participate in face-to-face meetings” (Barry, 2002, p. 73). The definition of *knowledge sharing* is adopted from Ford (2004) and slightly adapted to fit the VLT context. Thus, knowledge sharing within a VLT is defined as a behavior that allows individual members to impact their expertise, insight, or understanding to other individual members in the VLT or to the entire team. *Social presence* is defined as “the ability of learners to project themselves socially and affectively into a community of inquiry” (Rourke, Anderson, Garrison, & Archer, 1999).

The purpose of this study is to identify whether social presence has predictive relationship with the knowledge sharing aspect of cognitive presence in VLTs in distance education. This is an important issue to explore especially because there is concern about whether distance education students engage in “deep and meaningful learning” (Rourke & Kanuka, 2009). The theoretical framework for this study is the Communities of Inquiry (CoI). CoI is suggested to provide “a collaborative-constructivist perspective of understanding the dynamics of an online learning.” It proposes three overlapping, highly interdependent presences: social, cognitive and teaching (Garrison, Anderson, & Archer, 2000). The relationship between social presence and knowledge sharing aspect of cognitive presence does not seem to have been explored enough in the field of distance education. The findings of this study aimed to contribute to the research on knowledge sharing aspect of cognitive presence in VLTs by exploring social presence as an antecedent. This study will also contribute to the learning theory by suggesting a knowledge sharing model with an antecedent that has not been explored in distance education.

2. Background

2.1. Knowledge sharing

Team knowledge falls into four categories (Cannon-Bowers, Salas, & Converse, 1993; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rouse, Cannon-Bowers, & Salas, 1992): (a) technology/equipment knowledge, (b) job/task knowledge, (c) team interaction knowledge, and (d) team members' knowledge. In VLTs, technology knowledge is the knowledge of hard and soft technology (e.g., computers, MS Office, Internet, course management systems), how to obtain resources in their learning environment. Task knowledge is discipline specific knowledge and knowledge of task procedures and strategies. Team knowledge relates to VLT interactions; to the understanding of how VLTs work, to the understanding of the interdependence of VLT members, VLT members' roles and responsibilities, VLT interaction patterns, information resources, information flow, and communication channels, the knowledge of VLT members' entry-level characteristics, skills, attitudes, preferences, strengths, weaknesses, and so on. Sharing the knowledge in the above listed areas will allow VLTs to achieve their team goals, which, in turn, will enhance team effectiveness.

A number of studies have been found that focused on knowledge sharing and which used different antecedents. The majority of those studies were conducted in a corporate setting. A few of the antecedents that the above mentioned studies used are:

cultural antecedents (i.e. time, structure, output, orientation, and openness) (Mueller, 2014); diversity and mutual trust (Pinjani & Palvia, 2013); intention to share (Casimir, Ng, & Cheng, 2012); subjective norms, expected contributions, expected loss, distinctiveness, altruism, reinforcement, expected relationships, sharing interference (Wu, 2011); perceived online attachment motivation, perceived online relationship commitment (Ma & Yuen, 2011) and so on. However, no study was found that explored the relationship between social presence and knowledge sharing in VLTs, which is of interest to this study. Findings in this study will add to the line of research on CoI and on knowledge management in eLearning.

2.2. Cognitive presence

Garrison, Anderson, and Archer (2000) defined cognitive presence as “the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication”. Cognitive presence relates to purposive knowledge construction and has been operationally defined through “frequency counts of four types of discourse: triggering events, exploration, integration, and resolution” (Rourke & Kanuka, 2009). In other words, in a supportive VLT environment, VLT members should be able to trigger events that might require certain level of cognitive engagement, they might engage into exploration to not only find information for themselves, but also find information that could be shared with their team members. They will learn when helping others to understand information; therefore, knowledge is co-constructed. Thus, taking ownership in finding information and sharing it with others, VLT individual members will not only integrate into a learning community, but the newly obtained information or newly shared knowledge will integrate into their already existing information and knowledge structures. Often times, distance education students face scenarios when they are in search for a resolution to an issue or a problem. Cognitive presence in VLTs can assist them in this because provision of external substantive information can help better see resolutions and so on.

2.3. Social presence

Social presence theory emerged on the basis of media richness theory (Short, Williams & Christie, 1976). In recent years, social presence has been discussed in relationship with teaching presence, cognitive presence, and learner presence (Rourke, Anderson, Garrison, & Archer, 1999; Shea & Bidjerano, 2009). Initially, media richness theory ascribed the level of social presence to the objective characteristics of the medium only, or the “quality of the medium itself,” to convey degrees of social presence (e.g., facial expressions, nonverbal cues, body language), ignoring the social (subjective) aspect in mediated communication (Gunawardena & Zittle, 1997). In recent years, social presence has also been viewed from the perspective of the social aspect of computer communication, integrating into it “interaction of individual differences, task and environmental context” (Biocca, Burgoon, Harms, & Stoner, 2001, p. 12).

Computer-mediated communication (asynchronous) is considered a *lean* medium (Short, Williams & Christie, 1976). It lacks timely feedback and body language, has meaning barriers (Beers, Boshuizen, Kirschner, & Gijsselaers, 2007; Derks, Bos, & Grumbkow, 2007), and possesses less capacity to convey feelings and emotions (Tu, 2002). Subjective characteristics of computer-mediated communication relate to individuals’ preference for a particular form of communication medium, their becoming familiar with it, and making up for the gap in social presence created by the objective characteristics of the medium so that the level of experienced social presence can be

intentionally manipulated (Polhemus, Shih, & Swan, 2001; Swan & Shih, 2005; Walther, 1996).

Some discussions of the benefits of social presence are as follows. In the corporate world, members of highly productive virtual teams were found to engage in informal social communication more often than members of less productive teams (Saphiere, 1996). Social attributes in team communication are found to facilitate the formation of trust in virtual teams (Jarvenpaa & Leidner, 1999). Higher levels of social presence were found to result in higher satisfaction with communication, greater levels of interaction, and greater opportunities for learning (Swan & Shih, 2005). A strong positive correlation (0.83) between students' perceived social presence and their perceived learning was reported (Swan, 2003). Social presence was also reported to be critical for creating a community of learners (Fabro & Garrison, 1998).

Rourke, Anderson, Garrison, and Archer (1999) suggested three dimensions for social presence: (a) affective responses, (b) interactive responses, and (c) cohesive responses. Affect is created in computer-mediated communication by the use of emoticons (☺☺☺) (Falman, 1981), humor (Gorham, 1988), and self-disclosure (Cutler, 1995). *Affective responses* help convey good will, reduce social distance, invite conversation (Gorham & Christophel, 1990), create group cohesion (Eggins & Slade, 1997). *Interactive Responses* are thought to build and sustain relationships and to express a willingness to maintain and prolong contact; they tacitly indicate interpersonal support, encouragement, and acceptance of the initiator (Eggins & Slade, 1997). Garrison, Anderson, and Archer (2000) label this category "open communication." They describe it as "reciprocal and respectful exchanges" and suggest "mutual awareness" and "recognition of each other's contributions" as examples of open communication". They suggest that this type of behavior is realized by "reply features to post messages, by quoting directly from conference transcripts, by directing a comment to someone in particular, and by referring explicitly to the content of others' messages" (p. 100) and so on. *Cohesive responses* are "exemplified by activities that build and sustain a sense of group commitment" (Garrison, Anderson, & Archer, 1999). Cohesive responses are represented by phatics, salutations, vocatives, and addressing the group as "we," "our," or "us." Phatics relate to "shar[ing] feelings," and "establishing a mood of sociability" (Rourke, Anderson, Garrison, & Archer, 1999). Phatics serve to confirm ties of union, and include communicative acts such as formal inquiries about one's health, remarks about the weather, or comments about trivial matters (Bussmann, 1998). Salutations are expressions of greetings (e.g., "Hi all") (Rourke, Anderson, Garrison, & Archer, 1999). Vocatives are addressing participants by name. A number of empirical studies (Christensen & Menzel, 1998; Gorham, 1988) discovered a connection between addressing students by name and cognitive, affective, and behavioral learning. Mehrabian (1968) suggests that the use of the pronouns "we," "our," and "us" connote feelings of closeness and association. Social presence will be measured along these three dimensions discussed above.

Using Rourke, Anderson, Garrison, and Archer (1999) three-dimensional measurement of social presence is appropriate for this study context of VLTs because experience shows that VLTs exhibit different classroom dynamics. Some VLTs engage into providing more affective responses to their team members, while others prefer not to use humor, not to make attempt for self-disclosure. There is also difference in the level of interactive responses experienced in VLTs. Some VLTs seem to provide more interpersonal support and encouragement, while individual members on other VLTs simply submit the assignments without making an attempt to have frequent interaction with others. There are also cases when the interaction is very poor, and the rest of the

team might literally wait for days to hear from a team member. And finally, VLTs are different in their attempts for creating cohesion in teams. Some VLT members often times do emphasize "we", "our", "us" in interaction with team members, while others simply respond to messages without using the addressees' names. This study makes an assumption that all these differences in VLT dynamics might relate to VLT individual members' knowledge sharing behavior.

2.4. Theoretical framework

Garrison, Anderson, and Archer (2000) presented learning experience through the Community of Inquiry (CoI) framework structured through social presence, cognitive presence and teaching presence. *Social presence* is defined as "the degree to which learners feel socially and emotionally connected with others in an online environment". *Cognitive presence* is defined as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse". *Teaching presence* is defined as "the design, facilitation, and direction of cognitive and social processes for the realization of personally meaningful and educationally worthwhile learning outcome" (Swan et al., 2008). While highly important and working in conjunction with social and cognitive presence, teacher presence is not the focus of this study and will not be discussed further here. In this study only the relationship between the two subcategories of CoI, social presence and cognitive presence resulting in VLT individual members' knowledge sharing behavior will be explored. In the core of this study lies the argument that while, cognitive presence is assumed to contribute to knowledge construction, interaction does not always result in knowledge sharing (Fischer & Mandl, 2005; Jeong & Chi, 2007). Individuals might not always be willing to engage in knowledge sharing (Fisher & Fisher, 1998), and even employees may be reluctant to share their knowledge with others (Kelloway & Barling, 2000). For this reason, this study is interested in exploring whether social presence creates the necessary conditions for cognitive presence to result in VLT individual members' knowledge sharing behavior.

3. Methodology

3.1. Research design

This ex post facto study collected the data on students' perceptions on knowledge sharing and social presence in VLTs. The study used both split sample (approximately 50% of the total sample) and the total sample in different analyses. The independent variable in the study was social presence and the dependent variable was knowledge sharing.

3.2. Research questions and analyses

The main research question in the study was: *Does social presence affect knowledge sharing in VLTs?*

In order to find an answer to the main research question, responses to the questions below were also sought:

RQ1: *Does the current study achieve a three factor structure for social presence measurement representing three domains?*

Rourke, Anderson, Garrison, and Archer (1999) present the social presence construct as consisting of three domains, so it was important to explore whether a three-factor model could be achieved.

RQ2: *Does the study yield a reasonable first-order factor structure for the social presence construct?*

The conceptual model suggested by Rourke (2000) has not undergone construct validation, so there is no baseline social presence model to which the obtained model could be compared.

RQ3: *Which social presence factors have predictive relationship with knowledge sharing in VLTs?*

While all the social presence dimensions have been noted as important for virtual interaction, the study makes an assumption that all the identified dimensions might or might not relate to knowledge sharing.

3.3. Participants

A total of 1355 students participated in the study. Four criteria were considered during the sample recruitment: (a) gender, (b) academic level, (c) area of study, and (d) prior experience with at least one VLT at the point of completing the survey. Stratified random samples of 20,023 distance education students were pulled from the following five program areas: business, education, criminal justice, nursing, and information technology. The samples were stratified by program levels: bachelor, master, and doctoral. Study participants responded to an electronic survey uploaded on Adobe FormsCentral. Participants were provided 4 weeks to respond to the survey. 1374 students (7% response rate) responded to the survey. After data cleaning, the analysis was performed with 1355 students (97% of those responding). The higher percentages in the sample were as follows: females (71.5%), ages 35 to 44 (33.8%), White (non-Hispanic) (68.6%), graduate level (47.2%), and majoring in education (26.6%) (Topchyan, 2015).

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). On the original instrument, 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. The scale is designed based on the information found in Ford (2004) on knowledge sharing-hoarding. Topchyan (2015) conducted an exploratory factor analysis on the 15-item instrument. The analysis extracted one factor and suggested a KMO = .968. The results of the analysis were significant. The scale reliability analysis on the measurement yielded a Cronbach’s alpha of .974.

Measure of social presence. Social presence was measured using 14 out of 15 items on the social presence scale used by Rourke (2000). While Arbaugh et al. (2008) suggested a measure of Community of Inquiry framework, this study made a decision to use the framework found in Rourke (2000) because it seemed to more specifically target the possible activities that could have happened in a virtual classroom. For instance, an item that measures social presence on Arbaugh et al. (2008) measurement reads: “I felt

comfortable interacting with other course participants”, whereas a sample item suggested by Rourke (2000) reads: “Replied to the message of another team member by using the ‘reply’ feature of the conference software” (the items have been adjusted to measure social presence in VLTs). Actually, this and the other behaviors presented through the other items are encouraged by the University to be used in communication. The Rourke (2000) scale presents three areas or domains of social presence: affective responses, interactive responses, and cohesive responses. The measure used a 4-point Likert scale of “almost always,” “often,” “rarely,” and “never.” The source does not report a scale reliability coefficient. In this study, the social presence scale was used with a 5-point Likert scale of 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.” Items on the scale were slightly reworded to make them applicable to the VLT context.

3.5. Analyses

In this study the following analyses were performed: (i) confirmatory factor analysis, (ii) scale reliability analysis, and (iii) multiple regression analysis.

4. Findings

4.1. Does the current study achieve a three factor structure for social presence measurement representing three domains?

The social presence construct was entered into CFA as a three-factor model: cohesive responses (SP1, SP8, SP11 and SP13), interactive responses (SP2-SP7), and affective responses (SP9, SP10, SP12, and SP14). This study attempted to obtain a CMIN/DF of < 5.0; CFI and TLI of 95 or above; RMSEA value below .08 or lower, SMRM below .06. The results of the CFA suggested high correlation between cohesive and affective responses (1.04). This was an indication that cohesive and affective responses could not load on separate factors. For this reason, a two-factor social presence model with combined cohesive and interactive responses loading on one factor was obtained. The CFA on the social presence two-factor model yielded the following results: $\chi^2(76) = 1100.055$; CMIN/DF = 14.474; TLI = .824 CFI = .853; PGFI = .645; RMSEA = .100; SRMR = .1009; and AIC = 1158.055. Additionally, SP1 showed non-significant loading on cohesive/affective responses. This model could not be accepted because it did not show good fit to the data. The next step was to load SP1 on interactive responses. However, while the model slightly improved, it still could not be accepted because it did not meet the criteria for a good model. Repeating the analysis on the social presence two-factor model yielded the following results: $\chi^2(76) = 760.837$; CMIN/DF = 10.011; TLI = .882 CFI = .902; PGFI = .668; RMSEA = .082; SRMR = .072; and AIC = 818.832. The standardized residuals of some items showed high covariance: SP13 <--> SP14 = 82.611; SP6 <--> SP7 = 61.613; SP8 <--> SP9 = 84.315. Combining those items and repeating the analysis yielded the following results: $\chi^2(73) = 502.647$; CMIN/DF = 6.886; TLI = .923 CFI = .938; PGFI = .660; RMSEA = .066; SRMR = .066; and AIC = 818.832. Having closer look at the items suggested that their content was close. For instance, SP6 reads “Referred explicitly to the content of the message of a team member” and SP7 reads “Quoted the message of another team member in whole or in part”. It is assumed that quoting the message of another team member does mean explicitly referring to the message. While in future research, the above items could be combined, in the current

research only one item from the pair could be used. For this reason, the next thing that was done was to look at the level of covariance each item in the pairs above had in the model so that one of the items could be eliminated. This analysis showed the following level of covariance for different items: SP6=67.172; SP7 = 132.017; SP8 = 120.448; SP9 = 89.872; Sp13 = 18.61; SP14 = 42.479. These numbers suggested that eliminating SP7, SP8 and SP14 could have improved the model. Performing the CFA on social presence two-factor 11-items model yielded the following results: $\chi^2(43) = 264.528$; CMIN/DF =6.152; TLI = .947 CFI = .958; PGFI = .628; RMSEA = .062; SRMR = .051; and AIC = 310.528. The model showed better fit to the data and a decision was made to accept this model. The two factors also showed a moderate correlation of .46 that is appropriate for being considered subcategories of a construct. Table 1 presents the results of the CFA analysis on the difference social presence models.

Table 1
Results of analysis on social presence two-factor models

| | χ^2 | <i>p</i> | <i>df</i> | $\Delta\chi^2$ | TLI | CFI | PGFI | RMSEA | SRMR | AIC |
|--|----------|----------|-----------|----------------|------|------|------|-------|-------|----------|
| CFA Model 1: 2-factor, 14-indicator | 1100.06 | .000 | 76 | | .824 | .853 | .645 | .100 | .101 | 1158.055 |
| CFA Model 2: 2-factor, 14-indicator, SP1 loading on F2 | 760.84 | .000 | 76 | 339.22 | .882 | .902 | .668 | .082 | 0.072 | 828.832 |
| CFA Model 3: 2-factor, 14-indicator, SP6&SP7, SP8&SP9, SP13&SP14 combined | 502.65 | .000 | 73 | 258.19 | .923 | .938 | .660 | .066 | .066 | 566/647 |
| CFA Model 4: 2-factor, 11-indicator, SP7, SP8, SP14 dropped | 264.53 | .000 | 43 | 238.12 | .947 | .958 | .628 | .062 | .051 | 310.528 |

4.2. Does the study yield a reasonable first-order factor structure for the social presence construct?

Thus, CFA Model 4 yielded a reasonable first-order factor structure for the social presence construct and was confirmed as a social presence model to be used further in the analysis with its two factors and 11 indicators: *interactive responses* – SP1-SP6 and *cohesive-affective responses* – SP9-SP13. Standardized loadings on the factors showed the following ranges: interactive responses from .53 to .82, and cohesive-affective responses from .59 to .83. The scale reliability analysis yielded a Cronbach’s alpha of .811 for the entire measure, .832 for *interactive responses*, and .796 for *cohesive-affective responses*. All the values are acceptable.

4.3. Which social presence factors have predictive relationship with knowledge sharing?

In order to analyze which social presence factors have predictive relationship with knowledge sharing, a multiple regression analysis was performed. While logically it would have been more appropriate to perform a structural equation modeling (SEM) technique following confirmatory factor analysis, a decision was made to use multiple regression analysis because the obtained social presence model was simple, and because

even if the knowledge sharing model with two predictors had to be entered into SEM, the analysis still would have resembled a conventional linear regression analysis.

A simultaneous multiple regression analysis was performed using approximately 50% of the sample, Sample A (N=663) to identify whether the two dimensions of social presence have statistically significant predictive relationship with knowledge sharing in VLTs. The summed values of the two dimensions of social presence were entered into the analysis as: interactive responses – SP1-SP6, cohesive-affective responses SP9-SP13. The ANOVA table showed that the regression was statistically significant $F(2,660) = 48.339, p < .001$. Table 2 presents the standardized and unstandardized coefficients from regression analysis on Sample A.

Table 2
Standardized and unstandardized coefficients

| | B | Std. Error | Beta | Sig. |
|------------------------------|--------|------------|------|------|
| (Constant) | 39.674 | 2.686 | | .000 |
| Interactive responses | .983 | .111 | .347 | .000 |
| Cohesive-Affective responses | .072 | .101 | .028 | .478 |

Note: $R^2 = .128, \Delta R^2 = .125, p < .001$

The model accounted for approximately 13% of variance (moderate effect) in knowledge sharing ($R^2 = .128, \Delta R^2 = .125$). However, the table of coefficients suggested that cohesive-affective responses do not have statistically significant predictive relationship with knowledge sharing in VLTs.

Detecting Outliers. The next step in the analysis was to detect for possible outliers eliminating which might have improved the model. *Cook's* distance and *DFBETA* did not show values above the absolute values of 1. Centered leverage was calculated as 0.013525 using the formula suggested by Stevens (2002) $(3/(k+1)/n)$, where k is the number of predictors and n is the number of samples. 10 cases (1.5%) also exceeded the calculated values of centered leverage. 12 cases (1.8%) exceeded the absolute value of standardized residuals. Table 3 below presents the outlier analysis on Sample A.

Table 3
Outlier analysis on sample A

| | Min | Max |
|-------------------------------|---------|---------|
| Standardized Residual | -4.7660 | 2.1910 |
| Mahalanobis Distance | .0118 | 22.0686 |
| Centered Leverage Value | .0000 | .0333 |
| Cook's Distance | .0000 | .0657 |
| Standardized DFBETA Intercept | .0000 | .7393 |

Mahalanobis distance was above the value of 18.12 suggested by Barnett and Lewis (1978) for a sample size of 500 and above and 2 predictors at $p = .000$. 10 cases (1.5%) exceeded the value of 18.12. Cases that did not meet the different criteria decreased the sample size to N=633.

Analysis on Filtered Sample A. Repeating the analysis on the filtered Sample A also suggested that the regression is statistically significant $F(2,630) = 46.658, p < .001$. While the model still accounted for approximately 13% of variance (moderate effect) in knowledge sharing ($R^2 = .129, \Delta R^2 = .126, p < .001$). Removing the outliers suggested that the cohesive-interactive responses do have statistically significant predictive relationship with knowledge sharing. Table 4 presents the standardized and unstandardized coefficients from regression analysis on filtered Sample A.

Table 4
Standardized and unstandardized coefficients

| | B | Std. Error | Beta | Sig. |
|------------------------------|--------|------------|------|------|
| (Constant) | 41.353 | 2.644 | | .000 |
| Interactive responses | .875 | .107 | .321 | .000 |
| Cohesive-Affective responses | .195 | .091 | .085 | .032 |

Note: $R^2 = .129, \Delta R^2 = .126, p < .001$

However, *b*-values also suggested that interactive responses contribute approximately 4.5 times more (.875) to the knowledge sharing model than cohesive-affective responses (.195).

4.4. Model cross-validation

To cross validate the regression model, a multiple regression analysis was performed on Sample B (the second half of the sample, $N=692$). The same procedures were employed. The initial regression analysis suggested that the regression is statistically significant $F(2,689) = 25.818, p < .001$. Table 5 presents the standardized and unstandardized coefficients from regression analysis on Sample B.

Table 5
Standardized and unstandardized coefficients

| | B | Std. Error | Beta | Sig. |
|------------------------------|--------|------------|------|------|
| (Constant) | 48.098 | 2.559 | | .000 |
| Interactive responses | .708 | .108 | .263 | .000 |
| Cohesive-Affective responses | .004 | .097 | .001 | .971 |

Note: $R^2 = .070, \Delta R^2 = .067, p < .001$

This analysis suggested that the model accounted for approximately 7% of variance (small but meaningful effect) in knowledge sharing ($R^2 = .070, \Delta R^2 = .067, p < .001$). It also suggested that only interactive responses have statistically significant relationship with knowledge sharing. The next step was to detect and to remove the outliers.

Detecting Outliers. The outlier analysis suggested that the standardized DFBETA Intercept and the centered leverage did not create any concern because the values were below the absolute value of 1. Mahalanobis distance was below the accepted value of 18.12 for the sample size and the number of predictors. The standardized residual showed 15 cases (2.2%) above the absolute value of 2.58. And the centered leverage showed 8

cases (1.2%) above the accepted value of .013525. Table 6 below presents the outlier analysis on Sample B.

Table 6
Outlier analysis on sample B

| | Min | Max |
|-------------------------------|---------|--------|
| Standardized Residual | -5.076 | 1.792 |
| Mahalanobis Distance | .014 | 15.617 |
| Centered Leverage Value | .000 | .023 |
| Cook's Distance | .000 | .052 |
| Standardized DFBETA Intercept | -.78554 | .61038 |

Dropping the cases that did not meet the criteria, the sample size decreased to N=669. The ANOVA table showed the regression is statistically significant $F(2,666) = 32.286, p < .001$. The model accounts for approximately 9% of the variance in knowledge sharing ($R^2 = .089, \Delta R^2 = .086, p < .001$). However, the relationship between cohesive-affective responses with knowledge sharing was not found to be statistically significant. Table 7 presents the standardized and unstandardized coefficients from regression analysis on filtered Sample B.

Table 7
Standardized and unstandardized coefficients

| | B | Std. Error | Beta | Sig. |
|------------------------------|--------|------------|------|------|
| (Constant) | 47.828 | 2.403 | | .000 |
| Interactive responses | .734 | .102 | .293 | .000 |
| Cohesive-affective responses | .022 | .087 | .010 | .801 |

Note: $R^2 = .089, \Delta R^2 = .086, p < .001$

4.5. Analysis with filtered total sample

The next analysis was performed with the total sample of N=1322. This number was obtained by appending filtered Sample A and Sample B. Taking into consideration that combining the two halves of the samples although individually filtered still might have left outliers, an analysis was performed to detect the outliers. The analysis suggested that all the coefficients met the criteria except the standardized residuals. Table 8 presents the outlier analysis on filtered total sample.

20 cases (1.5%) showed standardized residuals above the absolute value of 2.58. These cases were dropped from the dataset which decreased the dataset to N=1282. Regressing knowledge sharing on interactive and cohesive-affective responses yielded a statistically significant model $F(2,1279) = 82.175, p < .001$. Table 8 presents outlier analysis on the total sample.

Table 8
Outlier analysis on total sample

| | Min | Max |
|-------------------------------|---------|--------|
| Standardized Residual | -3.129 | 2.005 |
| Mahalanobis Distance | .011 | 10.326 |
| Centered Leverage Value | .000 | .020 |
| Cook's Distance | .000 | .008 |
| Standardized DFBETA Intercept | -.22112 | .18479 |

Table 9 presented the standardized and unstandardized coefficients from regression analysis on the total sample.

Table 9
Standardized and unstandardized coefficients

| | B | Std. Error | Beta | Sig. |
|------------------------------|--------|------------|------|------|
| (Constant) | 45.595 | 1.700 | | .000 |
| Interactive responses | .793 | .071 | .319 | .000 |
| Cohesive-Affective responses | .087 | .059 | .042 | .142 |

In this model only the interactive responses showed statistically significant relationship with knowledge sharing. The model suggested that interactive responses count for 11% (moderate effect) of variability in knowledge sharing ($R^2 = .114$, $\Delta R^2 = .112$, $p < .001$).

5. Discussion

Thus, this study achieved a two-factor structure for social presence measurement representing the following domains: interactive responses and cohesive-affective responses. The first-order factor structure was reasonable because each factor had more than three indicators loading. Only interactive responses showed predictive relationship with knowledge sharing. Cohesive-affective responses showed statistically significant predictive relationship with knowledge sharing when analyzed with Sample A. In other words, this study suggests that for knowledge sharing behavior to occur in VLTs, team members should use names to refer to one another, should complement (acknowledge) one another’s message, should express their agreement with the posted messages and express appreciation for the contribution of team members. Often times, students forget to include team members’ names into their own when replying to them. This behavior creates some vagueness in communication and often times it is difficult to infer whose message is being responded to. Not including names into responses might discourage team members to share their knowledge with others. Additionally, team members should refer explicitly to the content of the message to which they respond because as the experience suggests, only messages addressed to team members and explicitly stating the parts of the message to which the response is written generate more discussion. Interestingly enough, this behavior might not always happen in online communication,

and it is understood that students might be unaware of the beneficial effect of more explicit messages in interaction. Expressing appreciation of team members' messages is also important for creating good communication dynamics in virtual learning teams. Messages that receive appreciation seem to lead to further discussions. However, this does not always happen. There are instances when students would simply state that "it is a good message" and then divert and discuss something else. This fact does not allow further deeper discussion of the previous theme, or invite the author to elaborate on the message, leaving the discussion unfinished. While expressing agreement with team members' messages is important, it is also important to provide constructive ideas why team members might or might not agree with others' messages or point to the content that they might think should be negotiated further. Negotiation of ideas in virtual classrooms is only possible through knowledge sharing, analysis, internalization and interactive responses to team members' messages.

6. Conclusion and recommendations

This study had a number of limitations: (i) it failed to validate social presence as a three-dimensional construct, (ii) it was conducted in one university only and at one point in time; (iii) it gathered data on individual VLT members' perceptions of the constructs of interest; (iv) different participant categories were unequally represented in the study, (v) 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.

The following issues will be considered in future work. First, the study should be replicated to test the relationships in the model with different samples. Second, the study could be made more rigorous if the participants' perceptions were collected while they engage in teamwork. Third, social presence construct should be expanded and tested again to develop better understanding of the number of dimensions that can be validated. Fourth, while the cohesive-affective responses showed significant predictive relationship with knowledge sharing when analyzed with one sub-sample and no significant relationship when analyzed with another sub-sample and the total sample, this relationship should be explored in further studies.

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