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Measuring social presence in online learning: A validation study

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Abstract

Despite continued research into the Community of Inquiry (CoI) framework, the best way to measure each presence of the framework, and in particular social presence, has not been effectively settled in prior research. The purpose of this study was to evaluate the validity of the social presence items in the CoI framework and its subscales, as well as to determine the strongest contributors to the social presence construct. An online survey of 413 students in online courses in the U.S. was administered to assess the validity and structural framework of the social presence construct. The findings from the current survey suggest that social presence is most strongly predicted by affective expression, and that all three subscales explain approximately 72% of the variance in social presence. The implications of this variance and future research items suggest that emotional expression is one of the more important factors for instructors to focus on in online courses to promote social presence.

Keywords Social presence · Online learning · Community of inquiry · Measurement · Validation

1 Introduction

Even before COVID-19, in higher education, enrollments in online courses have increased while enrollments in face-to-face courses have decreased (Seaman et al., 2018). As a result, online education has become an essential aspect of university-wide strategies for improving student experiences and retaining enrollment (Sanchez, 2020). However, online educators still struggle to improve retention

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rates in online courses and programs (McClendon et al., 2017), which is likely to become an even bigger problem as more students are forced to take some or all of their courses online (e.g., due to things such as pandemics, wars, or even simply course availability) despite preferring to take courses in an in-person face-to-face format. Research suggests that students struggle in online courses and online programs because of a lack of social presence (d'Alessio et al., 2019). At the same time, research also suggests that increasing a sense of social presence—that is, a sense that others are "real" and "there"—can help address feelings of isolation and in turn improve student success in online courses (Oregon et al., 2018; Rotar, 2020). Despite the potential of social presence to improve student retention and overall success, educational researchers continue to discuss the best way to operationalize and measure social presence (Lah & Tasir, 2018; Lowenthal & Dunlap, 2014; Lowenthal & Snelson, 2017; Richardson et al., 2017), with much debate around the Community of Inquiry (CoI) framework and its difference presences. The CoI framework has seen revisions in its recent past and has applied these changes to get a better understanding of social presence in blended courses and even in MOOCs (Alsayer, 2023; Ng et al., 2021; Wang et al., 2023), but the social presence construct has seen a lack of clarity in terms of both its structure (e.g., single vs. multiple factor outcomes; Stewart et al., 2021) and predictors of social presence (e.g., affective/emotional expression, open/interactive communication, and group/community; Maddrell et al., 2020). The purpose of this study was to address these gaps in the literature in a sample of students taking online courses in the U.S. The following paper presents the results of the study and its implications for future research and practice.

2 Background

2.1 The community of inquiry framework

Social presence theory dates to the work of Short et al. (1976). They were interested in the effect telecommunications media had on communication (Lowenthal, 2010). They defined social presence as the degree of salience—that is, the quality or state of being there—between communicators using a communication medium. However, social presence did not become a popular construct in online learning until Garrison, Anderson, and Archer's work on the Community of Inquiry during the late 1990s and early 2000s. Garrison et al. (1999) posited that a Community of Inquiry (CoI) involves a collaboration of learners who engage with course content through the interaction of three major elements: teaching, cognitive, and social presence. *Teaching presence* was conceptualized as primarily the completion of course construction tasks (e.g., design, topic structure, homework, actual distribution of course content in class, updating content, and developing formative assessments). *Cognitive presence* was conceptualized as the construction of knowledge, alongside the general sharing of information, association of related ideas, incorporation of feedback, and applying learned skills. Finally, *social presence*, which is the focus of this paper, was originally defined as the ability to present oneself to others as being a "real" person (Garrison et al., 1999). Garrison et al. conceptualized social presence as consisting of three

main categories: emotional expression, open communication, and group cohesion. Researchers, though, modified these categories over time depending on the focus of a given study. For instance, Rourke et al. (1999) labeled them as affective, interactive, and cohesive responses when focused on analyzing online course discussions, and then Arbaugh et al. (2008) later renamed them as affective expression, open communication, and group cohesion when focused on developing an instrument to measure students' perceptions (Arbaugh et al., 2008). Garrison et al. (1999) later defined social presence as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (p. 352). While these definitions are relatively consistent across research, concerns have been raised about the measurement of social presence and which indicators are essential to use to identify the construct. In the following sections, we will discuss the history of social presence and where these concerns arise.

2.2 Definition, history, and indicators of social presence

Definitions of social presence, even by Garrison, have varied over the years (see Lowenthal & Snelson, 2017). Early on, social presence was thought of as a psychological concept that was primarily related to concepts found in communication studies and, to some degree, was seen as a characteristic of a communication medium rather than a social context characteristic (Alanazi, 2019). Short et al. (1976), and other proponents of cues filtering-out theories (see Daft & Lengel, 1986; and Sproull & Kiesler, 1986) argued that this medium largely determined how people communicated and the subsequent degree of social presence. However, in the 1990s, Gunawardena (1995) challenged this notion by showing that social presence can be developed using text-based communication alone, thus suggesting that social presence was more dependent on the social context and people's communication skills than on any inherent constraints of a communication medium. Presently, the literature seems to suggest that the development of social presence stems most heavily from the social context (Garrison et al., 1999; Lowenthal & Dunlap, 2018; Richardson et al., 2016, 2017; Whiteside, 2015). This body of research suggests that the development of social presence depends on a host of different factors besides the communication medium itself. Furthermore, concerns have been raised about the various ways researchers continue to define and redefine social presence. As noted by Kreijns et al. (2022), a precise definition of social presence is presently under debate, and the measures which are currently being used may stem from various theories and frameworks that do not equivocally predict student outcomes, raising serious concerns about the utility of some of the social presence measures. Further noted by the researchers is that many aspects of the social presence construct initially emerged as a way to understand how people communicate in telecommunications, so the construct may be biased toward behaviors and processes that only exist in online contexts. Given this concern, the next section details how social presence arose in online learning, and how recent research has sought to resolve issues with the construct's measurement.

2.2.1 Role of social presence in online learning

Research has shown that, in online learning environments, social presence can lead to higher levels of organic social interaction (Kozan & Caskurlu, 2018; Oyarzun et al., 2018; Song et al., 2019). In fact, some researchers have found that student success in online learning requires some form of social collaboration with their peers (Cobb, 2009; Kim et al., 2015). Others have shown that learners are more likely to complete their courses with better grades when they possess a strong sense of social presence (Gregori et al., 2018; Liu et al., 2009). Conversely a lack of social presence has been shown to be related to poor learning outcomes (Lewis, 2019; McCreery et al., 2015; Song et al., 2019; Tu & McIsaac, 2002) and higher drop-out rates (Goodman et al., 2019; Lee & Choi, 2011; Levy, 2007; Li et al., 2019; Mancini et al., 2018; McClendon et al., 2017). Poor outcomes and high drop rates challenge not only online instructors (Trespalacios & Lowenthal, 2019), but also administrators involved with institutional planning and development. Findings like these continue to suggest and identify social presence as a prerequisite for many online learning outcomes.

Given the importance of social presence, researchers and practitioners have been interested in ways to measure and ultimately influence the development of social presence. Early on, Garrison et al. (1999) tried to find ways to better understand and identify social presence in computer conferencing (i.e., online discussions), although this measurement was primarily a coding process of looking for themes in qualitative data. Working from the literature, they made theoretical claims that social presence consisted of three previously mentioned categories: emotional expression (also called *affective expression*), open and interactive communication, and group cohesion. They used these categories to develop potential indicators of social presence in online discussions (Rourke et al., 1999). However, using content analysis to analyze online discussions was very time-consuming which led others to begin to develop surveys to measure perceptions of social presence, such as the scale developed by Hostetter and Busch (2006) which mixed Likert-scale responses with open-ended responses and was modified off of a similar scale by Richardson and Swan (2001). Another approach by Tu (2002) used the Computer-Mediated Communication questionnaire to approximate social presence, although this scale was not specifically designed to measure social presence. In 2008, recognizing the need to have a shared and common instrument and to build on the work of earlier researchers, Arbaugh et al. developed the Community of Inquiry (CoI) Questionnaire, which sought to establish the first set of agreed upon survey items to assess teaching presence, social presence, and cognitive presence. As will be noted below, there were issues with the initial rollout of the CoI Questionnaire as well.

While this was a positive step forward, researchers like Lowenthal and Dunlap (2014) identified problems with simply combining previous surveys, some of which were based on the earlier work of Gunawardena (1995; Gunawardena & Zittle, 1997) that focused more on immediacy than on social presence. For example, in the CoIQ, open/interactive communication metrics were designed to address this separation. For example, response options included "I felt comfortable conversing through the online medium"; "I felt comfortable participating in the course discussions"; "I felt comfortable interacting with other course participants" were found to center "too much on one's comfort level and not enough on one's ability or one's actual behavior

online as the indicators do" (p. 24). Lowenthal and Dunlap (2014) continued to point out other issues with the survey; however, the items they proposed have not yet been examined. In addition, the specific nature of the social presence construct remains to be fully clarified. Several researchers have questioned not only how we define and conceptualize social presence but also how we measure it and its proposed categories and indicators (Lim & Richardson, 2016; Lowenthal & Dunlap, 2014; Lowenthal & Snelson, 2017)—Lowenthal and Snelson (2020) even highlighted how some researchers conceptualize social presence in relation to the other two presences in the CoI framework, others do not. For instance, in one study, Stewart et al. (2021) had social presence items in the CoI load onto two separate factors, raising further concern about the reliability and validity of the scale as a single factor.

Contributing factors are another issue with the social presence construct. For example, while some posit that social presence is a higher-order construct indicated by certain lower-order constructs (Wertz, 2022), other research suggests that social presence could be considered an outcome variable predicted by certain predisposing factors, in this case affective/emotional expression, open/interactive communication, and group cohesion (see Kreijns et al., 2021). More specifically, Kreijns et al. (2021) note that social presence is likely closely related to certain constructs, such as sociability, yet distinct from those constructs, although this approach has yet to be adequately tested using affective/emotional expression, open/interactive communication, and group cohesion as such predictive factors. It should be noted that this approach has been utilized in other areas of the CoI framework as well, such as prior work exploring how cognitive presence is facilitated by certain factors (i.e., the Practical Inquiry Model; see Moore & Miller, 2022). This approach may be most useful for practitioners, as understanding which factors are the strongest predictors of social presence can help to guide instructional techniques in the online setting. In summary, clarity is still needed on the factors that are presumed to lead to social presence (e.g., affective/emotional expression, open/interactive communication, and group/community cohesion).

Therefore, a few gaps in the literature are increasingly clear. First, it is unclear if the previously used CoI social presence scale and subscale are internally consistent—in other words, should these factors truly be considered single factors, or will they separate in a manner analogous to that of Stewart et al. (2021)? Second, it has been proposed that affective/emotional expression, open communication, and group cohesion, are determinants of higher social presence. If this is the case, these factors should be strongly related to the social presence factor, but it is currently unclear which of these factors may be the strongest predictor, and therefore, hold the most importance for educational practitioners.

In response to recent concerns and investigations into the measurement and structural component of the CoI, we sought to answer the following research questions:

- First Research Question (Measurement): To what extent do affective/emotional expression, open communication, group cohesion, and social presence all relate to the observed responses on their respective indicators?
- Second Research Question (Structural): How strongly is the social presence construct indicated by affective/emotional expression, open/interactive communication, and group/community cohesion factors?

3 Methodology

We used Item Factor Analyses (IFA) and Structural Equation Modelling (SEM) to answer our research questions. As for the general research process, a series of courses were identified across the university, and instructors were notified to allow us to administer surveys to their students. Survey administration was done remotely, and participants completed the CoI questionnaire, alongside demographic items. Upon completion, survey data were pulled from Qualtrics and analyses began.

3.1 Validity and reliability

A valid instrument was needed to assess participants on the four latent constructs (i.e., affective/emotional expression, open communication, group cohesion, social presence; See Fig. 1). Prior work has suggested three modified items for this purpose (see Lowenthal & Dunlap, 2014). We elected to utilize these items to measure the predicting constructs: affective expression, open/interactive communication, and group cohesion. In addition, items were developed to measure the criterion construct of interest in this study, social presence, which incorporated relevant phrases from the definition of the social presence construct, including "*presence,*" "*real*," and "*salience*," in addition to phrases which summarize participant's ability to "*project*" within online environments.

We calculated McDonald's *omega* as a coefficient estimate to reflect the reliability of the four separate scales (Deng & Chan, 2017; Dunn et al., 2014; McDonald, 2013), as the omega coefficient is frequently used within the framework or SEM

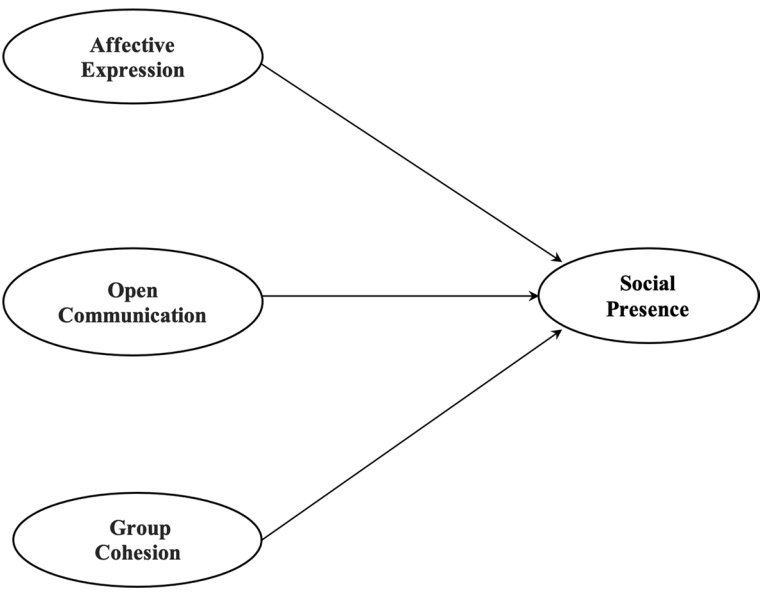

Fig. 1 Structural model

(Wirth & Edwards, 2007), and it minimizes the "risk of overestimation or underestimation of reliability" (p. 13). The reliability estimates produced by the omega method were then assessed for the four scales in the study (affective expression, interaction intensity, group cohesion, and social presence).

3.2 Measures

Thirty total items were administered to assess the constructs of interest. Six of these items measured the *affective expression* construct, seven items measured the *open communication* construct, six items measured the *group cohesion* construct, eight items measured the social presence construct, and three items measured demographic items for gender, age, and ethnicity. A 5-point Likert scale was used to score the 27 items across the four constructs (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neither Agree nor Disagree*, 4 = *Agree*, and 5 = *Strongly Agree*; *As seen in the Appendix*).

3.3 Data collection

The 30-item online instrument containing the four scales (affective expression, open communication, group cohesion, social presence) and demographic items was distributed to students who reported that they were taking online courses which were fully online (no hybrid method courses)—items were used from Lowenthal and Dunlap (2014). When data collection was completed, the sample size was over 200 observations, which provide sufficient power for statistical analyses (Barrett, 2007; Brown, 2015), data were exported, cleaned, coded, and analyzed using R version 4.1.2 (R Core Team, 2023). with the process employed commonly used software packages, including *lavaan* (used in Rosseel, 2012), *ggplot2* (used in Wickham, 2016), *haven* (used in Wickham & Miller, 2019), *and semPlot* (used in Epskamp, 2019).

3.4 Sample

The sample of analyzed data consists of 413 participants, all of whom took courses that were delivered completely online by institutions of higher education within the United States. Participants were approached via convenience sampling, with surveys distributed to students at a research institution in the Midwestern United States to collect data. The surveyed courses included multiple higher education courses in the school of education. Our total sample size vastly exceeded the classic "10 cases per variable" rule of thumb in SEM, as well as the minimum $N = 300$ threshold set by recent work for CFA and SEM approaches (Tabachnick & Fidell, 2013; Wolf et al., 2013). The participants had an average age of 25.33 years, with a standard deviation of ± 8.36 years. The majority of the sample were females (85.23%), and the majority of the sample was White/Caucasian (57.14%). A full description of the sample demographics is provided in Table 1.

Table 1 Sample description table

Variables	Category	*N*	Percentage
Gender	Females	352	85.23%
	Males	61	14.77%
Ethnicity	White/Caucasian	236	57.14%
	Black/African American	68	16.46%
	Hispanic	32	6.29%
	Asian/Pacific Island	26	7.74%
	Native American/Alaskan Native	7	1.69%
	Others	6	1.45%
	Multiple Ethnicities	38	9.2%

3.5 Data analysis

The current study used an IFA approach in order to address potential limitations with the measurement of social presence scales cited by prior research and a more general desire for robust measurement models. The sample exhibited a potentially non-normal distribution across the observed measures. This was addressed using a Diagonally Weighted Least Squares (DWLS) specification to analyze these categorical responses. Four indices were employed to assess the goodness of fit for these models, including: 1) Comparative Fit Index (CFI), 2) Tucker-Lewis Index (TLI), 3) the Root Mean-Square Error of Approximation (RMSEA), and 4) the Standardized Root Mean Square Residual (SRMR), where the chi-square (X^2) statistic and respective Degrees of Freedom (DF) were recorded for each separate model (Kline, 2015). However, the chi-square values were not used as a primary assessment of fit, given that there are "severe limitations" in its assumptions such as "multivariate normality" (see page 2 of Hooper, et al., 2007) and its well-known sensitivity to sample size (see Bentler & Bonett, 1980, as well as Bentler, 1990).

4 Results

4.1 IFA models

To ensure the consistency across the individual items arising from each scale, researchers estimated four IFA models with the DWLS estimator to assess model fit. The models, their fit indices, and the correlations between each pair of scale's items are presented along with figures to depict the IFA models.

4.1.1 Affective expression scale

In the model used for analyzing affective expression, researchers assessed an IFA model to ensure a proper evaluation of scale. After investigating the modification indices, it was shown that Items AffExp4 ("*I self-disclosed personal information about life outside of class"*) and AffExp5 ("*Others self-disclosed personal*

information in the course") required the addition of a residual covariance, given the extent to which items overlap in content about self-disclosure of personal information of the final values of the fit indices were calculated when the residual covariance was included. The results include: CFI = 0.998, TLI = 0.996, RMSEA = 0.071, SRMR = 0.034, and χ^2 (8) = 24.403. Each of the affective expressions was assessed using standardized factor loadings, which ranged in scale from 0.64 to 0.84 (the Appendix contains the table in its complete form). The affective expression scale exhibited an omega reliability estimate of 0.86. Table 2 reveals the relevant correlation coefficients, and Fig. 2 describes the IFA model used for the analysis.

4.1.2 Open communication scale

Another IFA was conducted for the open communication scale. The value of the indices indicating the final fit of the open communications coefficient estimates indicate a high degree of confidence. For example, the CFI value is 0.997, the TLI value is 0.995, the RMSEA value is 0.073, the SRMR value is 0.041, and the χ^2 (13) value is 41.657. The residuals produced by OpeCom3 ("*I felt comfortable participating in online threaded discussions*") and OpeCom4 *("I felt comfortable interacting with others*") were found to be correlated. This likely can be attributed to the overlap of both items in measuring the level of "*comfort*" in OLEs. The scale of standardized factor loadings arising from open communication ranges between 0.70 and 0.82 (the Appendix contains a complete table of these values). The estimated value for omega that reflects the open communication scale was 0.89. Table 3 lists these correlation coefficients and Fig. 3 illustrates the IFA model.

4.1.3 Group cohesion scale

A separate IFA model was applied to the group cohesion model. This included items GrCo5 and GrCo6 from among the group cohesion items ("*I referred to other participants by their first name.*" and "*Others addressed me by my first name*."). The correlated items were overlapping in content and used the participants' first names. The resulting coefficient estimates indicate a high degree of confidence. For example, the value of CFI is 0.999, the value of TLI is 0.997, the value of RMSEA is 0.071, the value of SRMR is 0.033, and the value of χ^2 (8) is 24.468. The scale of

Table 2 Affective expression correlation

	AffExp1	AffExp2	AffExp3	AffExp4	AffExp5	AffExp6
AffExp1	1					
AffExp2	0.674	1				
AffExp3	0.500	0.561	1			
AffExp4	0.425	0.457	0.512	1		
AffExp5	0.517	0.509	0.514	0.752	1	
AffExp6	0.483	0.441	0.402	0.394	0.473	1

All correlations in Table 2 are significant at $p < .05$

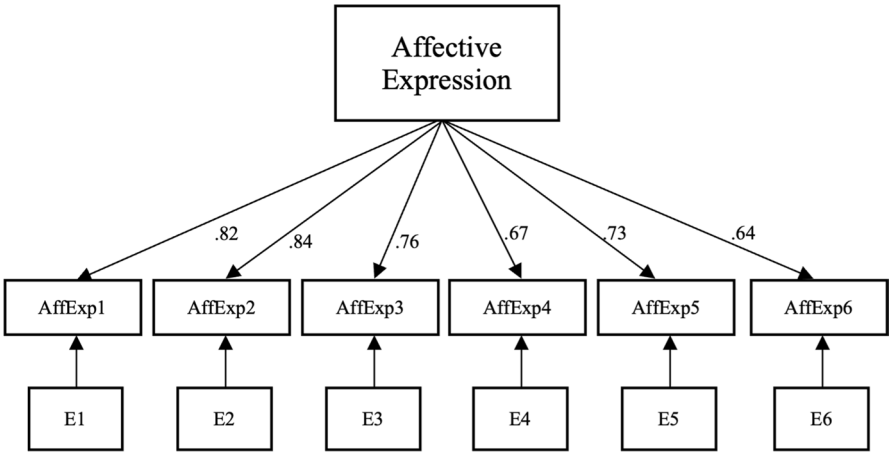

Fig. 2 Affective expression IFA model. Note: $N = 413$. AffExp = Affective Expression. Loading values are standardized

standardized factor loadings arising from group cohesion ranges between 0.69 to 0.92 (the Appendix contains a complete table of these values). The estimated value for omega that reflects the group cohesion scale was 0.89. Table 4 lists these correlation coefficients and Fig. 4 illustrates the IFA model.

4.1.4 Social presence scale

A final IFA was conducted for the social presence scale (see Fig. 5). Modification indices showed that item SP7 ("*I could easily project the participants' personal characteristics into the online course.*") and item SP8 ("*I was able to project course participants effectively into the online course.*") were likely related. This is likely due to both items questioning the participants' "projection" of the OLEs. This implies that there may be a covariance between the residuals of SP7 and SP78. The resulting coefficient estimates again indicate a high degree of confidence. For example, the value of CFI is 0.998, the value of TLI is 0.997, the value of RMSEA is 0.068, the value of SRMR is 0.036, and the value of χ^2 (19) = 55.473. The scale

Table 3 Open communication correlation

	OpeCom1	OpeCom2	OpeCom3	OpeCom4	OpeCom5	OpeCom6	OpeCom7
OpeCom1	1						
OpeCom2	0.578	1					
OpeCom3	0.481	0.604	1				
OpeCom4	0.446	0.585	0.777	1			
OpeCom5	0.351	0.465	0.534	0.589	1		
OpeCom6	0.494	0.588	0.521	0.538	0.505	1	
OpeCom7	0.462	0.501	0.553	0.504	0.522	0.584	1

All correlations in Table 3 are significant at $p < 0.05$

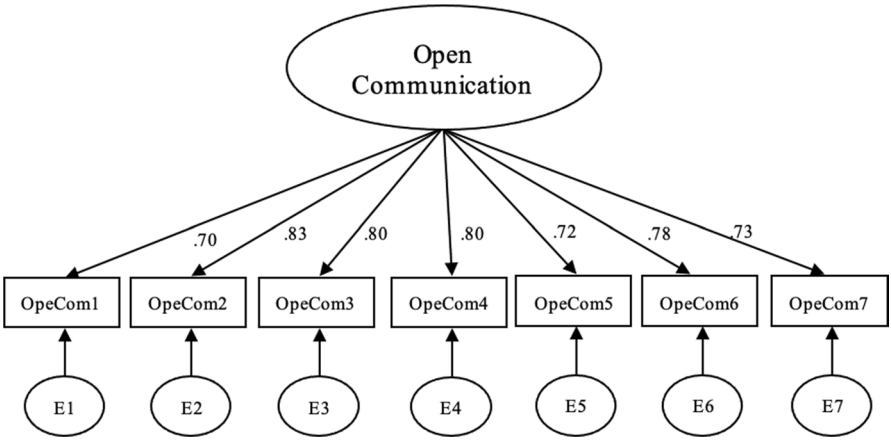

Fig. 3 Open communication IFA model. Note: $N = 413$. OpenCom = Open Communication. Loading values are standardized

of standardized factor loadings arising from social presence ranges between 0.59 to 0.89. The estimated value for omega that reflects the social presence scale was 0.91. Table 5 lists these correlation coefficients and Fig. 5 illustrates the IFA model.

The final measurement model investigated the links between the four latent constructs. The final model fit the data well: the value of CFI is 0.996, the value of TLI is 0.996, the value of RMSEA is 0.051, the value of SRMR is 0.044, and the value of χ^2 (314) is 651.983. Links between four constructs suggested moderate-to-high correlation coefficients ranging from 0.75 to 0.83. The three constructs of affective expression, open communication, and community cohesion are all highly correlated with the social presence construct. Specifically, an estimated r value of 0.79 ($p < 0.001$) implies that affective expression correlates positively with open communication. An estimated r value of 0.77 ($p < 0.001$) implies that effective expression also correlates positively with group cohesion. An estimated r value of 0.83 ($p < 0.001$) implies that affective expression correlates positively with social presence. Further, open communication correlates positively with both group cohesion ($r = 0.80$, $p < 0.001$) and social presence ($r = 0.76$, $p < 0.001$). Finally, group cohesion was linked with higher social presence ($r = 0.75$, $p < 0.001$). See Table 6 for correlation coefficients below.

Table 4 Group cohesion correlation

	GrCo1	GrCo2	GrCo3	GrCo4	GrCo5	GrCo6
GrCo1	1					
GrCo2	0.532	1				
GrCo3	0.575	0.772	1			
GrCo4	0.542	0.513	0.535	1		
GrCo5	0.495	0.589	0.587	0.452	1	
GrCo6	0.509	0.600	0.617	0.421	0.762	1

All correlations in Table 4 are significant at $p < 0.05$

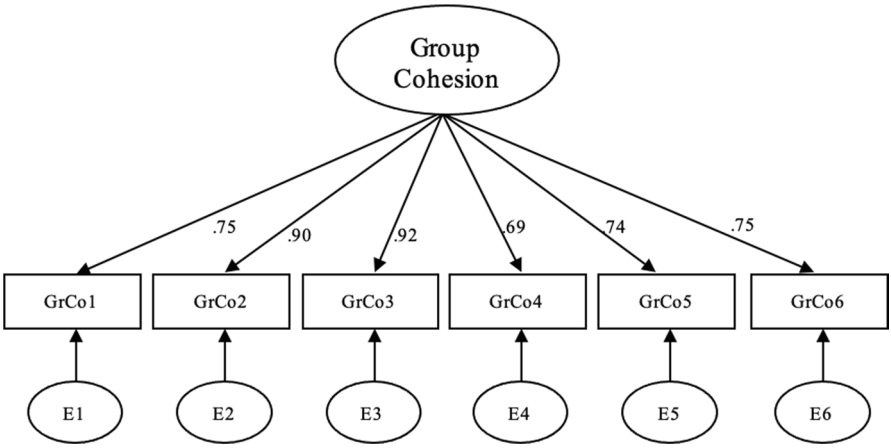

Fig. 4 Group cohesion IFA model. *Note:* $N = 413$. GrCo = Group Cohesion. Loading values are standardized

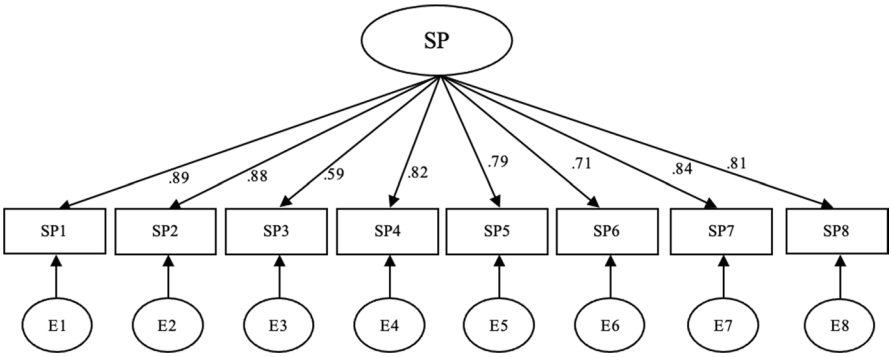

Fig. 5 Social presence IFA model. *Note:* $N = 413$. SP = Social Presence. Loading values are standardized. Full measurement model results

5 SEM results

An SEM analysis was conducted to verify that the measures provided by earlier researchers do, in fact, reflect the degree of social presence (see Fig. 6). This approach allows us to explore the potential structural relationships that may exist between social presence and these three constructs. Model fit indices showed that the three constructs fit well into one structural model, where all three factors predicted social presence (the value of CFI is 0.996, the value of TLI is 0.996, the value of RMSEA is 0.051, the value of SRMR is 0.044, and the value of χ^2 (314) is 651.983). The results indicate that these indices are consistent fit the data well (Brown, 2015; Kline, 2015). This evidence suggests that the construct of social presence is comprised of these measured constructs.

The links produced by the SEM imply that the strongest predictor of social presence is affective expression (ß = 0.546, $p < 0.001$), though it produces a moderate

Table 5 Social presence correlation

	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8
SP1	1							
SP2	0.762	1						
SP3	0.425	0.458	1					
SP4	0.615	0.636	0.467	1				
SP5	0.565	0.572	0.463	0.663	1			
SP6	0.506	0.556	0.430	0.570	0.537	1		
SP7	0.710	0.691	0.381	0.611	0.573	0.572	1	
SP8	0.665	0.600	0.434	0.614	0.621	0.551	0.761	1

All correlations in Table 5 are significant at $p < 0.05$

Table 6 Constructs' correlation table

	SP	AffExp	OpeCom	GrCo
SP	1			
AffExp	0.83	1		
OpeCom	0.76	0.79	1	
GrCo	0.75	0.77	0.80	1

effect. The results indicate that a one standard deviation (SD) increase in affective expression is associated with a 0.546 SD increase in social presence. In addition, the other two predictors of the model indicate significant yet objectively smaller influences. For example, open communication appears to be positively correlated with social presence (ß = 0.181, $p = 0.014$). The results indicate that a 0.181 SD increase in social presence increases the value of open communications by one SD. After analyzing this model, we can infer that a higher the level of interaction within the online community is likely to produce a higher social presence among learners.

Lastly, the cohesion of the online community is used as the third predictor in the SEM model. This last predictor also produces a statistically significant predictor of social presence in online learning environments (ß = 0.182, $p = 0.006$). This indicates that cohesion exerts a moderate impact on social presence, where a single SD increase in community cohesion increases social presence by 0.182 SD. All these three indicators are positively related to overall social presence in online learning environments. Finally, the three indicators explain 72.8% of the variance in social presence. To summarize, the factors of affective expression, community cohesion, and open communication in the course are all significantly linked to higher levels of social presence in online educational settings. Figure 6 below depicts the structural relationships.

6 Discussions

Prior to the current study, research was lacking in how to effectively measure social presence scales. Fully understanding the underlying constructs requires a comprehensive validation approach. However, such robust analysis appears to be lacking in

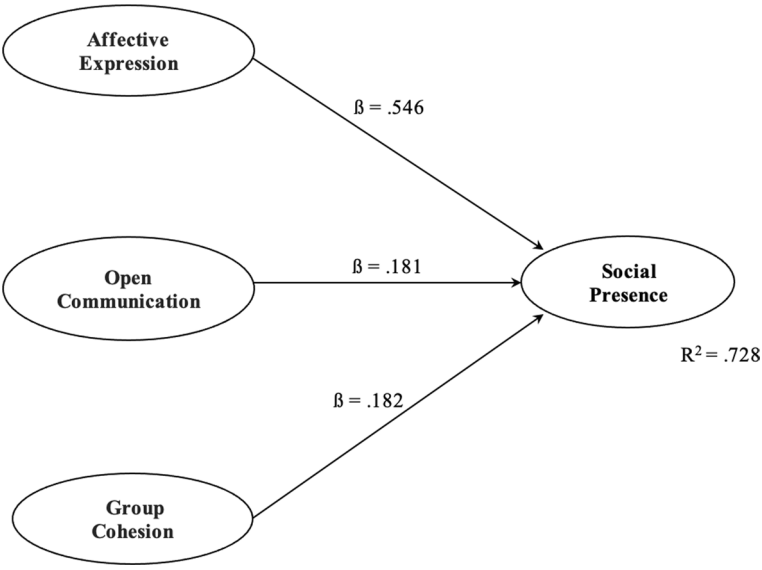

Fig. 6 Social presence structural model. *Note:* $N = 413$. Beta values are standardized

the literature. While a recent paper does look to analyze the effect of social presence on course outcomes, this work uses a highly complex social network approach to measuring social presence which involves data sources that are not easy to collect (log and social network data; Norz et al., 2023). Therefore, the current study uses scale items proposed by prior research to address this general measurement question, developing empirical measurement of the measures found in Lowenthal and Dunlap (2014) who recommended that the CoI scale be revisited and revalidated over time (this recommendation has been taken up by recent work; e.g., Heilporn & Lakhal, 2020). The results derived from our IFA models imply that social presence construct metrics appear to fit well together. Descriptions that included keywords from discussions of social presence appearing in past literature, like "*presence,*" "*real*," and "*salience*," and references to course participant abilities to "*project*" within their online environments, were found to effectively comprise the social presence measure. This result was based on high confidence levels of various model fit indices that have been suggested in the psychometrics literature (including Brown, 2015; Kline, 2015; Maydeu-Olivares & Joe, 2014).

When analyzing any links between these constructs, we found that all of the constructs were positively related to one another, though evidence of multicollinearity (two measures appearing to measure the same construct) was not found. In other words, the modest correlations found (what many would consider adequate strength of correlations) suggest that these constructs are related to one another, but can be considered unique factors in the social presence literature from this point forward. Furthermore, in the IFA models, the authors did not allow for cross-loading items, providing further evidence for the unique contributions of each item to its respective construct.

6.1 Affective expression

In the structural model, the affective expression construct was the strongest predictor of social presence. In the formulation of the current project, prior research on defining social presence (such as in Rourke et al., 1999 or Garrison et al., 1999) describe how social presence simply cannot be fully defined without including an emotional element. For example, Rourke et al. (1999) defined social presence as "the ability of learners to project themselves socially and emotionally in a community of inquiry" (see p. 4). The first category used by Garrison et al. (1999) to create a taxonomy of social presence was "*Emotional Expression,*" with the primary metric being "*Emotions*" (see p. 3). Other researchers such as Akyol and Garrison (2008), Argo, et al. (2005), Ekman et al. (2012), c, Shen, et al. (2010), and Tu (2002) continued to support the claim that emotional components were needed in order to fully understand social presence. These discussions used different approaches for understanding emotions in social presence, such as through discussions of immediacy (e.g., Tu, 2002) or intimacy, but emotional components do seem to be needed in the definition.

In an applied sense, this work suggests that online learners can develop social presence if they report that they have formed clear impressions of their classmates, have felt they could project their self-image into the online course, can express their emotions; within the course setting, are able to disclose information about themselves, and can use humor to a certain extent in their course (more on this below). These reports are critical in understanding the development of social presence in courses.

6.2 Open communication

Open communication has been reiterated as a predictor of social presence for many years at this point, as it addresses the ability to openly interact and collaborate with other classmates in online settings. In the current research, this construct measured the communication of both positive and negative aspects (e.g., agreement and disagreement,), alongside a general sense of comfort, a capacity to connect with other participant's course content/contributions and being able to interact without disruption with other classmates. The importance of this aspect of online courses has been discussed recently (Fiock, 2020).

6.3 Group cohesion

This indicator, in the current research, intended to refer to the extent which online communities reported a sense of cohesiveness and connection to one another—this factor did, unsurprisingly, emerge as a significant predictor in our SEM. Prior work, such as Eggins and Slade (1997) and Rourke et al. (1999) find empirical evidence that such a construct is correlated with the affective components of a course (which was originally labeled *affective responses* or *emotional expression*; Lowenthal & Dunlap, 2014).

In an interesting addition to this work, Eggins and Slade (1997) suggested that humor may play a meaningful role in critical discourse, implying that the ability to engage with humor in a course might elicit higher levels of cohesion. They posited that this was because cohesive groups feel comfort to joke around with each other, engaging in

forms of banter, and using other "fun" communication strategies to try and communicate important messages. These approaches are likened to how people communicate outside of the classroom allowing differences between group community to be presented casually, rather than perceived as classroom confrontations. This protects the cohesion of the group or the meaningful connections that exist between group members (see page 14).

Thus, group cohesion can be seen as a manifestation of enhanced communications and collaborations occurring among peers, achieved through various communications avenues. These may include both formal and informal greetings/salutations, referring to the group as "we", reporting a broad sense of unity within the group, and using first names to refer to other classmates. In addition to this, humor may facilitate the community of online learners' ability to develop social presence by permitting the disclosure of personal information like experiences and personal anecdotes.

It is important to note that one potential limitation of the current research is the lack of analyses regarding gender and ethnic differences. It is certainly of interest to consider that men and women may have different reactions to the online environment, especially considering a general lack of consensus on whether men and women differ in online courses. For example, Park and Kim (2020) found the gender moderates the link between tool selectivity and course satisfaction (e.g., Park & Kim, 2020), although Harvey et al., (2017) found no evidence for gender differences in online course satisfaction. Future work should consider exploring these potential differences in regard to social presence, as well as similar possibilities for ethnic groups.

7 Conclusion

The main purpose of this research was to evaluate modified and proposed items of the social presence categories as part of the CoIQ to measure the indicators of social presence, and to develop a scale for social presence itself based on the definitions stated in the literature. The items within the four constructs demonstrate appropriate correlation coefficients with different predicted values (See Appendix). As a result of the analyzed measurement and structural models, emotional expression appeared to be the most presented indicator that depicts and affects the degree of social presence in fully online learning environments, whether those aspects are individually delineated or as a combined whole of social presence. These findings suggest that online learners can develop social presence if they are able to be their authentic selves in the classroom, expressing their emotional responses to content. This has clear implications for instructors to build space for students to have natural responses to the content in class. While the current findings are limited in that they do not reveal potential gender and ethnic differences in the CoI framework, it does provide a roadmap for educational institutions to emphasize certain important aspects of their online courses and clarifies the importance of social presence in these goals.

The authors believe that as the potential for further classification within social presence may occur, the measurement tools utilized by future research will show that no matter the definition, social presence within an online learning community remains a vital part of the desired educational outcomes.

Appendix

Item Code	Item Text	Std. all
Affective expression Scale		
AffExp1	I formed distinct impressions of some course participants	0.82
AffExp2	I projected who I am to other course participants	0.84
AffExp3	I expressed emotions in this course	0.76
AffExp4	I self-disclosed personal information about life outside of class	0.67
AffExp5	Others self-disclosed personal information in the course	0.73
AffExp6	We used humor in this course	0.64
Open communication Scale		
OpeCom1	I expressed agreement or disagreement with others or the content of others' messages	0.70
OpeCom2	I complimented others or the content of their messages	0.83
OpeCom3	I felt comfortable participating in online threaded discussions	0.80
OpeCom4	I felt comfortable interacting with others	0.80
OpeCom5	I received answers to the questions I posed	0.72
OpeCom6	I directly referred to the content of others posts	0.78
OpeCom7	Others communicated effectively using online communication tools (e.g. threaded discussions, email, and instant messaging)	0.73
Group Cohesion Scale		
GrCo1	I was able to develop a sense of collaboration with my peers	0.75
GrCo2	I used greetings and salutations	0.90
GrCo3	Others used greetings and salutations	0.92
GrCo4	I addressed the group using inclusive pronouns such as "we"	0.69
GrCo5	I referred to other participants by their first name	0.74

Item Code	Item Text	Std. all
GrCo6	Others addressed me by my first name	0.75
	Social Presence Scale	
SP1	I was able to feel other participants' personality in the online course	0.89
SP2	I thought other people could feel my presence in the online course	0.88
SP3	We felt the presence of the instructor in the online course	0.59
SP4	I felt that other participants were present in the online course	0.81
SP5	I perceived participants as 'real' people in online course	0.79
SP6	The course participants were salient in the online course	0.71
SP7	I could easily project the participants' personal characteristics into the online course	0.84
SP8	I was able to project course participants effectively into the online course	0.81

Data availability The datasets analyzed during the current study are available from the author on reasonable request.

Declarations

Conflict of interest None.

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