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Investigating Effects of Telepresence and Social Presence in Online Courses

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ABSTRACT

While online learning has become a pivotal component of higher education, little research attention has been paid to understanding and dealing with the challenges of online learning. In this study, we aim to better understand the impact of communication technology on online learning in terms of telepresence and social presence, noting in particular that telepresence is unique to online learning environments and absent in face-to-face settings. This study proposes a research model to explore how interactive communication technology can drive telepresence and social presence and how those presences are associated with engagement and satisfaction in online learning. Data were collected from online business analytics courses in which interactive communication technology was required for class communication and collaboration. Results show that telepresence and social presence, driven by interactive communication technology, significantly impact engagement and satisfaction in online learning, and the effects of telepresence are fully mediated by social presence. The study also reveals that gender moderates the relationship between telepresence and social presence. These findings contribute to the literature by identifying telepresence and social presence as key factors for improving online learning experiences and outcomes.

Keywords: Telepresence, Social presence, Online learning, Gender disparities

1. INTRODUCTION

Online learning has become a pivotal component of higher education. According to the National Center for Education Statistics (n.d.), 54% of undergraduate students in the United States—approximately 10 million individuals—were enrolled in at least one online course as of fall 2022. Despite the growing popularity of online learning, research indicates that it may not be as effective as traditional in-person instruction (Munoz-Najar et al., 2021). For example, Bettinger et al. (2017) point out that interactions in online learning are different from those in in-person courses. Students may perceive fewer interactions in online learning because peers and professors are not physically present in the same classroom (Wu et al., 2022). This

perceived lack of presence may negatively affect student learning experiences or outcomes, such as engagement and satisfaction in online learning.

In this study, we identify presence as a key component that makes online learning (where students and instructors are typically located in separate spaces and connected through remote mediums) different from traditional face-to-face learning (where students and instructors are present together in the same physical space). Then, we empirically investigate how the perception of presence is related to the technology used and its impact on online learning. More specifically, this study attempts to examine the drivers and effects of presence in online learning. We also explore the relationship between distinct types of presence and the moderating role of gender in online learning. Thus, we pose the following research questions.

- How can we improve presence in online learning environments? More specifically, what technology characteristics can enhance telepresence and social presence?
- How do telepresence and social presence contribute to student engagement and satisfaction in online learning?
- Does gender play a role in the relationship between telepresence and social presence?

To answer these questions, we propose a comprehensive research model that investigates the role of technology interactivity in shaping two distinct forms of presence (i.e., telepresence and social presence) and their collective impact on student engagement and satisfaction in online learning. This study aims to clarify two critical aspects in online learning: (1) how telepresence and social presence facilitated by interactive communication technology can enhance student learning experiences and outcomes in online learning, and (2) how gender differences influence the relationship between telepresence and social presence in online learning.

The paper proceeds as follows. We first introduce the theoretical foundation, followed by the research model and associated hypotheses. Next, we describe the research method, present data analysis, and discuss the corresponding results. Finally, we highlight the implications of our findings for both research and practice, acknowledge the limitations of our study, and outline potential avenues for future research.

2. THEORETICAL BACKGROUND AND HYPOTHESES

2.1 Presence and Technology

Presence is defined as "a perceptual illusion of nonmediation in which the medium appears to become either invisible, or transformed into a social entity" (Lombard & Ditton, 1997, Causes of Presence as Transformed Medium section). Some researchers have suggested that presence consists of two interrelated phenomena: telepresence and social presence (Algharabat et al., 2018; Biocca et al., 2003). Telepresence can be defined as the extent to which one feels present in the mediated environment rather than in the immediate physical environment (Steuer, 1992). When people experience strong telepresence, they are no longer aware that their experiences are mediated through technology (Lombard & Ditton, 1997). According to Lowenthal and Snelson (2017), social presence may include multiple facets, such as "projecting" as the ability of learners to project themselves socially and affectively into a community of inquiry (Rourke et al., 1999); "connecting" as the degree of feeling, perception, and reaction of being connected on computer-mediated communication to another intellectual entity (Tu, 2002); and "belonging" as a student's sense of belonging in a course or group and the ability to interact with an instructor and other students (Picciano, 2002). Thus, while telepresence is more closely associated with the sense of "being there," social presence refers to the sense of "being together." Indeed, Kreijns et al. (2022) define social presence as "the psychological phenomenon in which, to a certain extent, the other persons are perceived as physical 'real' persons in technology-mediated communication" (p. 141). In online learning, students may experience both telepresence and social presence by interacting with instructors and peer students through learning technology.

Various approaches have been proposed to conceptualize the notion of "presence" in learning environments. The Community of Inquiry (CoI) framework, in particular, emphasizes the creation of deep and meaningful learning experiences through the interplay of three core elements: social presence, cognitive

presence, and teaching presence (Garrison et al., 1999). While the CoI framework primarily addresses these presences in relation to the overall learning experience, our approach distinguishes between telepresence and social presence to examine how presence is experienced specifically in interactions with computer-mediated technologies. In this study, we focus on how learners perceive and interpret different forms of presence (i.e., telepresence and social presence) when engaging with communication technologies in online learning environments.

Interactivity, as one of the key characteristics of communication technology, has been discussed as a contributor to the sense of telepresence in the literature (Kim & Ko, 2019; Leiner & Quiring, 2008). For example, Lim and Ayyagari (2018) found that a high degree of interactivity led to higher perception of telepresence in e-channels. Kang (2020) found that virtual reality in a head-mounted display creates stronger telepresence compared to 2D screens, indicating that more interactive media create stronger telepresence. Further, Khalifa and Shen (2004) conducted an empirical study demonstrating that interactivity significantly influences telepresence within a virtual community in which registered members exchanged health-related information through online discussion forums—a context closely analogous to that of online learning environments.

The relationship between interactivity and social presence has also been discussed in the literature. Gunawardena (1995) posited that the perception of interactivity in an online setting leads to the emergence of social presence. This suggests that greater perceived interactivity in online interactions increases the likelihood of experiencing social presence. Tu and McIsaac (2002) also found that interactivity positively impacts social presence and argued that a lack of interactivity could result in a reduced sense of social presence, indicating that the level of perceived interactivity plays a crucial role in shaping the extent of social presence in online interactions. Park and Kim (2020) empirically tested and confirmed the effect of interactivity on social presence in an online learning environment. In this study, we argue that the interactivity of the communication technology used in online learning positively affects both telepresence and social presence. Thus, we state the following hypotheses.

H1: Interactivity of the communication technology positively affects telepresence in online learning.

H2: Interactivity of the communication technology positively affects social presence in online learning.

While telepresence (i.e., perception of being in a place) and social presence (i.e., perception of being with others) have been discussed together in various fields, including psychology, education, communication, and computer science (Lee, 2004), there has been little research on their causal relationship. Oh et al. (2018) reviewed 152 studies on perceived social presence and attempted to provide a holistic understanding of the most influential features in predicting social presence. According to their findings, communication modalities, such as teleconferencing, which serve as a medium for telepresence, were related to perceived social presence. Choi and Kwak (2017) found that participants felt a sense of social presence when they were communicating with remote partners via a telepresence robot. Building upon the existing literature indicating a positive relationship between telepresence and social presence in various contexts, we propose that this relationship holds true in the context of online learning. Due to the limited empirical research on this relationship within an online learning environment, however, it is essential to test and validate the interplay between telepresence and social presence in the context of online learning. The exploration of this relationship will contribute to a deeper understanding of the factors influencing social presence and student learning experiences in online learning. Thus, we state the following hypothesis.

H3: Telepresence positively affects social presence in online learning.

2.2 Presence and Online Learning

Previous studies have introduced the concept of instructor or teacher presence and examined its influence on student learning experiences in online education (Gray & DiLoreto, 2016; Hackman & Walker, 1990). Zilka et al. (2018) found a positive relationship between instructor/teacher presence and social presence, both of which contributed to reduced transactional distance in virtual and blended learning environments. Consequently, instructor presence and social presence have been conceptualized as distinct yet interrelated

dimensions of presence in online learning contexts. This study specifically focuses on social presence and its role in online learning.

The relationship between social presence and engagement has been discussed in the literature. According to Tu and McIsaac (2002), social presence positively affects interaction among students and with an instructor in online classes, which is one of the major engagement activities in online learning (Swan, 2001). While social presence and its impact on engagement have been empirically studied, telepresence has received little research attention in the online learning literature. This is because telepresence was examined as part of the social presence concept, not as a separate presence. For example, Tu and McIsaac's (2002) study adopted intimacy and immediacy as two defining concepts of social presence and found that both concepts influenced interactions in online learning. While intimacy reflects the sense of being together with an instructor and other students (i.e., social presence), immediacy, as a measure of the psychological distance driven by the communication medium, is aligned with the sense of being there in a computer-mediated communication environment (i.e., telepresence). Thus, their findings may imply that both telepresence (i.e., immediacy) and social presence (i.e., intimacy) affect engagement in online classes, and we state the following hypotheses.

H4: Telepresence has a positive impact on engagement in online learning.

H5: Social presence has a positive impact on engagement in online learning.

Satisfaction is a fundamental metric for evaluating student learning success or outcomes across diverse educational contexts. Mohammadi (2015) defined satisfaction as the extent to which learners perceive that their specific needs, goals, and desires have been fulfilled in the learning environment. For example, Wu et al. (2010) investigated how performance expectations and learning climate influenced student satisfaction as the outcome variable in a blended learning environment. Dang et al. (2016) adopted satisfaction to assess student learning success in the education context.

The effect of presence on student satisfaction has been studied in the online learning literature. Akyol and Garrison (2008) investigated the effects of distinct types of presence, such as social, cognitive, and teaching presence, in online learning and found that those presences were positively associated with perceived learning and satisfaction in an online course. Additionally, Dang et al. (2025) examined the key factors influencing learning effectiveness and satisfaction in business analytics courses and found that teaching presence has a positive impact on student satisfaction. Although teaching presence is a concept developed in the education field, it serves as the primary means of communication in a computer-mediated communication environment (Garrison et al., 2010). This concept aligns with our understanding of telepresence in the context of online learning. A study by Maddrell et al. (2017), which examined graduate students across five online courses, further supports the significance of presence in online learning. Their findings revealed that presence, presumably referring to social presence within the online context, emerged as a significant predictor of student satisfaction. In this study, we attempt to examine the effects of both telepresence and social presence on student satisfaction in online learning. Thus, we posit that:

H6: Telepresence has a positive impact on satisfaction in online learning.

H7: Social presence has a positive impact on satisfaction in online learning.

Bomia et al. (1997) defined student engagement as a student's willingness, need, desire, and compulsion to participate in and be successful in the learning process. Prior research shows that engagement is positively associated with student satisfaction. For example, Lane et al. (2021) found that engagement was a reliable predictor for satisfaction and performance in blended-learning classes. Similarly, Rajabalee and Santally (2021) analyzed student feedback in an online course and reported a significant relationship between engagement and satisfaction. Thus, we state the following hypothesis.

H8: Engagement has a positive impact on satisfaction in online learning.

2.3 Presence and Gender

Prior research suggests that gender could influence the experience of both telepresence and social presence (Lombard & Ditton, 1997). More specifically, Felnhofer et al. (2014) found that men tend to experience a

higher level of telepresence compared to women. Bailenson et al. (2003) also reported the possibility of gender differences in social presence. To the best of our knowledge, however, there is currently no existing research that proposes and empirically tests the role of gender in the relationship between telepresence and social presence in online learning environments. This study aims to address this research gap by examining whether gender moderates the relationship between telepresence and social presence in online learning environments.

Gender as a moderator has been studied in the technology adoption literature. In their development of the unified theory of acceptance and use of technology, Venkatesh and his colleagues found and confirmed that performance expectancy, defined as the degree to which individuals believe that using technology will enhance their job performance, tends to be more salient for men (Venkatesh et al., 2003; Venkatesh et al., 2016). Based on this finding, we can speculate that male students are more likely to believe that technology-driven telepresence would positively impact their performance in online learning. They also found that men tended to be more task-oriented, i.e., more focused on task accomplishment (Venkatesh et al., 2003; Venkatesh et al., 2016). In online learning, we postulate that the facets of social presence (i.e., connecting, belonging, and projecting) are tasks that students seek to accomplish. From the literature, we can speculate that male students, compared to their female counterparts, are more inclined to establish social presence because they focus more on the accomplishment of task-related aspects of social presence, such as establishing connections, fostering a sense of belonging, and projecting their identities in online learning. This study explores the moderating role of gender in the relationship between telepresence and social presence in online learning and states the following hypothesis.

H9: The positive effect of telepresence on social presence is stronger for men than for women.

The schematic diagram in Figure 1 depicts the research model with all nine hypotheses.

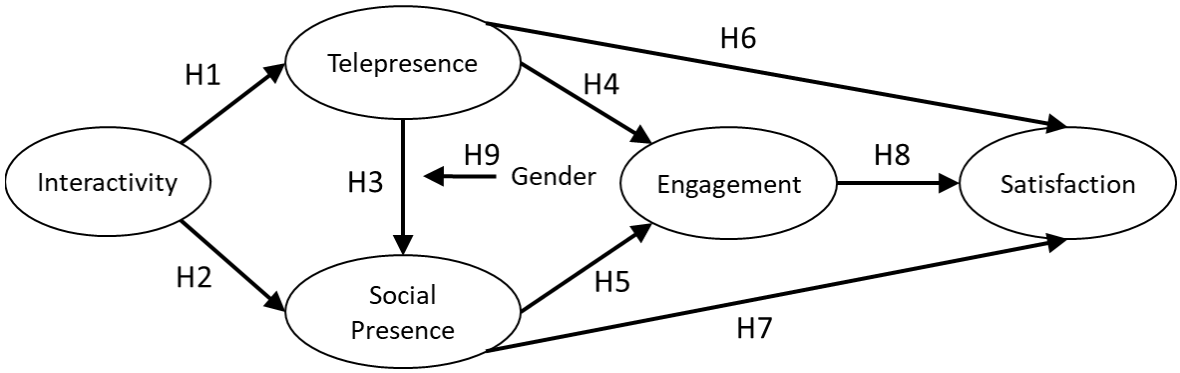

Figure 1. Research Model and Hypotheses

3. RESEARCH METHOD

3.1 Study Site

Data for this study were obtained from two online business analytics courses required for all business students at a public college in the southeastern United States. These courses focus on Microsoft Excel as a primary tool. The first course, designed for sophomores, utilizes Excel for various statistical computations and data visualization. The second course, designed for juniors, covers more advanced Excel techniques to solve business problems, such as pivot tables, Power BI visualization, simulation, and optimization.

To facilitate the learning process, both courses relied on instructor-created videos that explained concepts and Excel skills. Before attempting the homework assignments, students were instructed to watch these videos. Moreover, students were encouraged to interact with the instructor regularly while viewing videos and completing assignments to receive feedback and clarifications.

To foster faster response times and enhance interactive communications, the courses utilized Microsoft Teams as the primary platform for class-related discussions and interactions. Microsoft Teams is a comprehensive platform for workplace communication and collaboration, integrating various features such as chat, meetings, note-taking, and file attachments (Microsoft, n.d.). During the pandemic, the use of many online communication technologies, including Microsoft Teams, grew rapidly. For example, Microsoft revealed that the daily active users of Microsoft Teams increased by over 50% in six months to 115 million in October 2020 (Warren, 2020). Many courses in the college were converted to an online modality during the pandemic, and online communication technologies, such as Microsoft Teams or Zoom, were used to facilitate online course delivery. Students who responded to our survey had experience with these online communication technologies.

The instructor used Microsoft Teams to create a class site that served as the hub for announcements and collaboration. Messages posted were visible to all, fostering open and interactive discussions. Every week, the instructor posted a summary of the learning materials and activities in a designated weekly attendance post. Students were required to respond to this post, and their engagement was considered part of their weekly attendance, contributing to their overall grade. Beyond the class team site, students had the opportunity to interact with the instructor through the chat feature in Microsoft Teams. This interaction occurred either synchronously or asynchronously, offering flexibility for students to seek assistance or discuss course-related matters.

A notable feature frequently employed during the semester was the option for students and the instructor to hold online meetings. These virtual meetings allowed effective troubleshooting and in-depth discussions. Particularly, the screen-sharing capability was utilized to demonstrate and observe the practical use of Microsoft Excel. In summary, Microsoft Teams played a crucial role in facilitating communication, engagement, and collaboration between the instructor and students, enhancing the overall learning experience in both courses.

3.2 Procedure and Measures

We employed the survey method to collect data to test the hypotheses. The survey was conducted a week before the end of the semester to ensure that students had sufficient experience with the communication technology used for class interactions. To encourage voluntary participation, extra credit was offered as an incentive. The online surveys were distributed to 119 students enrolled in online business analytics courses. Five responses were excluded due to incomplete questionnaires, resulting in a final response rate of 95.8% with 114 completed responses (50 female, 64 male). Given the high response rate, non-response bias is unlikely to have significantly impacted the results.

To minimize potential measurement bias, validated instruments from previous studies were adopted (Nargundkar & Shrikhande, 2014). Specifically, to assess the interactivity of the technology, six measurement dimensions of perceived user-to-system interactivity developed by Leiner and Quiring (2008) were used. Telepresence was measured using five items from Klein (2003) and Nah et al. (2011), and social presence using four items from Gefen and Straub (2004) as well as Shen and Khalifa (2008). To assess engagement, four items from the absorption subscale of the Utrecht Work Engagement Scale (Schaufeli et al., 2002) were used. Lastly, satisfaction was measured with three items from Dang et al. (2016). All items were rated on a five-point Likert scale. A comprehensive presentation of the measurement items for each construct and their descriptive statistics appears in the Appendix.

4. ANALYSIS AND RESULTS

We used partial least squares (PLS) analysis with SmartPLS 4 to validate the measurement model and estimate structural paths. PLS computes optimal linear relationships between latent variables, first estimating indicator loadings and then determining causal relationships among constructs. PLS is preferred over other traditional methods, such as factor analysis and regression, because it assesses both measurement and structural models (Gefen et al., 2000). PLS is also preferred for research exploring how to understand variation in the dependent variable explained by the independent variables, rather than for research focused

on the goodness of fit between the model and data (Gefen et al., 2000; Petter, 2018). We use PLS because this study has an exploratory nature, focusing on the relationships between independent and dependent variables, and PLS allows analysis of a research model with multiple factors and paths in one unified process.

4.1 Measurement Model

In the measurement model, we evaluated both convergent and discriminant validity by examining the psychometric properties of the measures. For convergent validity, we examined standardized loadings for each factor. Standardized loadings should be greater than 0.70 to ensure that the shared variance between each item and its associated construct exceeds the error variance (Hair et al., 2009). Table 1 shows that the standardized loadings for all measurement items exceed the 0.7 threshold.

To evaluate the internal consistency of each construct, we conducted an assessment using Cronbach's alpha, composite reliability, and average variance extracted (AVE). While there are no absolute threshold values for Cronbach's alpha and composite reliability, it is generally accepted that values of 0.7 or higher indicate strong evidence of reliability (Hair et al., 2009). As depicted in Table 1, all constructs in the measurement model demonstrated Cronbach's alpha and composite reliability scores of 0.858 or higher, indicating excellent reliability. We also evaluated AVE as a measure of construct validity, which assesses the extent to which variance obtained from indicators is attributable to the construct rather than measurement error (Fornell & Bookstein, 1982). An acceptable level for AVE is considered to be 0.5 or higher, meaning that at least fifty percent of the variance in the indicators is accounted for by their respective constructs (Chin, 1998). In this study, all AVE values surpassed 0.5. Thus, all values in Table 1 indicate strong convergent validity.

Construct	Item	Standardized loading	Cronbach's alpha	Composite reliability	AVE
Interactivity	INT1 INT2 INT3 INT4 INT5 INT6	0.831 0.848 0.841 0.843 0.792 0.821	0.910	0.930	0.689
Telepresence	TP1 TP2 TP3 TP4 TP5	0.890 0.930 0.925 0.892 0.877	0.943	0.956	0.815
Social Presence	SP1 SP2 SP3 SP4	0.844 0.862 0.807 0.923	0.882	0.919	0.740
Engagement	ENG1 ENG2 ENG3 ENG4	0.820 0.861 0.854 0.814	0.858	0.904	0.701
Satisfaction	SAT1 SAT2 SAT3	0.969 0.967 0.955	0.962	0.975	0.929

Table 1. Construct Analysis

To assess discriminant validity, we employed two tests. First, we calculated the loading of each item

on its corresponding construct and compared it with the cross-loadings on all other constructs. As shown in Table 2, each indicator exhibited a higher loading with its intended construct than with any other constructs, confirming satisfactory discriminant validity. In addition, each block of indicators for each construct showed higher loadings on their own intended construct than the indicators from other constructs.

Construct	Item	1	2	3	4	5
1. Interactivity	INT1	**0.831**	0.423	0.503	0.324	0.484
	INT2	**0.848**	0.416	0.514	0.307	0.459
	INT3	**0.841**	0.439	0.596	0.434	0.403
	INT4	**0.843**	0.327	0.513	0.364	0.325
	INT5	**0.792**	0.255	0.442	0.296	0.277
	INT6	**0.821**	0.424	0.579	0.415	0.438
2. Telepresence	TP1	0.448	**0.890**	0.608	0.287	0.566
	TP2	0.467	**0.930**	0.656	0.351	0.598
	TP3	0.445	**0.925**	0.682	0.407	0.582
	TP4	0.368	**0.892**	0.630	0.297	0.505
	TP5	0.371	**0.877**	0.592	0.275	0.452
3. Social Presence	SP1	0.475	0.604	**0.844**	0.431	0.556
	SP2	0.498	0.625	**0.862**	0.410	0.620
	SP3	0.650	0.520	**0.807**	0.463	0.671
	SP4	0.562	0.668	**0.923**	0.484	0.699
4. Engagement	ENG1	0.399	0.233	0.420	**0.820**	0.467
	ENG2	0.381	0.374	0.489	**0.861**	0.573
	ENG3	0.337	0.313	0.428	**0.854**	0.498
	ENG4	0.338	0.278	0.400	**0.814**	0.432
5. Satisfaction	SAT1	0.459	0.579	0.702	0.578	**0.969**
	SAT2	0.460	0.567	0.724	0.532	**0.967**
	SAT3	0.486	0.596	0.723	0.603	**0.955**

Table 2. Construct Loadings and Cross Loadings

To further assess discriminant validity, we compared the AVE of each construct with the shared variance between construct pairs (Fornell & Larcker, 1981) and examined the heterotrait-monotrait (HTMT) ratio of correlations (Henseler et al., 2015). In Table 3, we observe that the AVE for each construct exceeds the squared correlation between pairs of constructs. This result indicates that each latent construct shares more variance with its own block of indicators than with other constructs representing different blocks, providing strong evidence of discriminant validity. In addition, all HTMT values in Table 4 were below the conservative threshold of 0.85, as recommended by Henseler et al. (2015). Thus, discriminant validity was satisfactorily established.

Construct	AVE	INT	TP	SP	ENG	SAT
Interactivity (INT)	0.69	-				
Telepresence (TP)	0.82	0.22	-			
Social Presence (SP)	0.74	0.41	0.49	-		
Engagement (ENG)	0.70	0.19	0.13	0.27	-	
Satisfaction (SAT)	0.93	0.24	0.36	0.55	0.35	-

Table 3. AVEs Versus Squares of Correlations Between Constructs

Construct	INT	TP	SP	ENG	SAT
Interactivity (INT)	-				
Telepresence (TP)	0.493	-			
Social Presence (SP)	0.702	0.770	-		
Engagement (ENG)	0.486	0.393	0.595	-	
Satisfaction (SAT)	0.512	0.629	0.804	0.647	-

Table 4. HTMT Results

4.2 Structural Model

In the structural model, we analyzed the path coefficients and their significance levels using the entire sample. To determine the significance of the path coefficients, we employed the bootstrapping method with 5,000 resamples as recommended by Hair et al. (2017).

Interactivity had a positive effect on both telepresence and social presence (β = 0.47 [0.34, 0.53], p < 0.001; β = 0.40 [0.26, 0.53], p < 0.001; with respective 95% confidence intervals), supporting H1 and H2. While telepresence had a positive effect on social presence (β = 0.52 [0.36, 0.65], p < 0.001), it did not have a significant direct effect on engagement or satisfaction (β = -0.01 [-0.24, 0.24], p > 0.10; β = 0.16 [-0.10, 0.39], p > 0.10; respectively). Therefore, H3 was supported, but H4 and H6 were not supported. Social presence had a positive effect on both engagement and satisfaction (β = 0.53 [0.33, 0.72], p < 0.001; β = 0.48 [0.29, 0.68], p < 0.001; respectively), supporting H5 and H7. H8 was also supported (β = 0.28 [0.11, 0.46], p < 0.01), indicating that engagement has a significant, positive impact on satisfaction.

The R^2 value of the final dependent construct, satisfaction, was high at 0.62, indicating that the research model accounts for 62% of the variance in the dependent variable. Therefore, we conclude the model has high explanatory power for satisfaction. That is, telepresence, social presence, and engagement collectively play a significant role in explaining variations of student satisfaction in online learning. We also examined the R^2 values for telepresence and social presence, which are the primary focus of this study and serve as mediators in the structural model. R^2 is 0.22 for telepresence and 0.62 for social presence, indicating that interactivity reasonably explains telepresence, and together with telepresence, significantly explains variations in social presence in online learning. The outcomes of hypothesis testing and the R^2 values for each construct are presented in Figure 2. These results provide strong empirical support for the relationships proposed in the research model and underscore the relevance of telepresence and social presence in online learning.

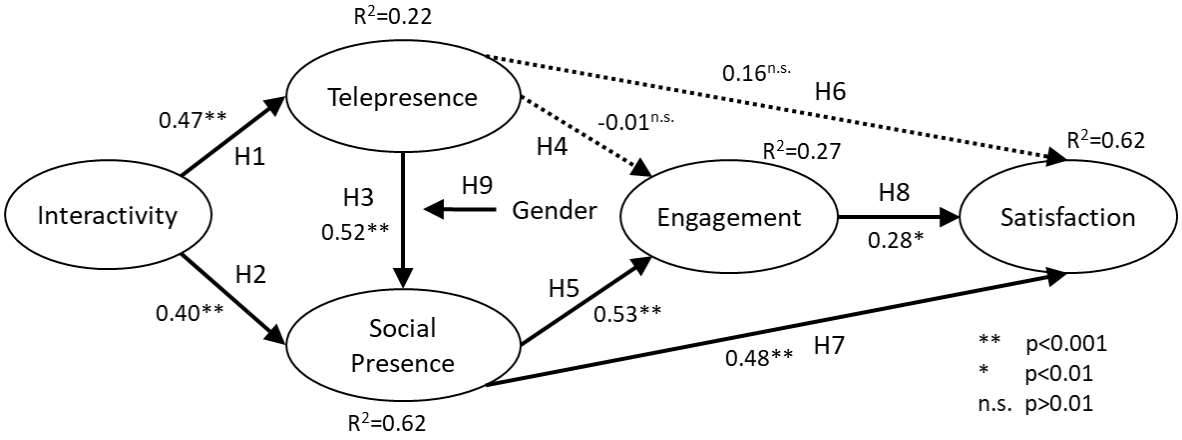

Figure 2. Structural Model

4.3 Analysis of the Moderating Effect of Gender

This study adopted the permutation test as a more robust method for multigroup analysis in PLS-SEM, following the recommendation of Hair et al. (2017). The permutation test in SmartPLS 4 allows testing for significant differences in the parameter estimates (e.g., path coefficients) between predefined data groups. We performed the permutation test with 3,000 permutations. In each permutation, two groups were created by randomly assigning 50 observations to the female group and 64 to the male group. Then, the coefficients of the path between telepresence and social presence were computed for each group, and their difference was calculated. The mean of these 3,000 differences, its 90% one-tailed confidence interval (based on the 10th percentile), and the significance test result are presented in Table 5.

	Path coefficients		Path coefficients diff.		Percentile	Permutation p-value
	Female (50)	Male (64)	Original	Permutations	10%	
TP → SP	0.389	0.630	-0.241	-0.004	-0.200	0.058

Table 5. Results of Testing the Moderating Effects of Gender

The results in Table 5 support H9, which states that the relationship between telepresence and social presence is stronger for males than for females. The original coefficients were 0.389 for female students and 0.630 for male students, showing that male students experienced higher levels of social presence for the same level of telepresence. In the 3,000 permutations, the mean difference of coefficients was -0.004, which is close to zero. This means that there is no systematic bias in the permutation process. A coefficient difference smaller than -0.241 occurred about 5.8% of the time, which serves as a p-value (0.058). This indicates H9 is supported at the significance level of 0.10. According to the 10th percentile, 90% of the differences were -0.2 or greater, which can be considered a 90% one-tailed confidence interval of (-0.200, ∞). Since the original difference of -0.241 is not included in the confidence interval, the interpretation of the confidence interval corroborates the test result. Therefore, we conclude that gender significantly moderates the relationship between telepresence on social presence.

4.4 Post Hoc Analysis on the Effects of Telepresence on Engagement and Satisfaction

While the direct relationships of telepresence to engagement (H4) and telepresence to satisfaction (H6) were hypothesized, they were not supported in our structural model analysis. To further explore this, we removed interactivity and social presence from the structural model and set up two simple regression models – one from telepresence to engagement and another from telepresence to satisfaction. Using the regression models, we tested the direct effects between telepresence and engagement, and between telepresence and satisfaction. The results showed that telepresence did have a significant effect on engagement ($\beta = 0.36$, $p < 0.001$, $R^2 = 0.13$) and satisfaction ($\beta = 0.60$, $p < 0.001$, $R^2 = 0.37$). In summary, the mediation analysis results imply that telepresence has a direct effect on engagement and satisfaction. However, its effect is mitigated significantly when a stronger factor, i.e., social presence, serves as a mediator between telepresence and engagement or between telepresence and satisfaction.

5. DISCUSSION

5.1 Implications for Research and Practice

As higher education institutions offer more online classes, it is important to gain a deeper understanding of student learning behaviors and experiences in online environments. This study introduced two types of presence (i.e., telepresence and social presence) driven by interactive communication technology and empirically examined their impacts on student learning experiences and outcomes. We also investigated how gender plays a role in the relationship between the two types of presence. We believe that our findings address the important research questions posed and contribute to the literature on online presence and online learning. Contributions and implications of this study for research and practice are discussed below.

First, technology characteristics such as interactivity were found to enhance perceptions of both telepresence and social presence in online learning. While the impact of interactivity on social presence has been studied before (Park & Kim, 2020), its impact on telepresence has not been empirically tested within online learning. This study confirms that interactivity, as a technology characteristic, contributes to distinct types of presence in online settings. It helps educators better understand what characteristics of new learning technology can enhance students' telepresence and social presence, thereby improving students' online learning experiences.

Second, to the best of our knowledge, this is the first empirical study to examine the relationship between telepresence and social presence within online learning. Prior research on online learning considered telepresence as one trait or dimension of social presence and did not differentiate telepresence from social presence. This study separated telepresence from social presence conceptually, introducing two separate presence concepts of "being there" and "being together," and tested their relationship empirically. While telepresence refers to the sense of presence experienced through technologically mediated environments (e.g., immediacy), and social presence pertains to the perception of presence derived from interpersonal relationships within an online space (e.g., intimacy), both concepts were discussed by Tu and McIsaac (2002). We found that telepresence leads to social presence. In other words, the higher telepresence students perceive in an online space, the higher social presence they perceive. This finding contributes to the study of presence in an online learning environment by providing insights into the causal relationship between the two types of presence – telepresence and social presence. It may also offer educators clearer guidelines on which presence to prioritize when adopting learning technologies and enhancing students' presence in online learning.

Third, another interesting finding is that the effects of telepresence on learning experiences and outcomes, such as engagement and satisfaction, are fully mediated by social presence. This provides insight into how distinct types of presence are associated with engagement and satisfaction in online learning. This implies that students in an online learning environment are more likely to engage and be satisfied through social presence (i.e., perceiving "being together"), rather than through telepresence (i.e., perceiving "being there"). Thus, any technology characteristics or class activities promoting social presence may contribute to greater engagement and satisfaction in online learning. By taking advantage of various technological tools and class activities that promote social presence, educators can create a more vibrant and interactive online learning environment, enhancing both social presence and student engagement and satisfaction.

These findings collectively suggest a sequential pathway for enhancing student engagement and satisfaction in online learning. Specifically, the use of interactive communication technology promotes telepresence (a sense of "being there"), which subsequently facilitates social presence (a sense of "being together"). It is this heightened social presence that ultimately contributes to meaningful learning outcomes. For online instructors, these results underscore the importance of beginning course design with the deliberate integration of interactive communication tools—such as Microsoft Teams, Zoom, or Slack—that support functionalities like real-time chat, video conferencing, screen sharing, and collaborative workspaces.

To foster telepresence, instructors should create immersive experiences that simulate the dynamics of a physical classroom. Strategies may include live video lectures with active student participation, virtual office hours, and the use of digital whiteboards or classroom-like virtual backgrounds. These elements help students feel mentally and emotionally present within the online learning environment. Once telepresence is established, the focus should shift to cultivating social presence through structured interpersonal engagement. Activities such as breakout group discussions, peer feedback, collaborative assignments, and synchronous team meetings can help students build relationships and develop a sense of community. Since social presence serves as the primary mechanism through which telepresence enhances engagement and satisfaction, fostering a socially rich environment is essential for maximizing the effectiveness of online learning.

Finally, this is the first study to propose and empirically test gender's moderating role in the relationship between telepresence and social presence within online learning. The findings on the moderating effect of gender suggest that male students are likely to experience higher social presence than

female students for a given technology. This gap may be supported by previous research on gender differences in technology use, which has indicated that males generally exhibit more positive attitudes toward using technology for learning than females (Kadijevich, 2000; Li & Kirkup, 2007).

This gender gap in the impact of technology must be carefully considered when educators select and implement technologies to facilitate telepresence and social presence in online learning. To address the gender gap identified in our findings, educators can adopt targeted strategies that build technological confidence and promote inclusive engagement, particularly for female students. For example, offering optional pre-course orientation sessions to familiarize students with communication platforms (e.g., Microsoft Teams or Zoom) and their features (e.g., screen sharing, breakout rooms, and chat) can help reduce initial barriers. Incorporating short, low-stakes technology tasks early in the course, such as posting a video introduction or participating in a guided discussion, can also support students in becoming comfortable with the tools in a low-pressure setting. Peer mentoring programs, where more experienced or confident students assist their peers in navigating technology, may further enhance confidence and participation. Instructors should structure group work to ensure equitable participation, potentially by rotating roles (e.g., facilitator, note-taker, presenter) and incorporating anonymous peer evaluations to encourage accountability. Additionally, instructors can monitor participation patterns and reach out to students who appear less engaged, offering personalized encouragement or support. Although these strategies are particularly relevant for mitigating gender-based disparities, they can be implemented to benefit all learners. By creating a more supportive and inclusive online learning environment, instructors can ensure that every student—regardless of gender—feels confident, connected, and engaged. As online education continues to expand, promoting equity in learning experiences and outcomes across genders will become increasingly vital.

5.2 Limitations and Future Research

This study has several limitations that future research could address. First, our research model was tested using data collected from online business analytics courses at a single institution. Replicating this study across different types of online courses (e.g., other IS courses or courses from various disciplines) and at multiple universities would enhance the generalizability of the research model and its findings. However, despite this limitation, our results remain pertinent to other online IS courses because both business analytics and many other IS courses share similar instructional objectives, employ common technological tools, and utilize comparable pedagogical methods designed to enhance students' analytical and decision-making skills. Consequently, educators teaching related IS courses may still effectively adopt or adapt the instructional strategies and engagement practices identified in our study.

Second, while our study focused on engagement and satisfaction as outcome variables, we acknowledge that these are not direct measures of learning outcomes such as academic performance or knowledge acquisition. However, both engagement and satisfaction are widely recognized as important precursors to effective learning. Engaged students are more likely to persist, invest cognitive effort, and achieve stronger academic outcomes, while satisfied students tend to exhibit greater motivation and commitment to their studies (Lane et al., 2021; Mohammadi, 2015; Rajabalee & Santally, 2021). Our findings suggest that interactivity and presence—particularly social presence—play a foundational role in fostering these affective and behavioral conditions that support learning. Although our model does not directly assess learning outcomes, it offers a theoretically grounded and empirically supported pathway through which presence may influence learning effectiveness. Future research should extend this model by incorporating direct measures of learning outcomes—such as course grades, test scores, or performance-based assessments—to more clearly establish the relationship between presence and actual learning. In addition to these academic indicators, it would be valuable to explore other aspects of the learning experience—such as happiness, anxiety, enjoyment, and sense of belonging—that may be shaped by telepresence and social presence. For example, drawing upon the Community of Inquiry framework (Garrison et al., 1999), Law et al. (2019) examined how social, cognitive, and teaching presence influence academic performance in a blended learning environment. Investigating a broader range of outcomes and experiences would help educators better align instructional strategies with the forms of presence that most

effectively support diverse learning goals.

Third, this study examines only one technology characteristic, i.e., interactivity, as a driver of telepresence and social presence. However, there may be other technology characteristics that influence those presences. Future research can extend our research model with different technology characteristics, such as ease of use, sensory descriptiveness, and vividness (Lim & Ayyagari, 2018), which can drive telepresence and social presence in online learning environments.

Another avenue for future research is to identify and examine more potential drivers of telepresence and social presence other than technology characteristics. For example, Lee (2018) proposed three customer experience aspects (sensory, emotional, and cognitive virtual attributes) that could affect telepresence on a hotel's website and found significant effects of sensory and emotional attributes on telepresence. Orth et al. (2018) proposed and tested mystery, complexity, legibility, and coherence as antecedents of telepresence in virtual service environments. Such potential drivers can be applied to online learning. For example, online activities such as discussion forums and team projects may promote students' perception of telepresence and social presence in online classes, which may ultimately influence online learning experiences and outcomes (Dennen & Burner, 2017; Lin et al., 2013). Furthermore, it would be interesting to include different types of drivers (e.g., technology characteristics, use experience aspects, informational variables, and/or online learning activities) together and compare their impacts on telepresence and social presence in online learning.

Another promising direction for future research would be to break down the two presences into their facets (e.g., belonging, connecting, and projecting for social presence; and being there and being real for telepresence) and explore their relationships with each other and/or their drivers. For example, while the "being there" facet of telepresence may be more associated with the "connecting" facet of social presence, the "being real" facet of telepresence may be more associated with the "belonging" facet of social presence. In addition, online learning activities such as online team projects can be closely related to the "belonging" facet because students may perceive more belonging in the online class by working and interacting with peers in their team (Picciano, 2002).

6. CONCLUSIONS

This study highlights the pivotal role of interactive communication technology in enhancing the quality of online learning experiences. By examining the constructs of interactivity, telepresence, and social presence, it demonstrates how such technologies foster not only learners' sense of "being there" (telepresence) but also their perception of "being together" (social presence) within the online learning environment. The findings reveal that although telepresence is unique to online contexts, its positive effects on engagement and satisfaction are fully mediated by social presence. Furthermore, the moderating role of gender in the relationship between telepresence and social presence provides deeper insight into individual differences in online learning experiences. Overall, we believe this study contributes to the growing body of literature on online education by identifying key psychological and technological mechanisms that support engaging learning experiences, with practical implications for the design and implementation of learner-centered online environments.

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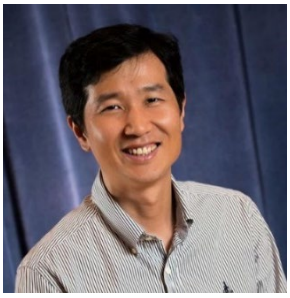

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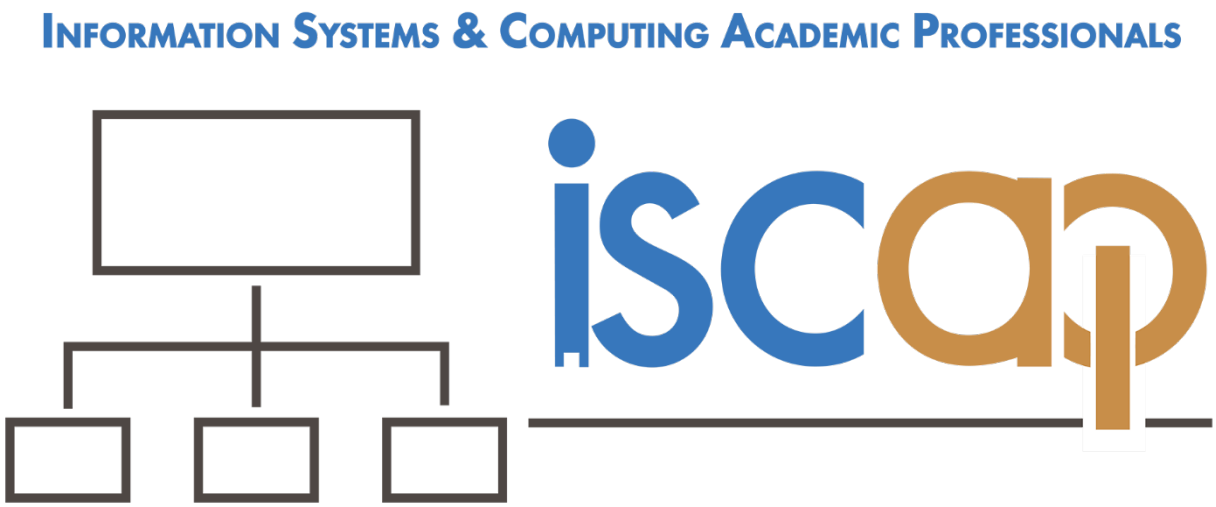
APPENDIX

Constructs, Measurement Items, and Descriptive Statistics

Constructs	Mean	SD	Items (5-point Likert scale; 5 - strongly agree; 1 - strongly disagree)
Interactivity	Class communications with the instructor using Microsoft Teams:		
	4.53	0.67	are up-to-date.
	4.46	0.69	are usually at hand.
	4.34	0.84	are fast.
	4.57	0.66	can be used anywhere.
	4.53	0.72	are flexible.
	4.29	0.87	are seamless.
Telepresence	3.59	1.12	During the Microsoft Teams class meetings, I felt I was in a virtual classroom the computer created.
	3.49	1.06	During the Microsoft Teams class meetings, my body was in the room, but my mind was inside the virtual classroom created by Microsoft Teams.
	3.58	1.04	The Microsoft Teams class meetings seemed to me something I "participate" rather than "watch."
	3.34	1.14	I forgot about my immediate surroundings when I was attending Microsoft Teams class meetings.
	3.46	1.00	When the Microsoft Teams class meetings ended, I felt like I came back to the "real world" after class.
Social Presence	3.88	0.98	When using Microsoft Teams, I felt I was getting individualized attention from the instructor.
	3.81	0.97	When using Microsoft Teams, there was a sense of sociability with the instructor and classmates.
	4.29	0.92	I felt I was closer to the instructor when using Microsoft Teams than when using emails.
	3.80	0.99	When using Microsoft Teams, I felt a sense of belonging to this class.
Engagement	3.52	1.21	Time flies when I am studying for this class.
	3.37	1.18	When I am studying for this class, I forget everything else around me.
	3.22	1.13	I feel happy when I am studying intensively for this class.
	3.32	1.13	I can get carried away by my studies for this class.
Satisfaction	3.97	1.03	Overall, taking this class as online makes me feel: (very satisfied … very dissatisfied).
	3.89	1.09	Overall, taking this class as online makes me feel: (very pleased … very displeased).
	3.81	1.08	Overall, taking this class as online makes me feel: (very delighted … very terrible).



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