

Enhancing teaching presence in videoconferences: The impact of personalized webcam communication on effective pedagogical e-leadership

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ABSTRACT: Teaching presence (TP) is crucial in online education, but its impact in videoconferencing contexts remains underexplored. This study aims to validate a framework that integrates various e-leadership strategies with personalized communication with webcams (PCW). A sample of 592 master’s students in management programmes participated in this research; all of these individuals were subjected to a pedagogical model that consisted of three weekly one-hour videoconferences. This study proposes that TP pertains to two key variables that were examined in this context—PCW and comprehensive e-leadership—on the basis of three different theories (i.e., situational, transformational, and socio-emotional). An exploratory factor analysis identified a valid four-factor model for e-leadership, and structural equation modelling was used to examine the associations between PCW and comprehensive e-leadership. A multigroup confirmatory factor analysis revealed significant group differences in the relationship between PCW-based teaching and situational e-leadership based on students’ learning approach (i.e., content acquisition, collaborative learning, and individual knowledge building through activities). The results also indicate that younger students tend to report higher valuations of comprehensive e-leadership, whereas female students indicate stronger appreciation for socio-emotional and situational e-leadership. The resulting model offers practical guidance for efforts to enhance teaching practices in videoconference-based learning environments.

Keywords: E-leadership, Teaching presence, E-communication, Videoconferences

1. Introduction

Presence in online learning environments is a comprehensive construct that significantly influences student engagement and learning outcomes (Wang, 2022). According to Garrison’s (2017) community of inquiry (CoI) framework, educational experience is shaped by the interactions among three types of presence: social, cognitive, and teaching. Teaching presence (TP) ensures the design, facilitation, and direction of meaningful educational interactions, thereby supporting the development of other types of presence. TP orchestrates the structure and flow of learning, bridging the gap between the physical absence of educators and students’ need for guidance and connection (Li & Wang, 2024).

Teaching presence (TP) is a central factor in online learning (Su et al., 2024). In asynchronous settings, it includes curriculum design, activity planning, and facilitation of collaboration, while implementation relies on communication quality, guidance, feedback, and encouragement (Jaggars & Xu, 2016). TP also fosters participation within constructivist and dialectical pedagogies (Ariati et al., 2025). Teachers’ digital competence and personal commitment further strengthen this presence (Fuertes-Alpiste et al., 2023; Blanchard et al., 2022). As noted by Caro-Valverde (2018), Socratic “oral communicative acts” reflect e-leadership that shapes students’ perceptions of TP.

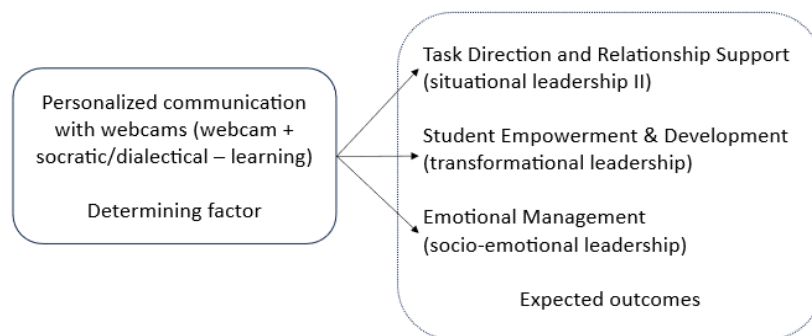
In synchronous learning environments, e-leadership is defined as a social influence process aimed at achieving planned objectives (Contreras et al., 2020). Through digital tools such as videoconferencing, it seeks to positively influence students’ attitudes, emotions, behaviour, and performance (Yuting et al., 2022). Evidence from videoconference-supported teaching shows that well-structured synchronous instruction enhances engagement, participation, and learning outcomes, highlighting videoconferencing as an effective medium for instructional leadership (Celikkan et al., 2013). Real-time interaction in videoconference-based teaching can be conceptualized as a central mechanism supporting both engagement and learning outcomes. Synchronous exchanges enable immediate feedback, dialogic scaffolding, and adaptive instructional adjustments, thereby facilitating cognitive processing and deeper conceptual understanding (Hung et al., 2024). Additionally, temporal co-presence strengthens social presence and accountability, enhancing motivation and sustained attention relative to asynchronous formats (Ratan et al., 2022). Beyond affective engagement, real-time communication directly

contributes to instructional effectiveness by aligning pedagogical intentions with students' ongoing meaning-making processes (Jarrah et al., 2025).

Evidence suggests that students generally prefer synchronous videoconferencing to asynchronous forums, as it enhances participation (Fuertes-Alpiste et al., 2023). Although videoconference teaching is often criticized for privileging technology over instructional quality (Knipe & Lee, 2002), technical infrastructure alone is insufficient. Effective implementation requires attention to the environmental and social conditions that promote engagement (Li & Yee, 2024). Accordingly, e-leadership practices must adapt to the specific demands of remote academic contexts to remain effective (Contreras et al., 2020). Given that a strong sense of community—fostered through meaningful interaction—improves learning outcomes (Barberà et al., 2018), synchronous videoconferencing can play a significant role in higher education.

As depicted in Figure 1, this study differentiates between management of the communicational channel and the exercise of e-leadership, while recognizing their dynamic interdependence in videoconference-based teaching. Communication is conceptualized as a proximal, interactional process centered on the teacher's visual presence and the immediate conditions enabling educational (Socratic) dialogue. These include webcam-mediated visibility, eye contact, non-verbal expressiveness, and personalized address, all of which foster perceptions of co-presence and instructional clarity during live sessions (Bailenson, 2021). Once this channel is established, e-leadership operates at a foundational and relational level, shaping the cognitive, emotional, and motivational frameworks through which communication is interpreted. Leadership practices—such as providing direction, relational support, learner empowerment, and emotional regulation—extend beyond discrete communicative acts and reflect enduring orientations that influence trust, commitment, and engagement over time (Van Wart et al., 2019).

Figure 1. Proposed research framework for teaching presence in live videoconferences



Teachers' self-presentation in virtual environments significantly shapes students' perceptions, influencing instructional effectiveness and the broader learning process. A personalized approach may therefore enhance the visibility and impact of e-leadership, enriching students' experience of teacher presence in webcam-mediated videoconference sessions. Adopting a dialectical perspective, this study examines how students' learning approaches—content acquisition, collaborative learning, and individual knowledge construction through activities (Badia et al., 2017)—mediate their participation in the teaching-learning dialogue and their perceptions of communication and e-leadership, ultimately shaping the manifestation of teaching presence (TP).

1.1. Factors in teaching presence through videoconferencing

According to Wu et al., (2022), beyond the cognitive asynchronous approach to teaching presence (TP), constructivism in online learning can also be understood through a social perspective that emphasizes interpersonal relationships and the co-construction of knowledge. In the scope of this research, TP adopts a synchronous real-time perspective in videoconferences. The main tool of a leader (in this case, a teacher) is communication, viewed through the complete Aristotelian lens of influence, encompassing *ethos*, *pathos*, and *logos* in which the teacher tries to encourage and mobilize students to reach their developmental potential (Himanka, 2015).

The research presented in this paper proposes two variables to explain how TP occurs during the constructive dialogue of the teaching-learning process, as the teacher communicates, and e-leads students working in a videoconferencing environment.

Personalized communication with webcams (PCW) is an instructional approach in online education that combines sustained webcam-mediated interaction with pedagogical personalization to enhance presence, engagement, and reciprocal communication. First, teachers must implement comprehensive communication, complementing verbal with non-verbal cues (Yoon et al., 2024), including eye contact with the webcam, appropriate facial expressions, and body language, while encouraging students to keep webcams on to maintain co-presence and attention. Second, teaching should be personalized to students' needs, preferences, objectives, and abilities (Kickmeier-Rust et al., 2011), reducing interactional distance by addressing students by name, offering individualized attention, using informal modes of address, and facilitating real-time feedback. This approach fosters engagement, deeper learning, and meaningful interaction. Aligning with humanistic educational principles (Hernández-Sellés et al., 2023), videoconferencing can integrate moral, cognitive, affective, and practical dimensions of learning (Akrivou & González, 2021), strengthening teaching presence and promoting a holistic and effective online learning experience.

The second variable that constitutes TP in these scenarios concerns teacher e-leadership. Meuser et al. (2016) identified over 40 leadership styles and proposed an integrative framework based on “theoretical neighbours”. Complementing this, Bass and Avolio’s (1995) full-range leadership theory emphasizes both proximity and a dynamic continuum among styles. This study adopts an integrative approach, applying established leadership theories drawn from validated models in leadership research. The following theories are selected for this research:

- Task Direction and Relationship Support – Situational Leadership II
- Student Empowerment & Development – Transformational Leadership
- Emotional Management – Socio-Emotional Leadership

These theories address complementary dimensions of videoconference teaching. Transformational leadership emphasizes values, vision, and meaning, shaping students' motivation and commitment. Socio-emotional leadership focuses on emotions and interpersonal dynamics, which are critical in online settings where cues are reduced and isolation may occur. Situational leadership highlights adapting instruction to students' competence, engagement, and technological approach. Together, these perspectives integrate values, emotions, and situational demands, offering a comprehensive framework for understanding influence processes in videoconference-based teaching.

The first selected theory, Situational Leadership II, operates along two axes: promoting students' social development through class belonging and collaborative group work, and providing instructional guidance to direct learning effort (Zigarmi & Roberts, 2017). Adaptive leadership behaviors, which flexibly adjust relational and task-oriented actions to students' developmental levels, strengthen social integration and learning regulation (Want et al., 2024). These include monitoring progress, addressing errors, providing timely assistance, and maintaining an available presence, corresponding to instructional design and facilitation dimensions of teaching presence—key predictors of engagement, persistence, and perceived learning quality in synchronous and hybrid contexts (Fiock, 2020). By clarifying direction and aligning actions with learning objectives, teachers integrate cognitive and social processes through communicative interaction (Mesa-Rave et al., 2023), fostering collective efficacy and enhancing students' capacity to achieve intended outcomes (Skaalvik & Skaalvik, 2023). Consequently, the following hypothesis is proposed:

- H1: Personalized communication with webcams is positively correlated with situational e-leadership, fostering synchronous teaching presence perceived by students

The second theory, transformational leadership, is one of the most studied approaches in this field (Agazu et al., 2025). It emphasizes motivation as the foundation for achieving higher performance while supporting students' skill development and needs (Kadiyono et al., 2020). Transformational e-leadership empowers students to identify their values, motivations, and needs, fostering psychological safety, trust, and autonomy (Firmansyah et al., 2022). By recognizing shared responsibility and delegating decision-making, it encourages active ownership of learning (Sharma et al., 2024), enhancing accountability, engagement in digital contexts (Chiu, 2021), and long-term competencies such as independence, ethical responsibility, and lifelong learning (Schiller, 2025). The hypothesis related to transformational e-leadership is proposed as follows:

- H2: Personalized communication with webcams is positively correlated with transformational e-leadership, fostering synchronous teaching presence perceived by students

The third theory, socio-emotional leadership, emphasizes balancing the pursuit of challenging academic goals with their potential stressors (Grau-Alberola et al., 2022). It highlights the teacher's need to be emotionally engaged so that TP is perceived consistently, with social and personal support valued highly by students (Hernández-Sellés et al., 2023). This includes creating a relaxed climate in live videoconferences through humor and warm communication (Li et al., 2024). Practically, this may involve brief informal conversations at the start

of a session to humanize interaction, reduce affective barriers, and build relational closeness, followed by a smooth transition to curricular content. Such behaviors signal care, availability, and emotional support, reinforcing students' perception of TP beyond information delivery (Sun et al., 2025). Therefore, the following hypothesis is proposed:

- H3: Personalized communication with webcams is positively correlated with socio-emotional e-leadership, fostering synchronous teaching presence perceived by students

Dialectical learning in videoconferences is shaped by both the teacher's role and students' learning approaches (Badia et al., 2017). Students adopting a content acquisition approach focus on receiving well-structured information, benefiting from clear and organized teaching presence (Mayer et al., 2020). Collaborative learners value faculty who facilitate interaction, manage group dynamics, and scaffold peer discussion, while those engaged in individual knowledge building rely on critical questioning and individualized feedback to support reflection and sense-making (Vermunt & Donche, 2017). Thus, students' learning approaches, together with teaching presence, create distinct pathways and experiences in videoconference-based education. Thus, H4 is presented as follows:

- H4: Students' learning approaches are positively correlated with teaching presence in videoconferences

2. Method

Fieldwork was conducted in September 2024 using a self-administered online questionnaire distributed to all master's students in management across two campuses of a business school. Data collection took place during orientation week to capture baseline learning approaches prior to substantive coursework and exposure to instructional practices. The survey was administered within an introductory workshop focused on technical training for the Blackboard Collaborate videoconferencing module, which emphasized self-activation and engagement in the programme. Students were introduced to a constructivist pedagogical model promoting active participation and social learning through three weekly one-hour videoconference sessions. This model was operationalized via continuous Socratic-style questioning to stimulate dialogue and ensure active engagement.

Participation invitations were communicated verbally during the workshop and reinforced through the institutional learning management system. To protect participant privacy, the survey platform was configured to collect no identifying information (e.g., names, student IDs, email addresses, IP addresses, or device metadata). Once data collection was completed, all responses were exported without any system-generated identifiers. The final dataset was stored, processed, and analyzed exclusively in anonymized and aggregated form, with no possibility of linking responses to individual students.

The following sections first introduce the profile of the participants, then provide a detailed description of the instrument and, finally, a discussion of the analytical strategy.

2.1. Participants

Table 1. Baseline sociodemographic characteristics of participants by country of origin (N = 592)

Variable	Colombia (n = 142)	Spain (n = 139)	Peru (n = 114)	Other American countries (n = 177)	Europe (n = 19)
Gender, n (%)					
Female	98 (69.0)	92 (66.2)	82 (71.9)	124 (70.1)	13 (68.4)
Male	44 (31.0)	47 (33.8)	32 (28.1)	53 (29.9)	6 (31.6)
Age (years)	32.1	33.0	32.2	31.3	37.1
Campus, n (%)					
Barcelona	74 (52.1)	70 (50.4)	60 (52.6)	95 (53.7)	10 (52.6)
Madrid	68 (47.9)	69 (49.6)	54 (47.4)	82 (46.3)	9 (47.4)
Learning strategy, n (%)					
Content acquisition	53 (37.3)	52 (37.4)	42 (36.8)	66 (37.3)	7 (36.8)
Collaborative learning	64 (45.1)	62 (44.6)	51 (44.7)	79 (44.6)	9 (47.4)
Individual knowledge building	25 (17.6)	25 (18.0)	21 (18.4)	32 (18.1)	3 (15.8)

A convenience sampling strategy was employed, inviting all students enrolled in this online learning modality (N = 733), yielding 592 valid responses (response rate = 80.8%) across two campuses in Spain (Barcelona: n = 310;

Madrid: n = 282). Learning approaches were distributed as follows: content acquisition (n = 220), collaborative learning (n = 265), and individual knowledge building (n = 107).

The sample comprised 410 female (69.2%) and 179 male (30.2%) students; one participant identified as non-binary and two selected “do not know/do not answer.” The mean age was 32.46 years, with age groups distributed as <26 (14.3%), 26–30 (32.2%), 31–35 (24.8%), 36–40 (15.0%), 41–45 (6.7%), and >45 (6.7%).

Students originated mainly from Colombia (n = 142), Spain (n = 139), and Peru (n = 114), with additional participants from other American countries (n = 177), Europe (n = 19), and Cape Verde (n = 1). The predominance of Ibero-American nationalities reflects the Spanish language of instruction; the online format allowed participation irrespective of geographic location (see Table 1).

2.2. Materials

Because no suitable instruments were available, items were developed specifically for online training via videoconferencing to capture the theoretical constructs under study. Responses were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), and items were randomly ordered to minimize response patterning across dimensions. Content validity was strengthened through a three-step expert review involving three leadership scholars: (1) independent evaluation of item clarity and relevance, (2) written feedback and suggested revisions, and (3) a consensus discussion to finalize item wording. This refinement process resulted in the final set of items (see Table 2), all of which begin with the stem: *I consider it important that an online teacher in his or her videoconferences...*

Table 2. Questionnaire structure and items

Personalized communication with webcam (PCW)	<ul style="list-style-type: none"> - ... Addresses us by using our names - ... Can be addressed informally - ... Promotes as long as we all have webcams on - ... Looks directly at the webcam so that we can see his or her eyes - ... Has proper facial and body language even when viewed on the webcam
Comprehensive pedagogical e-leadership	A set of 20 items addressing socio-emotional, transformational, and situational e-leadership styles was developed as part of this research. These items are presented in the following sections to the extent that they are going to be tested through exploratory factor analysis.

Based on Badia et al. (2017), three learning approaches in online environments were identified: collaborative learning, content acquisition, and individual knowledge building. A categorical variable, “learning approach,” was created using the question: “Which teaching and learning approach do you consider most suitable for learning in videoconference settings?” Response options were collaborative learning with peers, content acquisition via teacher-led instruction, and individual knowledge building through independent activities.

Demographic and control variables included gender (1 = female; 2 = male; 3 = non-binary; 4 = other; 5 = Dk/Da) and age, coded as a dummy variable (1 = 32 years or younger; 0 = older than 32).

2.3. Data analysis

Exploratory factor analysis (EFA) was conducted to examine the latent structure of the instrument measuring PCW and e-leadership in videoconferencing. The initial pool consisted of 25 items (PCW: 5 items; e-leadership: 20 items). Data suitability for factor analysis was verified using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett’s test of sphericity. Given the theoretical expectation of correlated factors, we used principal component extraction with direct oblimin rotation to identify the underlying factor structure. Items were retained based on factor loadings $\geq .40$, absence of cross-loadings, and theoretical interpretability. Reliability of the resulting factors was assessed using Cronbach’s α , composite reliability (CR), average variance extracted (AVE), and the square root of AVE to ensure convergent and discriminant validity.

Following the EFA, a confirmatory factor analysis (CFA) was performed using the retained 5 items for PCW and 16 items for e-leadership, and their corresponding latent factors to validate the factor structure prior to hypothesis testing. The CFA served both to confirm the measurement model and to ensure that the items demonstrated adequate fit to the theorized constructs. Model fit was evaluated using χ^2/df , RMSEA ($< .06$), GFI ($> .90$), AGFI

(> .80), CFI (> .90), PGFI (> .70), NFI (> .90), IFI (> .90), and TLI (> .90). Given the large sample size (N = 592), the χ^2 statistic was interpreted cautiously due to its sensitivity to sample size (Kline, 2015).

Measurement invariance across the categorical variable “learning approach” was assessed through a sequential procedure: configural invariance (same factor structure), followed by metric invariance (equality of factor loadings). Once satisfactory invariance was established, the CFA results were used to confirm that the measurement model was stable across groups.

Hypotheses were subsequently tested using structural equation modeling (SEM) via path analysis based on the validated measurement model. Pearson’s correlation coefficients were computed to examine associations between e-leadership factors and the control variables, appropriate for relationships involving dichotomous and continuous data.

3. Results

3.1. Exploratory factor analysis

Exploratory factor analysis (EFA) of PCW using principal component analysis supported a single-factor solution (KMO = .747; Bartlett’s $p < .001$), explaining 48.07% of the variance. All five items met normality assumptions (Curran et al., 1996) and loaded between .646 and .744 after direct oblimin rotation. The scale demonstrated acceptable internal consistency (Cronbach’s $\alpha = .713$), supporting its unidimensional structure.

A second EFA examined comprehensive e-leadership. Three items were removed, and the remaining 16 met normality assumptions (Curran et al., 1996). Principal component analysis indicated a four-component structure (KMO = .883; Bartlett’s $p < .001$), explaining 62.67% of the variance: socio-emotional (35.49%), transformational (12.41%), and two situational leadership dimensions—support-task (7.92%) and support-relationships (6.88%). Internal consistencies were acceptable ($\alpha = .818, .838, .768, \text{ and } .712$), with an overall reliability of $\alpha = .868$. Direct oblimin rotation with Kaiser normalization produced component loadings ranging from .683–.836, .600–.919, .645–.775, and .783–.837, respectively (see Table 3).

Table 3. Rotated Component Matrix (Factor Loadings) for E-Leadership (N = 592)

		Socioem	Transf	Sit rel	Sit task
Se1	Incorporates fun elements that allow you to relax in his or her live sessions	.836	.311	.301	-.338
Se2	Uses a sense of humour in the videoconferences	.806	.299	.208	-.308
Se3	Uses a very lively tone in live sessions	.725	.202	.367	-.372
Se4	Reassures us in times of stress so that we can dedicate our effort constructively to learning	.697	.324	.584	-.407
Se5	Communicates in virtual face-to-face sessions in a consistently warm manner	.683	.258	.372	-.585
Tr1	If I demonstrate competence, lets me follow the subject autonomously	.239	.919	.239	-.150
Tr2	If I show commitment, I will be able to follow the course in my own way	.288	.893	.276	-.128
Tr3	Empowers me and lets me act with full autonomy	.309	.841	.221	-.256
Tr4	Delegates and leans on those creditworthy students who demonstrate progress	.317	.600	.281	-.440
Sta1	Helps me progress by directing my attention to mistakes when completing learning tasks	.219	.222	.775	-.367
Sta2	Is there when we need him or her	.312	.247	.775	-.258
Sta3	During activities, asks us whether we need assistance	.328	.253	.657	-.477
Sta4	Directs my work and monitors that I am progressing properly	.416	.220	.645	-.283
Srel1	Contributes to the development of good relationships among class group members	.419	.189	.317	-.837
Srel2	Makes clear the importance of having a strong sense of duty (being committed)	.434	.307	.383	-.793
Srel3	Suggests ways to improve group work	.327	.186	.409	-.783

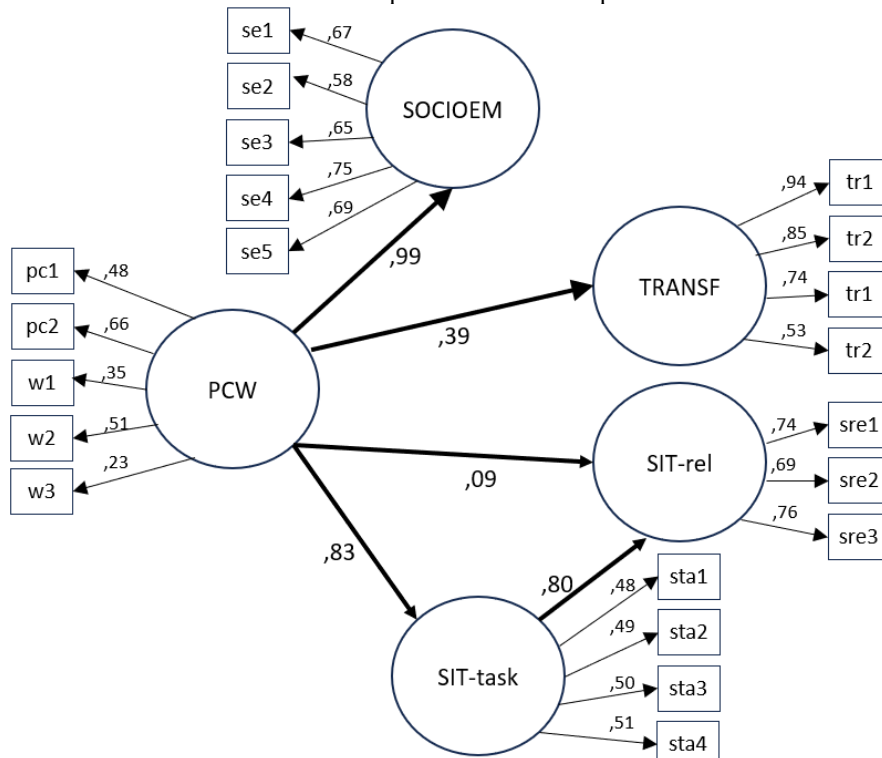
3.2. Confirmatory Factor Analysis of the Model

The model obtained through EFA is explored, and its indicators are shown in Table 4, where two structural models were developed. Model 1 (M1) specifies situational e-leadership as two distinct factors—support-task and support-relationships—whereas Model 2 (M2) represents this e-leadership as a single, unified factor.

Table 4. Summary of Fit Indices of Structural Equation Models.

Model	Description	χ^2	df	CFI	GFI	AGFI	NFI	IFI	TLI	PGFI	RMSEA
M1	Five-factor model with 1 personalized communication with webcams factor and 4 e-leadership (socio-emotional, transformational, situational-task and situational-relationships)	438,248	177	.936	.928	.906	.903	.936	.924	.711	.054
M2	Four-factor model with 1 personalized communication with webcams factor and 3 e-leadership (socio-emotional, transformational, situational-task social relationship being one factor)	499,990	179	.933	.926	.904	.900	.933	.921	.717	.055

Figure 2. Simplified Version (without Error Terms) of the Graphical Representation of the Exploratory Structural Equation Model Accepted



The first model (M1) yielded the following fit indices: χ^2 : 483,236 ($p < .000$); df: 176; GFI = .928; AGFI = .906; CFI = .936; PGFI = .711; NFI = .903; IFI = .936. TLI = .923; and RMSEA = .054. Although both M1 and M2 demonstrate a good fit, M1 presents comparatively stronger indicators and is therefore adopted in this research.

Significant relationships were observed between PCW and the integrated types of e-leadership scrutinized: socio-emotional e-leadership ($\beta = .990, p < .001$), transformational ($\beta = .387, p < .001$), and situational-task ($\beta = .828, p < .001$). However, the relationship between PCW and situational-relationships was not significant ($\beta = .091, p < .627$). A significant relationship between situational-task and situational-relationships was also present ($\beta = 1.29, p < .001$).

Multicollinearity was not a concern, as all Variance Inflation Factors (VIF) were within acceptable limits (1.244 – 1.781), falling well below the common cutoff of 5. The HTMT ratios (ranging from .544 to .817) were all below the established .85 cutoff, with the highest ratio observed at .817 (PCW-Socioemotional), providing evidence of discriminant validity between the study variables.

Thus, H1 and H2 are statistically supported, whereas H3 is partially supported. Figure 2 shows the standardized solution.

Finally, CR, AVE and $\sqrt{\text{AVE}}$ were assessed. For Model 1: PCW (CR = .822; AVE = .481; $\sqrt{\text{AVE}} = .693$, indicating that convergent validity is practically at the accepted threshold); socio-emotional e-leadership (CR = .866; AVE = .565; $\sqrt{\text{AVE}} = .752$); transformational e-leadership (CR = .891; AVE = .677; $\sqrt{\text{AVE}} = .823$); situational task-oriented e-leadership (CR = .807; AVE = .512; $\sqrt{\text{AVE}} = .715$); situational relationship-oriented e-leadership (CR = .846; AVE = .648; $\sqrt{\text{AVE}} = .850$).

For Model 2: integrated situational e-leadership (CR = .748; AVE = .233; $\sqrt{\text{AVE}} = .483$); convergent validity was not supported, as both the AVE (.233) and its square root ($\sqrt{\text{AVE}} = .483$) are well below recommended thresholds.

These results suggest that M2 does not reflect a theoretically meaningful measurement structure.

3.3. Learning approach multigroup CFA

The measurement invariance of the latent variables across different learning approaches was tested. The model exhibited acceptable fit ($\chi^2 = 1004.09$, df = 531, $p < .001$; GFI = .866; AGFI = .825; CFI = .905; PGFI = .663; NFI = .822; IFI = .907; TLI = .888; and RMSEA = .039), indicating that acceptable to good structural (configural) invariance was achieved across the three groups. Furthermore, the evidence supported metric invariance ($p = .354$).

The multigroup CFA revealed significant differences across groups in the relationship between PCW and situational e-leadership according to the SEM. The relationship between PCW and situational-relationships was significant ($p = .047$), as was the relationship between PCW and situational-task ($p = .004$). No significant differences were observed for the relationships between PCW and socio-emotional ($p = .474$) or between PCW and transformational ($p = .862$).

The comparison among the three groups within the categorical variable learning approach is presented in Figure 3.

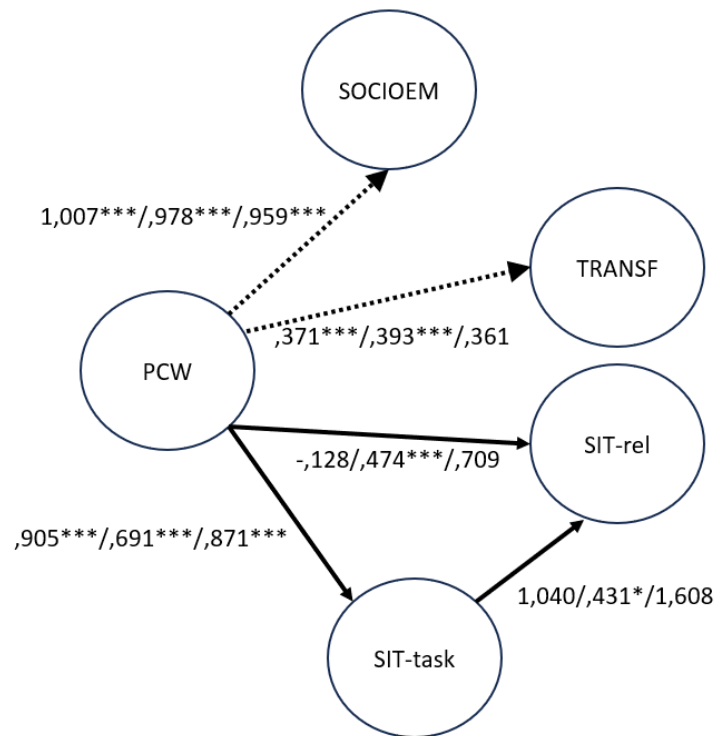
The first group: “content acquisition” approach, showed that PCW was significantly related to situational-task e-leadership ($\beta = .905, p = .001$), whereas no significant relationship was observed between PCW and situational-relationships e-leadership ($\beta = -.128, p = .826$).

For the second group: “collaborative learning” learning approach, PCW was significantly associated with both dimensions of situational e-leadership: situational-task ($\beta = .691, p = .001$) and situational-relationships ($\beta = .474, p = .001$). Additionally, a significant difference was found between situational-task and situational-relationships ($\beta = .431, p = .016$).

Finally: “knowledge building through individual activities” approach, PCW was significantly related to situational-task ($\beta = .871, p < .001$) but not to situational-relationships ($\beta = .709, p = .385$).

These results support Hypothesis 4 (H4).

Figure 3. Results of the Partially Constrained Models. * $p < .05$, ** $p < .01$, *** $p < .001$; β for the Learning Approach (Content Acquisition/Collaborative Learning/Individual Knowledge Building); Solid Lines Indicate that the Structural Coefficients Differ Significantly Across the Categorical Variable Learning Approach



3.4. Control variables

Gender was significantly correlated with situational-relationships ($r = -.127, p = .002$), situational-task ($r = -.105, p = .010$), and socio-emotional e-leadership ($r = -.085, p = .039$). Age also showed statistically significant correlations with transformational e-leadership ($r = -.148, p = .001$), socio-emotional e-leadership ($r = -.097, p = .017$), and situational-task e-leadership ($r = -.094, p = .022$). These results indicate important differences in e-leadership perceptions depending on the individual's gender and age.

4. Discussion

4.1. Interpretation of the findings

Personalized communication via webcams (PCW) appears central to how students perceive comprehensive e-leadership and teachers' teaching presence (TP) in online education. Real-time verbal and nonverbal exchanges in videoconferencing are associated with greater empathetic engagement and complement asynchronous methods by enabling immediate collaboration and dialogue. When educators emphasize personalized interaction, students report stronger trust and relational connection—elements highlighted in the e-leadership literature (Shek & Chai, 2019). Participants in this study indicated that direct interaction with instructors supports attention and collaboration. These findings suggest that videoconferencing environments can accommodate multiple e-leadership styles simultaneously, consistent with full-range leadership theory (Bass & Avolio, 1995).

Socio-emotional leadership emerged as the dimension most strongly valued within the proposed model. Students' perceptions indicate that understanding and acknowledging their emotions through PCW is associated with enhanced TP, with warm and empathetic interactions corresponding to reports of more positive teacher-student relationships. Consistent with this, TP in synchronous settings appears stronger when teachers communicate empathetically and holistically (Murtafi'ah & Pradita, 2024). These perceived connections may help students navigate spatial and temporal distance in online learning (Anderson & Rivera-Vargas, 2020). Although further studies are needed, prior research suggests that socio-emotional leadership styles correspond to higher engagement in professional environments (Gaan et al., 2024). Comparable patterns could potentially emerge in synchronous online university contexts. Thus, teachers who understand and acknowledge students'

emotions through comprehensive communication may be perceived as exhibiting higher levels of e-leadership and TP.

Transformational leadership in effective TP in live online settings is closely tied to understanding students' individual expectations and aspirations, serving as a foundation for inspiring, motivating, and fostering their academic commitment. Personalized engagement in this context is associated with a shared sense of vision, objectives, and values, which students report as reinforcing their intersubjectivity, connection, and empowerment toward learning goals. The process aims to transform online university students, enabling them to reach the expected competencies. According to Liu et al. (2020) and Van Wart et al. (2019), managing change is a core element of e-leadership, consistent with transformational principles. This leadership orientation aligns with constructivist learning environments, where shared values are acknowledged and collectively enacted by students (Aas & Brandmo, 2016).

Situational leadership theory highlights that both the task-oriented and the relational aspects of e-leadership are valued by students. Ensuring success in this modality may require teaching methods that are thoughtfully adapted to maintain a balanced and interactive teaching–learning process (Caro-Valverde, 2018). Furthermore, as noted by Bailey et al. (2022), students' perceptions of the learning process in videoconferences strongly influence their perceived learning success—positive attitudes enhance self-efficacy. Consistent with prior e-leadership research (Liu et al., 2020; Van Wart et al., 2019), students in the present study emphasized the importance of both situational support relationships and task guidance. The adaptability attributed to e-leadership appears particularly relevant, as students value responses tailored to their levels of commitment and competence. PCW may help facilitate such tailoring by enabling teachers to adjust their communication to perceived student needs. Addressing these situational aspects may be associated with greater student confidence and perceived skills development (Thompson & Glasø, 2015).

The findings indicate that the relationship between PCW and situational e-leadership varies according to students' preferred learning approaches. For the group that adopted a collaborative learning approach, PCW was significantly related to both situational-task and situational-relationships e-leadership, suggesting that students who learn collaboratively tend to value leadership styles combining task guidance with relational support. For these students (seeking collaborative learning), the strong association between the task and relationship dimensions further emphasizes the integrated nature of situational e-leadership. The implications for teaching pertain to the teacher's ability to orchestrate group work within the videoconference environment, foster an atmosphere of active participation, stimulate peer-to-peer exchange, and effectively manage interaction.

In contrast, both the “individual knowledge building” group and the “content acquisition” group exhibited a differentiated pattern in which they appreciated situational-task e-leadership but did not value the relational dimension as being particularly important within their teachers.

Students oriented toward individual knowledge building reported greater appreciation for structured instructional support, including problem-solving communication, additional content, and activity clarification. This reliance reflects a preference for guidance aligned with clearly defined learning objectives. From the instructor's perspective, pedagogical strategies emphasizing pragmatic, results-oriented interaction may effectively support these learners. In this context, teachers facilitate learning by scaffolding reflection, providing feedback, and assessing individual progress to promote deeper meaning-making and skill application.

A similar pattern emerges among students adopting a content acquisition approach, who respond primarily to task-focused guidance and place less emphasis on relational leadership. In videoconference settings, these students seek clarity, in-depth analysis, and access to up-to-date disciplinary knowledge, requiring teachers to present current theoretical models and extend beyond assigned readings. While videoconferencing facilitates real-time content transmission and instructional control, an exclusive focus on content acquisition risks rendering teaching transactional, rather than supporting the dialectical, practice-oriented model of e-leadership advocated here (Badia et al., 2017).

Since every videoconferencing class is likely to include students who align with all three groups, Badia et al. (2017) argue that effective online teaching requires a balance of learning approaches. In this context, comprehensive e-leadership involves a style that flexibly shifts across different theoretical orientations, such as socio-emotional, transformational, and situational leadership.

Regarding control variables, students aged 32 years or younger rated comprehensive e-leadership significantly higher, indicating stronger pedagogical needs across situational, transformational, and socio-emotional dimensions. Female students showed a significant association with socio-emotional e-leadership, consistent with

evidence linking this orientation to higher emotional intelligence (Hsu et al., 2022). This group also placed greater value on situational leadership, encompassing both task- and relationship-oriented approaches.

The findings differ from Avolio and Kahai's (2003) claim that e-leadership requires an entirely new framework distinct from traditional leadership models (Kahai et al., 2013). Instead, the present results align with Fuertes-Alpiste et al. (2023), highlighting that videoconferencing designs incorporating open-ended activities are perceived as supporting dialogue, reflection, and critical thinking. The evidence suggests that elements of traditional leadership models may still hold relevance in synchronous online environments (Liu et al., 2020). However, this does not diminish the importance of ongoing research into how digital transformation is reshaping leadership practices (Van Wart et al., 2019). Across modalities—face-to-face, hybrid, and online—establishing a climate of trust remains a common theme in leadership theory and is regarded as particularly relevant for reducing perceived distance in digital contexts (Cowan, 2014).

4.2. Implications and directions for future research

Future research should examine how personalized, real-time verbal and nonverbal communication strategies shape teaching presence (TP) in synchronous environments, particularly which communicative behaviours most strongly enhance engagement and collaborative knowledge construction. Studies should also explore instructional approaches that operationalize Socratic learning in synchronous videoconferencing. The case method, adapted to webcam-mediated classrooms, may be especially suitable: when students prepare cases in advance and sessions are structured around pre-announced, open-ended questions, videoconferences can function as spaces for dialogue, inquiry, and collective sense-making. In this context, teaching presence is enacted through questioning rather than exposition, positioning leadership as an ongoing conversation that requires active student participation. Future work could empirically examine how this Socratic, case-based design enhances participation quality, dialogical depth, and leadership-related competencies in synchronous online education.

Further research should also investigate the role of trust in videoconferencing-based learning. Although trust appears central to effective comprehensive e-leadership, additional studies are needed to clarify how it is developed and sustained in online classrooms and how it influences participation and learning outcomes. Specific attention should be given to interactional processes—such as instructional design, feedback practices, and structured dialogue—that foster durable trust.

The socio-emotional dimension of e-leadership warrants deeper exploration, particularly regarding how teachers' responsiveness to students' emotional needs promotes psychological safety, positive classroom dynamics, and sustained academic success. Related work could analyze how transformational e-leadership supports constructivist online environments, including the negotiation of shared values, ethics, and goals in virtual settings.

Future research should also assess how students focused on content acquisition and individual knowledge construction engage collaboratively, and whether such orientations constrain social learning.

Finally, further investigation is required into the adaptability of e-leadership styles to diverse learner profiles. Situational approaches—where leadership adjusts to students' competence and commitment—appear especially relevant in videoconferencing contexts characterized by varied learning approaches. Longitudinal studies should evaluate how adaptive e-leadership influences motivation, performance, and group cohesion over time.

4.2.1. Limitations

Studies with larger and more diverse samples will also be essential to confirm these findings and to explore their applicability across various fields beyond that of management, and educational levels, particularly concerning the key factors that shape students' educational experiences in online learning via videoconferencing.

Although initial validation included expert review, EFA, CFA, and invariance testing, we acknowledge the use of PCA during exploration and the lack of a pilot/external validation sample; future studies will apply common-factor EFA, independent-sample validation, and test-retest analyses.

The cross-sectional design prevents causal inference. Although associations are theoretically meaningful, longitudinal or experimental designs are needed to determine directionality among PCW, TP, and e-leadership.

The study's measurement of learning approach relied on a single forced-choice categorical item, an approach that does not fully capture the multidimensional nature of this well-established construct. This constrained operationalization may weaken the robustness of the multigroup CFA findings, and thus the related results should be interpreted with appropriate caution. This approach oversimplifies a well-established multidimensional construct (e.g., deep, surface, or strategic dimensions) and further research could capture its complexity and continuous nature.

Within a constructivist framework, Wu et al., (2022) found social interaction non-significant, suggesting content–student interaction as the main driver of online learning. Future research should replicate Model 1 across diverse cultural contexts to test cultural influences beyond the Ibero-American sample. Cultural factors may shape outcomes and inform cross-cultural applicability. Supporting this view, Shadiev et al., (2025) reported that cross-cultural competence relates to cognitive and emotional, rather than social, interactive behaviors.

5. Conclusion

The proposed model provides guidance on how students perceive teaching presence (TP) in webcam-mediated communication, informing online educators' professional development (Lanzo et al., 2022) and supporting the design of videoconference-based courses in higher education. It addresses limitations of asynchronous online models that prioritize access over meaningful interaction (Anderson & Rivera-Vargas, 2020; Sangrà, 2020) and offers a constructivist, dialectical, and holistic framework for teacher–student interaction (Bass & Avolio, 1995). The model emphasizes the importance of accommodating diverse learning approaches—content acquisition, individual knowledge building, and collaborative learning—highlighting the need for TP to be flexible and inclusive in videoconferencing classrooms.

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