

## Studies in Second Language Learning and Teaching

Department of English Studies, Faculty of Pedagogy and Fine Arts, Adam Mickiewicz University, Kalisz

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### ***Enhancing multifaceted interactions in EFL learning: The roles of classroom social climate, perceived L2 proficiency, and willingness to communicate***

**Jinfen Xu**

Huazhong University of Science and Technology, Wuhan, China

<https://orcid.org/0000-0003-0515-0887>

[xujinfen@hust.edu.cn](mailto:xujinfen@hust.edu.cn)

**Xiaoli Feng** ✉

Huazhong University of Science and Technology, Wuhan, China

<https://orcid.org/0009-0005-4810-3302>

[xlffeng1208@hust.edu.cn](mailto:xlffeng1208@hust.edu.cn)

#### **Abstract**

Interaction provides second language (L2) learners with opportunities for authentic language use and promotes their language development, underscoring the need to identify factors that contribute to L2 interactions. Drawing on the pyramid model of willingness to communicate (WTC), this study explores how classroom social climate (CSC), perceived L2 proficiency (PLP), and WTC influence students' multifaceted interactions (MI) with their teachers, peers, and computer tools. A total of 665 Chinese non-English majors voluntarily participated in the study. A two-phase analytical approach combining partial least squares structural equation modeling (PLS-SEM) and psychological network analysis (PNA) was employed to examine both linear and non-linear relationships among the variables. The PLS-SEM results showed that CSC and WTC significantly and positively predicted MI, whereas the direct effect of PLP on MI was negligible. WTC significantly mediated the paths from CSC and PLP to MI, with mediating effects exceeding the corresponding direct effects. The PNA further underscores the central position of WTC in the network and its bridging

role in linking CSC and PLP to MI. These findings highlight key factors shaping L2 interactions and offer practical implications for language education.

*Keywords:* classroom social climate; perceived L2 proficiency; willingness to communicate; multifaceted interactions; psychological network analysis

## 1. Introduction

Interaction is a dynamic and reciprocal process in which learners adjust their actions and thoughts through information exchange (Wei et al., 2012). In second language (L2) education, interaction primarily comprises teacher-student interaction, student-student interaction (Loewen & Sato, 2018), and student-computer interaction (Pikhart, 2021), which together form an integrated dynamic system of multifaceted interactions (MI) throughout the L2 learning process (Zhang et al., 2026). According to the interaction hypothesis (Long, 1996) and the output hypothesis (Swain, 1985), interactive exchanges can facilitate L2 development by providing opportunities for meaning negotiation and pushed output. Complementing this perspective, the cognitive interactionist approach (Kim, 2017) addresses the cognitive foundations of interaction, emphasizing the role of attention to linguistic form and corrective feedback in mediating the effects of interaction on L2 learning. In line with these theoretical accounts, empirical research has confirmed the benefits of interaction for vocabulary acquisition, grammatical accuracy, and overall communicative competence (Loewen & Sato, 2018; Mackey & Goo, 2007). Accordingly, identifying the factors that enhance learners' multifaceted interactions is of central importance to L2 research.

L2 learners' interaction behaviors may fluctuate due to different intrinsic and extrinsic factors (Loewen & Sato, 2018; Wang et al., 2019). When it comes to the learner-internal antecedents, willingness to communicate (WTC) is a psychological factor referring to a person's readiness to initiate communication in the L2 when given the opportunity (MacIntyre et al., 1998). WTC has been found to be a positive predictor of interpersonal classroom interactions (Wang et al., 2019), but its effect on MI that also involve student-computer interaction remains an open question. Perceived L2 proficiency (PLP) is another vital learner-internal factor. It represents learners' subjective judgment of their own L2 ability, which can potentially influence their actual interaction behaviors. When learners perceive their L2 proficiency as higher, their communication anxiety tends to decrease (Su, 2021), which in turn reinforces their WTC and stimulates communication behaviors (MacIntyre et al., 1998). Moving on to the learner-external antecedents, classroom social climate (CSC) plays a fundamental role in shaping experiences in

learning English as a foreign language (EFL) (Joe et al., 2017). Positive CSC is conducive to improving learners' WTC and sustaining active engagement in learning behaviors (Derakhshan et al., 2022; Joe et al., 2017). Yet, it is unclear whether and how CSC contributes to learners' multifaceted interactions in the EFL context.

In L2 education, researchers generally agree that learners' interactions are shaped by the interplay of intrinsic and extrinsic factors (Derakhshan et al., 2022; Ji et al., 2024). However, existing research has primarily examined the effects of WTC, PLP, and CSC in isolation, leaving it unclear how these variables work together to influence students' interactions with their teachers, peers, and computer tools. Besides, prior research has relied largely on conventional analytical methods (e.g., regression analysis, structural equation modeling) to test unidirectional hypothetical relationships. While such methods are well-suited for examining linear pathways, they are limited in capturing the complex interconnections among multiple variables (Freeborn et al., 2023). Psychological network analysis (PNA) complements these methods by enabling researchers to examine interrelationships among psychological constructs, identify key factors, and gain more nuanced insights (Epskamp et al., 2018). To address these research gaps, this study adopts a two-phase analytical approach combining PLS-SEM and PNA to examine how CSC, PLP, and WTC interact to predict MI. This study seeks to advance a nuanced understanding of factors shaping MI in L2 learning, offering empirical insights to improve EFL instructional practices.

## **2. Literature review**

This section first introduces the WTC pyramid model, which serves as the theoretical framework for this study. Then it moves to a conceptual analysis of MI, CSC, and PLP, followed by a review of empirical studies on their relationships. This part lastly sums up existing research limitations, offers the conceptual model and formulates the research questions accordingly.

### **2.1. L2 WTC model as the framework**

WTC was initially conceptualized as a stable predisposition or personality trait that indicates an individual's possibility to engage in communication in their native or first language (McCroskey & Baer, 1985). In second language acquisition (SLA) research, given the uncertainty and complexity involved in L2 learning, researchers started to consider WTC a situational variable with both transient and enduring influences (Henry & MacIntyre, 2024). This implies that WTC is not

only a trait-like variable but a state where an individual feels inclined to initiate communicative activity using L2 in specific contexts (Peng & Woodrow, 2010).

In the pyramid model of L2 WTC (MacIntyre et al., 1998, p. 547), a variety of social, psychological, and context-dependent variables are arranged into six hierarchical layers. The upper three layers correspond to context-dependent factors shaping WTC at a specific moment, while the lower three layers reflect enduring influences on the underlying process. Factors in the lower layers (e.g., intergroup climate and L2 self-confidence) influence factors and WTC in the upper layers, thereby facilitating L2 use (Yang & Lin, 2024). With the dynamic turn in WTC research, L2 use is conceptualized as the outcome of a complex system of interrelated variables, and the fluid and emergent nature of WTC is emphasized (Henry & MacIntyre, 2024). This dynamic perspective highlights the need to examine the WTC model not as a static structure but as a fluid system that fluctuates based on contextual and psychological conditions.

According to the WTC model, intergroup climate and L2 self-confidence are theorized as distal and proximal antecedents of WTC, which in turn serves as the immediate precursor to communicative behaviors. In this study, the concept of MI corresponds to the communicative behaviors, including activities like participating in classroom discussions and engaging in technology-mediated online communication (Henry & MacIntyre, 2024). Intergroup climate pertains to community structural characteristics and their perceptual-affective correlates, and is conceptualized as learners' perceptions of and feelings toward the L2 community (MacIntyre et al., 1998). Adopting this logic in the classroom context, the present study focuses on learners' perceptions of support and respect within their classroom, operationalized as CSC (Joe et al., 2017). Meanwhile, L2 self-confidence refers to an individual's belief in their L2 communicative ability. This self-confidence comprises cognitive (e.g., self-evaluation of L2 skills) and affective (e.g., language anxiety) components (MacIntyre et al., 1998). In our framework, the cognitive component is operationalized as PLP. Therefore, based on these theoretical alignments, we propose that CSC and PLP predict WTC. Furthermore, these variables may reciprocally influence one another and jointly shape MI.

## **2.2. Multifaceted interactions in L2 learning**

Interaction can stimulate deep learning by enabling learners to integrate new information with existing concepts and link it to their life experiences (Jung et al., 2002). According to the interaction hypothesis (Long, 1996) and the output hypothesis (Swain, 1985), interaction facilitates L2 development through mechanisms such as meaning negotiation, corrective feedback, and pushed output.

Consistent with this theoretical view, empirical evidence shows that when learners take part in interactions, they concurrently perform behaviors and engage in cognitive processes conducive to L2 learning and their eventual language development (Fan & Xu, 2020; Sato, 2022). Traditionally, research on interaction focused on classroom-based communication between students and their teachers or classmates (Sato, 2022). Bolstered by the evolution of educational technology, student-computer interaction, particularly in the context of computer- and mobile-assisted language learning, has increasingly captured the interest of L2 researchers (Hampel & Stickler, 2012; Pikhart, 2021). The recent rise of generative artificial intelligence (GenAI) has further reinforced the pivotal role of student-computer interaction in SLA research (Ji et al., 2024; Wang et al., 2024).

Previous studies have extensively explored three types of interactions in L2 education. Specifically, teacher-student interaction refers to the bidirectional feedback between students and their instructors in and out of class (Loewen & Sato, 2018; Wang et al., 2019). In this reciprocal process, the teacher generally serves as the guide and supporter of the interaction activities (Loewen & Sato, 2018). Student-student interaction is the communication and collaboration that occurs among learners through synchronous or asynchronous means (Hampel & Stickler, 2012; Long & Porter, 1985). It has been found to increase opportunities for learners' meaning negotiation and feedback (Fan & Xu, 2020; Long, 1996) and enhance the effectiveness of collaborative learning (Saeed & Alharbi, 2023). Student-computer interaction mainly encompasses the process by which learners engage in learning using mobile devices, computer software, ChatGPT, and other online or AI tools (Pikhart, 2021; Wang et al., 2024). Student-computer interaction offers significant advantages to SLA by addressing key challenges in language classrooms, including the scarcity of tailored feedback, limited chances for language use, and the hesitancy or nervousness associated with speaking a novel language (Wang et al., 2024). The three interaction types are not mutually exclusive but jointly constitute an integrated system (Ji et al., 2024; Xu et al., 2025), which the present study terms *multifaceted interactions*. However, as the three types are conceptually distinct and not interchangeable, they are better conceived as independent contributors to the overall construct of MI rather than as reflective indicators (Hair & Alamer, 2022). MI is therefore operationalized as a formative second-order construct in this study.

### **2.3. Classroom social climate and L2 interactions**

CSC is a pivotal factor concerning the traits, perceptions and activities of learners in L2 environments (Derakhshan et al., 2022; Joe et al., 2017). Dörnyei and Murphey

(2003) claimed that all the classroom social relationships, learners' communication modes and other group processes could be included in the category of CSC. In a similar vein, based on the identification of adaptive classrooms by Patrick and Ryan (2005), Joe et al. (2017) posited a three-dimensional CSC construct comprising teacher academic support, teacher emotional support, and classroom mutual respect, and validated its applicability in L2 contexts. Specifically, *teacher academic support* captures learners' perceived instructional assistance from teachers in learning academic content. *Teacher emotional support* concerns the extent to which teachers care for students' personal well-being and offer emotional encouragement. *Classroom mutual respect* pertains to the perceived emphasis placed by teachers on fostering an environment of respect and peer support within classroom interactions. An increasing number of studies suggest that CSC not only influences how learners think and act in the classroom (Joe et al., 2017; Yang & Lin, 2024) but also plays a crucial role in fostering their emotional engagement and sustained effort in L2 learning beyond the classroom (e.g., Derakhshan et al., 2022; Wang et al., 2024).

Positive CSC can act as a potential predictor of MI. Raghul and Saradha (2016) describe a favorable classroom environment as appealing to L2 learners and conducive to developing their confidence in becoming socially active in class. In a study of 287 EFL majors, Derakhshan et al. (2022) found that growth mindset and other individual differences were determinants of positive CSC, where students' classroom interaction can be effectively nurtured. In addition, drawing on empirical studies on CSC and online learning, Qiu (2022) concluded that a positive CSC facilitates students' social interaction in the online L2 classroom by fostering a sense of community and reducing interaction anxiety. While these studies have confirmed that CSC facilitates classroom-based interactions, they have largely been confined to teacher-student and peer interactions in instructional settings. However, classroom experiences may carry over to influence learners' engagement with English beyond the classroom (Rotjanawongchai, 2023). Unfortunately, little attention has been paid to whether and how CSC predicts a broader spectrum of MI, including engagement with digital tools and AI, as well as out-of-class interactions.

## **2.4. Perceived L2 proficiency and L2 interactions**

PLP refers to learners' subjective assessment and degree of self-confidence regarding their proficiency in a second language (Vincze & MacIntyre, 2017). It has been operationalized as a multidimensional construct comprising self-assessed reading, writing, speaking, and listening skills (Peng & Patterson, 2022). In L2 education, PLP plays a crucial role as it not only influences students' learning behaviors,

but also significantly impacts their self-assessment and learning motivation more than actual growth in L2 proficiency (Tanaka, 2024). Du (2015) found that American students studying Chinese abroad took great pride in their L2 proficiency and used it to their social advantage, suggesting that positive self-perceptions can serve as an asset that encourages active language engagement.

Empirical evidence suggests that learners with higher PLP tend to participate more actively in communicative activities (Su, 2021; Vincze & MacIntyre, 2017). Su (2021), for example, reported that 333 Taiwanese EFL students who perceived themselves as more proficient reported lower communication anxiety and more frequent use of oral communication strategies. Vincze and MacIntyre (2017) examined the psychological processes underlying WTC among 310 Hungarian-speaking secondary school students learning Slovak. They observed that more frequent and pleasant contact with L2 speakers was associated with higher perceived proficiency and lower L2 use anxiety. Kim (2024) further investigated the interplay among language mindsets, self-efficacy, engagement, and perceived proficiency among 257 Korean university students and found that PLP was positively correlated with students' engagement in L2 learning. These conditions may encourage more frequent L2 practice in online and offline settings, thereby increasing both language use and interaction frequency. Taken together, these findings suggest that PLP may be linked to learners' interactions with teachers, peers, and digital tools. However, the direct relationship between PLP and MI remains under-explored

## **2.5. Empirical studies on the links among CSC, PLP, WTC and MI**

Several empirical studies have examined the predictive effect of WTC on L2 interaction behaviors. Wang et al. (2019) conducted a study with 329 English majors from northern Taiwan and found that WTC significantly predicted learners' classroom interaction to a substantial degree ( $\beta = .47^{**}$ ). Yashima et al. (2018) conducted an interventional study in an EFL class with 21 students in a Japanese university, revealing that students with high WTC were more likely to initiate communication proactively in class compared with those reluctant to talk. However, another study carried out by Cao and Philp (2006) reported that the relationship between learners' WTC and their actual classroom behaviors was not always consistent as it varied across different interactional contexts. Informed by these inconsistent results, there is a compelling need to explore the extent to which WTC predicts interaction behaviors in a larger sample size.

Prior research has also established the relationships between CSC or PLP and WTC, providing a basis for examining WTC as a mediator in the pathways from CSC and PLP to MI. Yang and Lin (2024) employed a latent growth curve

analysis to examine the changes in 894 Chinese EFL learners' WTC over a semester and found that CSC had a long-term and significant influence on learners' classroom engagement, WTC, and ultimate L2 achievement. Soyoof (2023) interviewed 50 Iranian secondary school EFL learners and discovered that the inter-group climate significantly influenced learners' WTC and communication in extramural digital settings. Similarly, PLP was found to be closely correlated with oral communication strategies (Su, 2021). Learners perceiving a higher level of L2 proficiency in speaking topics were more likely to increase their WTC and opportunities to speak in the classroom (Rotjanawongchai, 2023). Informed by these findings, we propose that CSC and PLP may also indirectly influence MI through WTC.

Apart from the research focusing on the unidirectional effects of CSC, PLP, and WTC on interaction behaviors mentioned above, studies have also proved the interplay between these factors. For instance, Wang et al. (2024) surveyed 547 American undergraduate students learning languages other than English and found a small to moderate significant positive correlation between WTC and CSC in and out of the classroom. This suggested a reciprocal predictive relationship between these two factors. Wang et al. (2019) conducted a study with 329 university students in Taiwan and reported that learners' perceptions of group interaction and interaction with the teacher significantly predicted L2 WTC and classroom communication in the target language. In a mixed-methods study with Thai EFL first-year university students, Rotjanawongchai (2023) found that perceived proficiency was closely linked to WTC as topics matching students' perceived level increased their willingness to speak in class. These findings imply that CSC, PLP, and WTC may be interrelated in their influence on L2 learning. However, to the best of our knowledge, no research has examined how these three variables interact to jointly predict MI among Chinese EFL learners.

## **2.6. The present study**

While numerous studies have examined the impact of CSC, PLP, and WTC on unidimensional interaction (e.g., teacher-student or peer interaction), limited research has focused on the influence of these factors on students' MI with their teachers, peers, digital or AI tools. Moreover, previous research has only demonstrated the unidirectional paths from CSC, PLP, and WTC to L2 interactions, failing to reveal the interplay among these factors. Additionally, the analytical methods used in previous studies have primarily been qualitative and linear (e.g., Rotjanawongchai, 2023; Soyoof, 2023; Wang et al., 2024), which may not fully capture the potential non-linear patterns of learners' psychological dynamics in foreign language learning.

The present study draws on the WTC pyramid model (MacIntyre et al., 1998) to frame the hypothesized relationships among CSC, PLP, WTC, and MI. To examine

these relationships, a two-phase analytical approach is adopted, as illustrated in Figure 1. Phase 1 uses PLS-SEM to test the paths from CSC and PLP to MI, both directly and through the mediation of WTC. Phase 2 employs PNA to explore the interconnections among the four constructs and to identify which variable is most central to the network. This combination of methods makes it possible to examine both the directional paths and the relational structure among the key variables. The following research questions guide this investigation:

RQ1: To what extent do CSC, PLP and WTC predict MI among Chinese EFL learners?

RQ2: To what extent does WTC mediate the relationship between CSC, PLP and MI among Chinese EFL learners?

RQ3: How are CSC, PLP, WTC, and MI interconnected in the psychological network, and which variable is most central in this network?

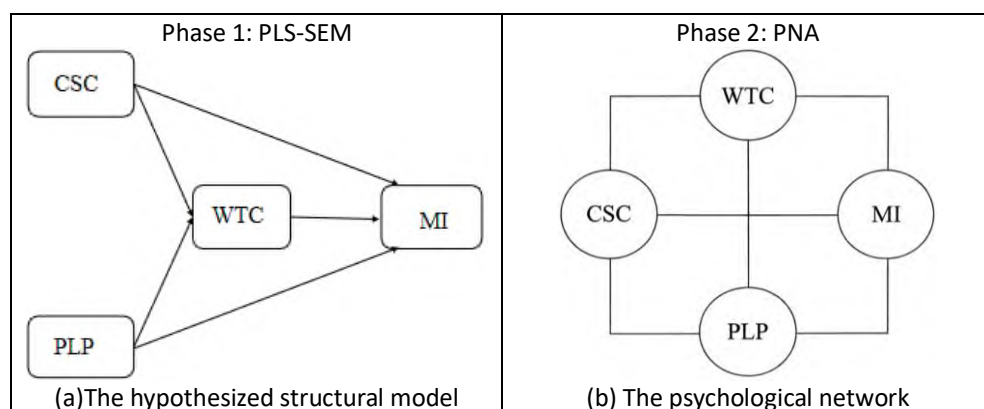


**Figure 1** Two-phase analytical framework: hypothesized structural model and psychological network (CSC = classroom social climate; PLP = perceived L2 proficiency; WTC = willingness to communicate; MI = multifaceted interactions)

### 3. Methodology

#### 3.1. Participants

Participants were recruited through convenience sampling to access a large and diverse sample from multiple universities within a limited time frame. A total of 665 non-English majors from 12 universities across China voluntarily participated in this study. These participants included 347 males (52.2%) and 318 females (47.8%), with an average age of 18.98 years ( $SD = 0.96$  years). Their academic backgrounds

spanned science and engineering, economics and management, humanities, medicine, arts, and sports. At the time of the study, they had been learning English as a foreign language for at least nine years as they had been required to take English as a compulsory subject since primary school. All the participants in this sample had passed the National College Entrance Examination; 95.2% of them had passed the College English Test Band 4 (the average score of the participants is 516.5 out of 710). They also reported having prior L2 interaction experience with teachers, peers, and computer-mediated platforms.

### **3.2. Instruments and data collection**

A composite questionnaire was administered in Chinese to ensure participants' full comprehension as all respondents were native Chinese speakers. It consisted of four parts, including demographic information, followed by scales measuring CSC, PLP, WTC, and MI (see Appendix for the full instrument). All scales were re-validated for the purpose and context of this study, with the results presented in the section reporting the results. The scales are described below.

#### **3.2.1. Multifaceted interactions scale**

The scale developed by Xu and Feng (2024) was used to indicate English learners' interaction behaviors as it had been validated in the Chinese EFL context. It encompasses three sub-scales, namely, teacher-student interaction, student-student interaction, and student-computer interaction. A total of 18 items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item representing student-computer interaction is "I interact with digital tools to obtain English learning resources."

#### **3.2.2. Classroom social climate scale**

The *Classroom Social Climate Scale* developed by Joe et al. (2017) was used to assess students' perceptions of the classroom atmosphere in Chinese EFL settings. The scale comprises 12 items, three of which are reverse-scored. It assesses CSC in terms of teacher emotional support, teacher academic support, and classroom mutual respect. The items were rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). A sample item of this scale (teacher academic support) is "My English teacher cares about how much we learn."

### **3.2.3. Perceived L2 proficiency**

Participants' perceived L2 proficiency was measured with the scale developed by Peng and Patterson (2022). A total of four items were included in this scale. Responses were rated on a 5-point Likert scale ranging from 1 ("far below average") to 5 ("far above average"). A sample item is "How well do you read English?"

### **3.2.4. Willingness to communicate**

This study employed an adapted L2 WTC scale developed by Peng and Woodrow (2010) to measure the participants' willingness to initiate communication when given the opportunity. The scale comprises 10 items, covering two dimensions, namely, *WTC in English for meaning-focused activities* and *WTC in English for form-focused activities*. We revised the term "group mates" in the original scale to "others" to better align with the context of this study. Each item was scored from 1 ("strongly disagree") to 5 ("strongly agree") on a Likert scale. A sample item is "I am willing to give a short self-introduction without notes in English to the others."

The questionnaire was distributed via the researchers' institutional networks. English teachers at 12 universities administered the survey during class breaks to facilitate participation. Ethical approval was obtained from the relevant institutional review board. Informed consent was obtained from all participants prior to their participation, and they were assured of their anonymity and their right to withdraw at any time.

## **3.3. Data analysis**

Initially, SPSS 23 was used for data screening, during which cases with identical responses across all items or with implausible values in age or English test scores were removed. Descriptive statistics and correlational analysis were computed on the remaining data. The formal data analysis was then conducted in two phases: hypothetical model validation and psychological network analysis.

In the first phase, PLS-SEM with Smart-PLS 4 was employed to examine the structural relationships among CSC, PLP, WTC, and MI. This method was chosen because it is particularly suited for complex models that include formative constructs (Hair & Alamer, 2022). The PLS-SEM analysis comprises measurement model and structural model estimation. For the reflective first-order measurement models, reliability and validity were evaluated using factor loadings, composite

reliability (CR), average variance extracted (AVE), and the Heterotrait-monotrait ratio (HTMT). Given that this study also incorporates a formative second-order measurement model for MI, additional tests were conducted to examine variance inflation factor (VIF), indicator weights, and their statistical significance among the three formative dimensions: teacher-student interaction, student-student interaction, and student-computer interaction. The structural model estimation mainly involves path coefficient analysis and mediation analysis, with reference indicators including  $R$ -squared ( $R^2$ ),  $f$ -squared ( $f^2$ ), 95% confidence intervals from bootstrapping,  $t$ -values, and  $p$ -values (Hair & Alamer, 2022).

Subsequently, PNA was performed in JASP to illustrate the interconnections among the variables. As a method for examining and visualizing interrelationships among variables in a network, PNA involves three steps: network estimation and visualization, centrality analysis, and stability estimations (Epskamp et al., 2018). First, to minimize spurious connections and ensure a sparse, interpretable network, a Gaussian graphical model (GGM) was estimated using the least absolute shrinkage and selection operator (LASSO) regularization and the extended Bayesian information criterion (EBIC). In the network, nodes represent variables, and edges indicate the strength and direction of associations. The edges are generally undirected, reflecting the assumption that variables influence one another in an interconnected, multicausal system. Edge weights (i.e., the strength of relationships between variables) are represented by partial correlation coefficients and visualized through edge thickness and node distance, with positive and negative associations shown as solid and dashed lines, respectively. Larger absolute edge weights indicate closer associations between variables. Second, centrality indices, including strength, closeness, betweenness, and expected influence, were analyzed to identify key variables central to the network. Finally, the stability of the network estimates was assessed using two bootstrap procedures. Non-parametric bootstrapping with 5,000 resamples was used to compute 95% confidence intervals for the edge weights, and case-dropping subset bootstrapping was employed to examine the stability of the centrality indices (Epskamp et al., 2018).

## 4. Results

The results section begins with descriptive statistics and correlational analyses, followed by the two-phase analytical framework. Phase 1 reports the PLS-SEM findings, including measurement model evaluation, structural path coefficients, and mediation effects. Phase 2 presents the psychological network structure and centrality indices.

## 4.1. Descriptive analysis and correlational analysis

Table 1 shows the means, correlations, skewness and kurtosis of the variables. Skewness and kurtosis values were within the range of  $\pm 2$ , indicating that the data were normally distributed (Collier, 2020). The participants reported a high level of CSC and moderately high degrees of WTC and MI, with PLP being relatively lower. The correlational analysis revealed that CSC, PLP, WTC, and MI were all significantly correlated with each other ( $p < .01$ ). The strongest correlation was observed between WTC and MI ( $r = .763$ ). CSC also showed strong correlations with both WTC ( $r = .697$ ) and MI ( $r = .656$ ). PLP showed relatively weaker but still significant correlations with the other variables ( $r = .198$  to  $.360$ ).

**Table 1** Results of descriptive analysis and correlational analysis

| Variable | CSC    | PLP    | WTC    | MI    |
|----------|--------|--------|--------|-------|
| CSC      | —      |        |        |       |
| PLP      | .198** | —      |        |       |
| WTC      | .697** | .360** | —      |       |
| MI       | .656** | .334** | .763** | —     |
| Mean     | 4.132  | 2.951  | 3.768  | 3.565 |
| SD       | .705   | .654   | .725   | .727  |
| Skewness | -.831  | -.112  | -.123  | -.023 |
| Kurtosis | 1.395  | 1.753  | .117   | .321  |

Note. \*\* $p < .01$ .  $N = 665$ . CSC = classroom social climate; PLP = perceived L2 proficiency; WTC = willingness to communicate; MI = multifaceted interactions; SD = standard deviation

## 4.2. Measurement model estimation

The measurement model was assessed using PLS-SEM. Reliability and validity were evaluated through indicator loadings, CR, AVE, and the HTMT. This study encompassed eight first-order reflective measurement models and a second-order formative measurement model. For the first-order reflective models, following the recommendations of Hair and Alamer (2022), items with factor loadings lower than .70 and variance inflation factors (VIF) higher than 5 were eliminated during the measurement model assessment. The remaining observable items all exhibited factor loadings exceeding .70 (see Table 2), indicating high indicator validity for these measurement models. Additionally, Cronbach's  $\alpha$  and CR values for all reflective constructs surpassed .80, demonstrating excellent internal consistency reliability. The AVE were greater than .50, which supports good convergent validity among the constructs. Furthermore, the HTMT ratios were below .85, confirming that the measurement models had good discriminant validity (see Table 3).

**Table 2** Results of construct reliability and convergent validity

| Construct                                                | Item                         | Loading | Mean    | <i>a</i> | CR    | AVE  |
|----------------------------------------------------------|------------------------------|---------|---------|----------|-------|------|
| Teacher-student interaction                              | M1                           | .839    | 3.300   | .925     | .941  | .727 |
|                                                          | M2                           | .854    | 2.850   |          |       |      |
|                                                          | M3                           | .873    | 3.470   |          |       |      |
|                                                          | M4                           | .826    | 3.540   |          |       |      |
|                                                          | M5                           | .869    | 3.400   |          |       |      |
| Student-student interaction                              | M6                           | .854    | 2.880   | .935     | .949  | .756 |
|                                                          | M7                           | .870    | 3.640   |          |       |      |
|                                                          | M8                           | .892    | 3.570   |          |       |      |
|                                                          | M9                           | .898    | 3.560   |          |       |      |
|                                                          | M10                          | .851    | 3.460   |          |       |      |
| Student-computer interaction                             | M11                          | .836    | 3.650   | .915     | .940  | .797 |
|                                                          | M12                          | .868    | 3.580   |          |       |      |
|                                                          | M13                          | .891    | 4.160   |          |       |      |
|                                                          | M16                          | .901    | 4.110   |          |       |      |
|                                                          | M17                          | .923    | 4.010   |          |       |      |
| Willingness to communicate in meaning-focused activities | M18                          | .855    | 3.860   | .904     | .929  | .723 |
|                                                          | W1                           | .792    | 4.200   |          |       |      |
|                                                          | W2                           | .830    | 4.040   |          |       |      |
|                                                          | W3                           | .904    | 3.850   |          |       |      |
|                                                          | W4                           | .844    | 3.620   |          |       |      |
| Willingness to communicate in form-focused activities    | W6                           | .878    | 3.800   | .894     | .934  | .825 |
|                                                          | W7                           | .885    | 3.380   |          |       |      |
|                                                          | W8                           | .916    | 3.660   |          |       |      |
|                                                          | W9                           | .924    | 3.590   |          |       |      |
| Perceived L2 proficiency                                 | P1                           | .883    | 3.150   | .870     | .911  | .719 |
|                                                          | P2                           | .843    | 2.900   |          |       |      |
|                                                          | P3                           | .844    | 2.810   |          |       |      |
|                                                          | P4                           | .821    | 2.950   |          |       |      |
| Teacher emotional support                                | C1                           | .952    | 4.290   | .956     | .968  | .883 |
|                                                          | C2                           | .951    | 4.340   |          |       |      |
|                                                          | C3                           | .929    | 4.230   |          |       |      |
|                                                          | C4                           | .927    | 4.260   |          |       |      |
| Teacher academic support                                 | C5                           | .940    | 3.870   | .944     | .964  | .899 |
|                                                          | C6                           | .946    | 3.970   |          |       |      |
|                                                          | C7                           | .959    | 3.970   |          |       |      |
| Formative construct                                      | Items                        | Weight  | t-value | VIF      | Mean  |      |
| Multifaceted interactions                                | Teacher-student interaction  | .364    | 7.582   | 2.317    | 3.241 |      |
|                                                          | Student-student interaction  | .354    | 6.922   | 2.605    | 3.575 |      |
|                                                          | Student-computer interaction | .458    | 10.535  | 1.464    | 4.035 |      |

For the second-order formative measurement model of multifaceted interactions, the weight and its significance of formative indicators, along with multicollinearity, are key criteria for evaluating model acceptability. As shown in Table 2, the three formative indicators (teacher-student interaction, student-student interaction, and student-computer interaction) exhibited weights of .364, .354, and .458, respectively. All corresponding *t*-values exceeded 1.96, and VIF values were less than 5, indicating the absence of multicollinearity and the acceptability of the formative model (Hair & Alamer, 2022).

**Table 3** Heterotrait-monotrait (HTMT) ratio matrix

| Construct                       | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8 |
|---------------------------------|------|------|------|------|------|------|------|---|
| 1. Teacher-student interaction  |      |      |      |      |      |      |      |   |
| 2. Student-student interaction  | .807 |      |      |      |      |      |      |   |
| 3. Student-computer interaction | .511 | .598 |      |      |      |      |      |   |
| 4. Willingness to communicate_1 | .767 | .728 | .537 |      |      |      |      |   |
| 5. Willingness to communicate_2 | .577 | .617 | .661 | .661 |      |      |      |   |
| 6. Perceived L2 proficiency     | .373 | .305 | .264 | .395 | .338 |      |      |   |
| 7. Teacher emotional support    | .428 | .507 | .593 | .512 | .601 | .149 |      |   |
| 8. Teacher academic support     | .627 | .677 | .581 | .712 | .685 | .261 | .728 |   |

Note. Willingness to communicate\_1 = WTC in meaning-focused activities; Willingness to communicate\_2 = WTC in form-focused activities

### 4.3. Structural model analysis

Structural model analysis was conducted using a bootstrap method with 5,000 resamples to estimate the model parameters. The results are presented in Table 4. As shown in the table, both CSC and WTC significantly and positively predicted MI ( $t > 1.96$ ,  $p < .001$ ). In contrast, PLP exhibited only a negligible positive predictive effect on MI ( $\beta = .086 \approx .10$ ,  $t > 1.96$ ,  $p > .001$ ), suggesting that increasing PLP is unlikely to yield meaningful improvements in MI (Hair & Alamer, 2022). The  $R^2$  values indicated strong explanatory power, with .635 for MI and .535 for WTC, both exceeding the .50 threshold in L2 research (Hair & Alamer, 2022). This suggests that the variances in MI and WTC were well accounted for by their respective predictor constructs. Effect size ( $f^2$ ) was used to assess the relevance and magnitude with which each path contributed to explaining the variance of the endogenous constructs. Following Cohen's (1988) guidelines, the effect size analysis revealed a medium effect size of CSC on MI ( $f^2 = .109$ ) and a large effect size of WTC on MI ( $f^2 = .376$ ). Notably, the effect size of PLP on MI fell below the threshold for a small effect ( $f^2 < .02$ ), indicating that PLP exerts virtually no practical influence on the variance of MI.

**Table 4** Results of the direct effect analysis

| Path      | $\beta$ | SD   | $t$ -value | $p$ -value | $R^2$ | $f^2$ | 2.5% LLCI | 97.5% ULCI |
|-----------|---------|------|------------|------------|-------|-------|-----------|------------|
| CSC → MI  | .279    | .048 | 5.800      | < .001     | .635  | .109  | .184      | .371       |
| WTC → MI  | .544    | .047 | 11.461     | < .001     |       | .376  | .453      | .638       |
| PLP → MI  | .086    | .027 | 3.151      | .002       |       | .017  | .032      | .141       |
| CSC → WTC | .650    | .027 | 24.209     | < .001     | .535  | .875  | .597      | .701       |
| PLP → WTC | .230    | .031 | 7.438      | < .001     |       | .110  | .170      | .292       |

Note. CSC = classroom social climate; PLP = perceived L2 proficiency; WTC = willingness to communicate; MI = multifaceted interactions

Regarding the mediation analysis results (see Table 5), WTC was found to significantly mediate the relationship between CSC and MI, with a standardized indirect effect of .354 ( $p < .001$ ; 95% confidence interval did not include zero). Similarly, WTC also significantly mediated the link between PLP and MI, yielding a standardized indirect effect of .125 ( $p < .001$ ; 95% confidence interval excluded zero). Importantly, in both cases, the indirect effects through WTC were larger in magnitude than the corresponding direct effects of CSC and PLP on MI. This finding highlights the prominent mediating role of WTC in transmitting the influence of both CSC and PLP onto MI.

**Table 5** Results of the mediation effect analysis

| Path                                   | $\beta$ | SD   | $t$ -value | $p$ -value | 2.5% LLCI | 97.5% ULCI |
|----------------------------------------|---------|------|------------|------------|-----------|------------|
| Total effect                           |         |      |            |            |           |            |
| CSC $\rightarrow$ MI                   | .632    | .029 | 21.644     | < .001     | .575      | .688       |
| PLP $\rightarrow$ MI                   | .211    | .033 | 6.468      | < .001     | .149      | .276       |
| Indirect effect                        |         |      |            |            |           |            |
| CSC $\rightarrow$ WTC $\rightarrow$ MI | .354    | .037 | 9.455      | < .001     | .285      | .432       |
| PLP $\rightarrow$ WTC $\rightarrow$ MI | .125    | .020 | 6.360      | < .001     | .088      | .166       |

*Note.* CSC = classroom social climate; PLP = perceived L2 proficiency; WTC = willingness to communicate; MI = multifaceted interactions

#### 4.4. Psychological network analysis

Following Epskamp et al. (2018), the EBIC with a tuning parameter set to .5 was applied to prune the initial network structure. This refinement process yielded a final network comprising five positive association edges and one negative association edge, as depicted in Figure 2. In the network model, the strength and direction of edges are quantified by partial correlation coefficients (denoted as partial  $r$ ), which capture the unique association between two variables while controlling for all other variables in the network. As can be seen in Figure 2, three positive edges were found to directly link MI with WTC (partial  $r = .53$ ), PLP (partial  $r = .13$ ) and CSC (partial  $r = .27$ ). Positive association was also observed between PLP and WTC (partial  $r = .18$ ). Additionally, although the zero-order Pearson correlation between PLP and CSC was positive ( $r = .198$ ), their partial correlation was negative (partial  $r = -.09$ ), suggesting that their apparent positive association is driven by shared connections with other variables. Among these factors, WTC was the closest variable to MI and had the thickest edge connection to MI, followed by CSC and PLP. These findings revealed that CSC, WTC, and PLP were interconnected with MI within the complex network, either directly or indirectly.

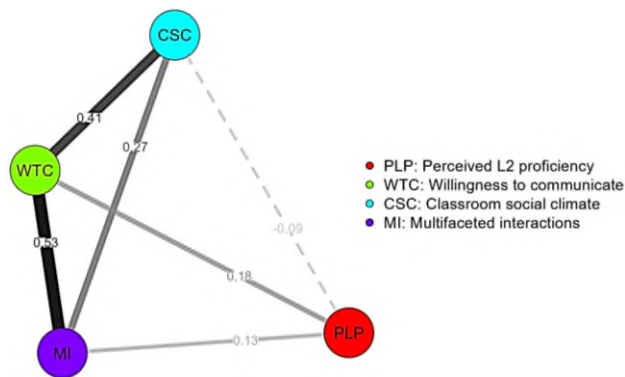


**Figure 2** The results of network analysis

Table 6 presents the standardized centrality indices of the variables. Specifically, betweenness centrality quantifies the extent to which a node acts as a bridge connecting other nodes in the network. Closeness centrality reflects the speed at which a node can influence the rest of the network, based on the average shortest distance to all other nodes. Strength centrality refers to the sum of the direct connection weights for a node (Epskamp et al., 2018; Freeborn et al., 2023). Expected influence assesses the potential impact of a node on other nodes according to its position in the network. As shown in Table 6, WTC had the highest values across all four metrics, indicating it is the most central and influential variable in the network. This underscores the role of WTC as a structural hub that bridges, connects, and potentially drives dynamics within the network. In contrast, PLP exhibited the lowest centrality, suggesting it occupies a peripheral position with limited connectivity to other constructs.

**Table 6** Centrality indices

| Variable | Betweenness | Closeness | Strength | Expected influence |
|----------|-------------|-----------|----------|--------------------|
| CSC      | -.500       | -.155     | -.118    | -.315              |
| PLP      | -.500       | -1.192    | -1.320   | -1.247             |
| WTC      | 1.500       | 1.243     | 1.042    | 1.031              |
| MI       | -.500       | .103      | .396     | .531               |

*Note.* CSC = classroom social climate; PLP = perceived L2 proficiency; WTC = willingness to communicate; MI = multifaceted interactions

After estimating the network structure, non-parametric bootstrapping with 5,000 resamples was used to assess the stability of the edge weights. Figure 3 presents the bootstrapped 95% confidence intervals for all edges. All intervals excluded zero except for the connection of PLP and CSC, suggesting that most pairwise associations were statistically meaningful and stable. The confidence interval for the edge between PLP and CSC contained zero, indicating that this specific link

was less stable and likely to vary across samples. The mean edge weights from the original sample and those from the bootstrapped samples showed minimal deviation, indicating that the network estimates were accurate (Epskamp et al., 2018).

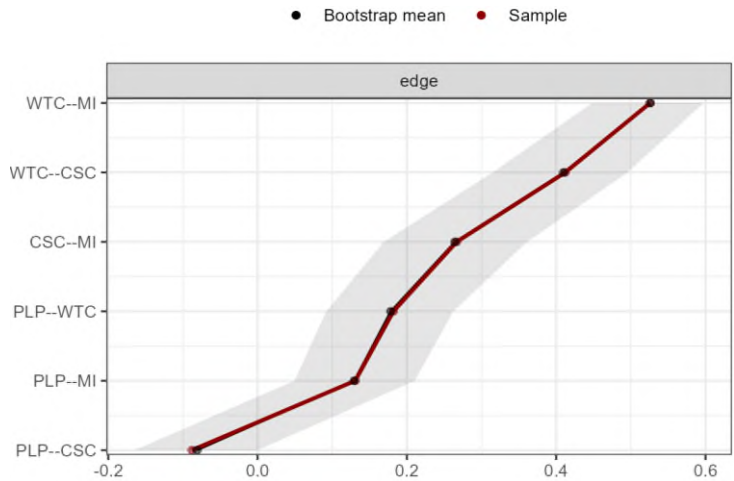


**Figure 3** Accuracy and stability of the estimated edge weights (the y-axis ranks the average bootstrapped edge weights from highest to lowest. The red line denotes the edge weight estimated from the original sample, the black line represents the mean of the bootstrapped edge weights, and the gray area indicates the corresponding 95% confidence interval)

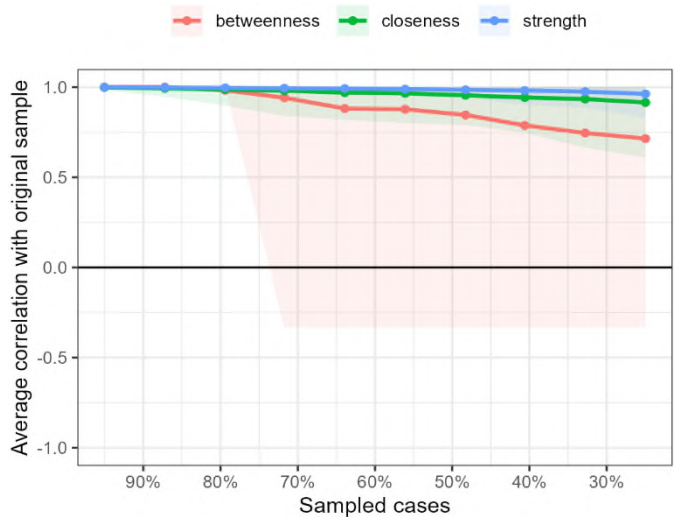


**Figure 4** Stability of centrality indices (lines show the average correlations between original and subsample centrality estimates, with shaded areas representing the 95% confidence intervals)

Finally, case-dropping subset bootstrapping with 5,000 resamples was conducted to assess the stability of node centrality. As shown in Figure 4, the average correlations between the original and subsample centrality estimates for strength and closeness remained above .75 even at 30% of the original sample size, with confidence intervals excluding zero. This suggests good stability for these indices. The betweenness estimates maintained average correlations above .5 across all sampling fractions. However, the confidence intervals contained zero at smaller sample sizes. This suggests relatively lower stability for betweenness centrality. Since WTC was the most central node in the network, the subsequent discussion focuses on its implications rather than betweenness centrality.

## **5. Discussion**

This section discusses the findings in relation to the three research questions. It first addresses the direct effects of CSC, PLP, and WTC on MI, followed by the mediating role of WTC in the paths from CSC and PLP to MI. The final part interprets the network structure among the four variables, with a focus on the most central nodes and their relevance to MI.

### **5.1. Direct predictive effects of CSC, PLP, and WTC on MI**

RQ1 examined the extent to which CSC, PLP, and WTC predict MI. The PLS-SEM results showed that CSC and WTC positively predicted MI, whereas PLP had only a negligible direct effect. Specifically, CSC directly predicted MI, suggesting that when learners perceive a supportive and respectful English learning environment, they are more likely to interact with their teachers, peers, and digital tools. This finding aligns with previous research that underscores the importance of positive learning atmosphere in fostering interactive behaviors (Qiu, 2022; Wei et al., 2012). This phenomenon can be explained by the affective pathway through which classroom atmosphere operates. A supportive environment reduces communication anxiety and boredom, and increases enjoyment, thereby strengthening learners' WTC and their engagement in L2 interactions (Derakhshan et al., 2022; Joe et al., 2017; Wang et al., 2024). Interestingly, the effect of CSC on MI was driven primarily by teacher academic and emotional support, rather than by classroom mutual respect. This finding aligns with prior research emphasizing that teachers' emotional support predicts students' interactional engagement (Zhou et al., 2025). It reflects the teacher-centered nature of Chinese EFL contexts, where learners rely more on instructor-led support than peer mutual respect to engage in multifaceted interactions (Wang & Ryan, 2020).

WTC directly predicted MI, and the effect was the largest among the three predictors. This finding is in line with the WTC pyramid model (MacIntyre et al., 1998), which positions WTC as the most proximal antecedent of L2 communication. It also implies that WTC acts as a vital condition for interaction to occur. Consistent with prior empirical evidence (Wang et al., 2019; Yashima et al., 2018), this result underscores the volitional nature of communication as learners only tend to engage in interactions when they possess adequate communicative willingness. However, this robust association diverges from Cao and Philp (2006), who reported little correlation between trait WTC and observed classroom behavior in a sample of eight English as a second language (ESL) learners. This discrepancy likely reflects a mismatch between the trait-level measure and the situated nature of classroom interaction, rather than a challenge to the predictive validity of WTC. In the present study, WTC was conceptualized as a situational readiness in specific interactional contexts, which may explain the stronger predictive effect observed.

Contrary to prior research that has linked PLP to L2 communication (e.g., Su, 2021; Vincze & MacIntyre, 2017), PLP had little direct contribution to MI in this study. One plausible explanation is the misalignment between perceived proficiency and interactive readiness. PLP reflects learners' self-judgment of general linguistic skills, whereas MI depends on dynamic real-time communicative capacity. As illuminated by the WTC pyramid model (MacIntyre et al., 1998), PLP acts as a foundational individual factor, which cannot drive MI without the activation of situational enablers (e.g., WTC). This weak link suggests that perceived competence alone is insufficient to drive actual interaction, and that the relationship between PLP and MI is likely mediated by other variables. Moreover, most EFL learners in this study perceived their L2 proficiency as below average, a result consistent with Su (2021) in Taiwan. This may be attributed to their limited daily engagement in English learning, which left their PLP below their own aspirations and expectations.

## **5.2. Mediating role of WTC**

RQ2 investigated the mediating role of WTC in the paths from CSC and PLP to MI. The results showed that WTC significantly mediated both pathways, with its indirect effects far exceeding the direct effects of CSC and PLP on MI. These findings empirically confirm that enduring factors such as CSC and PLP in the lower layers of the WTC model do not directly drive ultimate interactive behavior. Instead, they exert influence through learners' volitional intention to communicate.

Specifically, WTC significantly and positively mediated CSC and MI, demonstrating that positive classroom climate was conducive to fostering WTC among learners, which in turn predicted a higher level of multifaceted interactions. This

suggests that merely creating a favorable classroom environment is not enough to encourage learners to interact in English. Their psychological states and intentions must also be considered. These findings align with prior research establishing WTC as a key psychological construct in SLA (e.g., Peng & Woodrow, 2010; Wang et al., 2024), and support Raghul and Saradha's (2016) claim that a positive classroom climate boosts learners' willingness to communicate.

Similarly, WTC played a significant mediating role between PLP and MI, with a larger effect size than the direct path. This pattern suggests that PLP does not simply translate into interaction on its own; its influence is channeled through learners' WTC. Theoretically, this distinction matters because PLP reflects a reflective judgment about one's general ability, whereas WTC captures a prospective readiness to act at a specific moment. A learner may feel capable of using English, yet without the intention to initiate communication, that perceived capability may remain dormant. In this sense, WTC serves as the motivational trigger that activates PLP into observable interaction. This finding extends prior research that has emphasized the role of PLP in L2 learning (Kim, 2024; Su, 2021) by identifying WTC as the key mechanism through which PLP exerts its influence on actual behavior. While PLP helps learners feel capable, it is WTC that ultimately propels them to participate in diverse L2 interactions. This supports the assumption of the WTC model that enduring traits like L2 self-confidence operate through proximal, situational states such as WTC to influence real-time L2 communication (Henry & MacIntyre, 2024; MacIntyre et al., 1998).

### **5.3. Relationships among CSC, PLP, WTC and MI in the psychological network**

With respect to RQ3, this study utilized PNA to explore the dynamic and complex relationships among CSC, PLP, WTC, and MI. This method responds to recent calls for applying network analysis to model complex systems in SLA research (Freeborn et al., 2023). The result revealed an interconnected network among CSC, PLP, WTC, and MI, supporting the view that learners' psychological, social, and contextual conditions tend to be intertwined in a dynamic and complex manner (Ji et al., 2024; Soyoof, 2023; Xu et al., 2025).

In the network, WTC exhibited the strongest association with MI, followed by CSC and PLP. Theoretically, the strongest connection between WTC and MI echoes the core logic behind MacIntyre et al.'s (1998) WTC pyramid model. As a situational upper-layer variable connecting distal enduring factors to ultimate communicative behaviors, WTC serves as the core psychological driver of interaction. The connection also helps reconcile the discrepancy with Cao and Philp's (2006) study, which used a smaller sample and found that trait WTC was only weakly related to actual classroom interaction. The results suggest that this association

is not inherently weak. Rather, it becomes evident when WTC is measured as a context-sensitive state and when MI includes technology-mediated modes in addition to face-to-face settings. Besides, the findings provide critical empirical support for the dynamic nature of WTC emphasized by Henry and MacIntyre (2024). Unlike the static personality trait initially conceptualized by McCroskey and Baer (1985), WTC is a dynamic construct that interacts in real time with multifaceted interactions such as classroom discussions and technology-mediated communication. Moreover, the network also revealed a suppression effect between CSC and PLP. Although they were positively correlated at the bivariate level, their partial correlation turned negative in the network. This implies a trade-off between the two factors WTC and MI are controlled for. A less supportive classroom climate may be offset by higher perceived proficiency to sustain MI and vice versa.

Furthermore, WTC was the most central node in the network, as indicated by its highest values on all four centrality indices (i.e., strength, closeness, betweenness, and expected influence). This confirms its position as the most influential variable in the network and its function as a psychological converter. This result underscores the intricate nature of L2 communication, in which WTC serves as a nexus point for various psychological and situational factors (MacIntyre et al., 1998). It suggests that when teachers address these factors, WTC deserves special attention as these factors mutually enhance each other and collectively influence other variables. In contrast to the central role of WTC, PLP showed the lowest centrality across all indices, suggesting that perceived proficiency alone does not actively channel influences within the network. This peripheral position further explains its negligible direct effect on MI in the SEM analysis. Meanwhile, CSC displayed moderate centrality, indicating that while classroom climate contributes to the network, its influence is largely transmitted through WTC rather than exerted directly. The PNA findings echoed the SEM results, confirming the complementarity of the two research methods (Wang & Hui, 2024).

## **6. Pedagogical implications**

The findings offer several pedagogical implications. First, the direct effect of CSC on MI was substantial, and its indirect effect through WTC was even larger. Teachers therefore are advised to strengthen both academic and emotional support. This might involve scaffolding tasks at different levels, such as providing sentence frames for those who need more structure and open-ended prompts for those ready to stretch. It can also include brief check-ins with students to acknowledge their feelings and build a sense of safety. In addition, given the strong predictive power of WTC for MI and its central position in the psychological network, it

makes sense to design tasks that are personally relevant and low in risk, such as hobby-based discussions or asynchronous online exchanges, while treating errors as a normal part of communication. These efforts can help activate situational WTC and encourage more spontaneous involvement in MI. For PLP, even though its direct effect on MI was weak, its indirect effect through WTC was substantial. This suggests that teachers can still attend to students' self-perceptions by offering specific, growth-oriented feedback and low-stakes self-assessment opportunities. But the key is to combine these efforts with activities that spark WTC, so that perceived proficiency can translate into actual interaction.

## **7. Conclusions**

This study set out to investigate the influences of L2 learners' CSC, PLP, and WTC on Chinese EFL learners' interactions with their teachers, peers and digital technologies. Through the combined use of PLS-SEM and PNA, this study found that CSC and PLP not only predicted MI directly but also influenced MI through WTC. The analysis indicated a complex interplay among these factors, with WTC emerging as the most influential predictor of MI. These findings underline the importance of learners' psychological factors in language learning and provide evidence for the interconnected nature of social and psychological factors in fostering effective language interactions.

This study has several limitations. First, the cross-sectional design precludes causal claims. Longitudinal panel studies tracking the same cohort across semesters could examine the temporal precedence among CSC, PLP, WTC, and MI. Second, our sample was drawn from non-English majors in Chinese universities. Replicating this study with English majors or vocational college students would reveal whether the observed relationships are universal or population-specific. Third, our measures relied entirely on self-reports, which are susceptible to biases. Future studies could supplement these with behavioral data, such as logged frequencies of technology-mediated interaction or classroom observations.

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## **APPENDIX**

### **Instruments**

#### **Teacher-student interaction**

- M1. I frequently interact with teachers in English classes.
- M2. I often ask teachers questions related to English.
- M3. I actively answer questions raised by English teachers.
- M4. I seek help from English teachers when I need assistance.
- M5. English teachers provide me with abundant feedback when I need help.
- M6. I take the initiative to consult English teachers when encountering confusing problems.

#### **Student-student interaction**

- M7. I discuss with classmates about the content learned in English class.
- M8. I receive plenty of feedback from classmates.
- M9. I discuss English-related topics with classmates.
- M10. I help classmates solve English-related problems.
- M11. I turn to classmates for help when facing difficult English problems.
- M12. I evaluate classmates' opinions in English.

#### **Student-computer interaction**

- M13. I interact with digital tools (e.g., ChatGPT, learning apps, websites) to deepen my understanding of English class content.
- \*M14. I interact with digital tools to enhance my interest in English learning.
- \*M15. I use digital tools to integrate new and existing English knowledge.
- M16. I interact with digital tools to obtain English learning resources.
- M17. When encountering obstacles in English learning, I interact with digital tools to seek solutions.
- M18. I engage in interactive practice of English listening, speaking, reading and writing skills on digital platforms.

#### **WTC in meaning-focused activities**

- W1. I am willing to do a role-play standing in front of the class in English (e.g., ordering food in a restaurant).
- W2. I am willing to give a short self-introduction without notes in English to the others.
- W3. I am willing to give a short speech in English to others about my hometown with notes.
- W4. I am willing to translate a spoken utterance from Chinese into English to others.
- W5. I am willing to ask the others in English to repeat what he/she just said in English because I didn't understand
- \*W6. I am willing to do a role-play in English at my desk, with my peer (e.g., ordering food in a restaurant).

#### **WTC in form-focused activities.**

- W7. I am willing to ask the others in English the meaning of an English word.
- W8. I am willing to ask the others in English the meaning of a word I do not know.
- W9. I am willing to ask the others in English how to pronounce a word in English.

- \*W10. I am willing to ask the others in English how to say an English phrase to express the thoughts in my mind.

**Perceived L2 proficiency**

- P1. How well do you read English?
- P2. How well do you write in English?
- P3. How well do you speak English?
- P4. How well do you understand spoken English?

**Teacher emotional support**

- C1. My English teacher respects our opinions.
- C2. My English teacher really understands how we feel about things.
- C3. My English teacher tries to help us when we are sad or upset.
- C4. We can count on our English teacher for help when we need it.

**Teacher academic support**

- C5. My English teacher cares about how much we learn.
- C6. My English teacher wants us to do our best in school.
- C7. My English teacher likes to help us learn well.

**Classroom mutual respect**

- \*C8. My English teacher wants us to respect each other's opinions.
- \*C9. My English teacher wants all students to feel respected.
- \*C10. My English teacher does not allow students to make fun of other student's ideas in class. (R).
- \*C11. My English teacher makes sure that students do not say anything negative about each other in class (R).
- \*C12. My English teacher does not let us make fun of someone who gives the wrong answer. (R).

*Note.* \* Items removed in this study during measurement model assessment