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A Visualization Analysis of Research on Foreign Language Willingness to Communicate

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ABSTRACT

Willingness to communicate (WTC) in oral communication is one of the key factors influencing learners' spoken language production and has attracted widespread attention in the field of second language acquisition (SLA) since the mid-1990s. To systematically examine the development, research hotspots, and emerging trends in international research on second language (L2) WTC, this study employs CiteSpace 6.4.R1 to conduct a visual analysis of 166 publications retrieved from the Web of Science Core Collection for the period 2008–2026. After data processing in CiteSpace, 165 publications were retained for analysis. The analysis focuses on annual publication trends, collaboration networks among countries and institutions, highly cited publications, and keyword co-occurrence and clustering. The results show that the overall number of publications in this field has increased, with growth accelerating after 2022. Three domains stand out as the major research hotspots: emotions and affect, motivation, and individual differences. Beyond these established lines of inquiry, topics concerning artificial intelligence (AI) and technology-mediated communication have attracted increasing attention. Through keyword clustering and burst detection, emotion and technology are identified as important research directions in this field, and the research contexts have gradually expanded toward digital and AI-mediated environments. The present study helps elucidate the knowledge structure and developmental trends of international research on L2 WTC, while offering insights for L2 speaking instruction and future empirical research in China.

Keywords: willingness to communicate; CiteSpace; bibliometric analysis; knowledge mapping; research frontiers

1. INTRODUCTION

In the field of second language (L2) research, the Interaction Hypothesis (Long, 1983) emphasizes the role of interaction in facilitating language learning. Consequently, learners' willingness to engage in communication using an L2 has become an important topic in second language acquisition (SLA) research. Willingness to communicate (WTC) was introduced into the field of L2 research by MacIntyre and his colleagues and was defined as “the probability of engaging in communication when free to choose to do so” with a particular person at a particular time (MacIntyre et al., 1998, p. 547).

Nevertheless, existing reviews have relied largely on qualitative narrative approaches. Previous CiteSpace-based bibliometric studies, such as Zheng and Song (2024), have used data covering periods only up to 2022 and have paid insufficient attention to subsequent developments, particularly those associated with the integration of generative AI into foreign language education. Furthermore, the reporting of indicators used to assess the reliability of clustering results, such as modularity (Q) and silhouette (S) values, could be improved in existing studies. To address these gaps, 166 publications indexed in the Web of Science Core Collection from 2008 to 2026 are examined in the present study, and knowledge maps are constructed using CiteSpace 6.4.R1. Covered in this analysis are annual publication trends, collaboration networks among countries and institutions, highly cited publications, keyword co-occurrence and clustering, and burst detection. Its aim is to elucidate the developmental trajectory, research hotspots, and evolving frontiers of international research on L2 WTC, and to offer insights for L2 speaking instruction and future empirical research in China.

2. LITERATURE REVIEW

The heuristic pyramid model proposed by MacIntyre et al. (1998) provides an important framework for examining the factors influencing WTC. Early studies primarily adopted a relatively static, trait-based perspective, investigating the predictive effects of factors such as personality, attitudes, and anxiety on WTC. In EFL contexts in countries such as Japan and China, scholars such as Yashima (2002) and Peng and Woodrow (2010) tested theoretical models and adapted measurement scales, promoting the application of WTC theory across diverse language-learning settings.

Over the past decade, research in this field has expanded primarily along two directions. Anchored in complex dynamic systems theory (CDST; Larsen-Freeman & Cameron, 2008), the first is represented by MacIntyre and Legatto (2011), who employed an idiodynamic approach to extend WTC research beyond relatively stable individual characteristics toward the examination of moment-to-moment dynamics at a micro level. The second is shaped by the affective turn in positive psychology, under which research has gradually expanded from foreign language anxiety (Horwitz et al., 1986) to a broader range of emotional variables, including foreign language enjoyment (Dewaele & MacIntyre, 2014) and foreign language boredom, as well as individual characteristics such as grit. Khajavy et al. (2016, 2018) investigated the relationships among classroom environments, emotional factors, and WTC. The widespread adoption of online learning and the development of generative artificial intelligence (AI) have brought WTC in digital learning environments and AI-assisted conversations to the forefront as emerging research topics.

3. METHODOLOGY

3.1 Research Questions

This study addresses four research questions:

1. What has been the trajectory of annual publication output in international research on foreign language willingness to communicate (WTC) from 2008 to 2026, and how can its developmental stages be delineated?
2. What is the distribution pattern of major contributing countries/regions and institutions, and what structural characteristics do the cross-national and cross-institutional collaboration networks exhibit?
3. What constitutes the highly cited publications in this field? How can its intellectual base be divided into coherent blocks, and through which publications are these blocks interconnected?
4. What clusters emerge from the keyword co-occurrence network, and what core research issues does each cluster represent?

3.2 Data Sources

The present study draws on the Web of Science Core Collection as its data source, with the citation index restricted to the Social Sciences Citation Index (SSCI). The time span was set from 2008 to 2026. The topic search terms included “willingness to communicate” and its commonly used variants, combined with contextual restrictors pertaining to second and foreign language settings. The detailed search string was as follows: TS=(“willingness to communicate” OR “L2 WTC” OR “EFL WTC” OR “ESL WTC” OR WTC) AND TS=(“second language” OR “foreign language” OR “L2” OR “EFL” OR “ESL” OR “English as a foreign language” OR “language learner”)

The standalone abbreviation WTC was retained among the search terms to prevent the omission of publications that use only this abbreviated form. Document type was restricted to Article, and language to English. Four subject categories were selected—Linguistics, Education Educational Research, Language Linguistics, and Psychology Multidisciplinary—in order to exclude cross-disciplinary publications not directly related to L2 willingness to communicate (WTC).

Following the aforementioned search and refinement procedures, a total of 166 English-language publications were initially retrieved. Titles and abstracts of all records were then examined individually to verify their relevance to the topic of L2 WTC, and all 166 publications were ultimately retained as the initial sample. Once the data were imported into CiteSpace, the software excluded one publication, and 165 documents remained for subsequent visual analysis. Of the 166 publications in the sample, all were indexed by Web of Science as Article, and 25 of these records also carried the designation Article; Early Access, having been published online ahead of print and not yet assigned formal volume, issue, and page numbers. The sample data were exported from Web of Science in Plain Text format, with the option selected to include full records and cited references. The search and export were conducted on October 4, 2026, so the 2026 publication data do not cover the full calendar year.

3.3 Research Methods

Bibliometric methods and scientific knowledge graph visualization techniques are adopted in this study to analyze the sample literature on international research on foreign language willingness to communicate (WTC) from 2008 to 2026, with CiteSpace 6.4.R1 (64-bit) as the primary analytical software. Developed by Professor Chaomei Chen, this software supports multivariate, time-sliced, and dynamic visual analysis of the literature through the construction of scientific knowledge graphs (Chen, 2006), and reveals the distribution of research

hotspots and developmental trends within a given field. In the knowledge graphs, node size generally reflects the frequency or quantitative magnitude of the corresponding node. The purple ring around the node's periphery indicates betweenness centrality, with a higher centrality value typically signifying that the node plays a more critical bridging role in connecting different clusters. The colored rings surrounding the nodes represent temporal information about their emergence.

Before the analysis proper, keyword normalization was carried out to mitigate the dispersion of keywords caused by synonyms and morphological variants. In total, 65 synonymous and fragmented variants were merged, 30 generic contextual terms (occurring 548 times in total) were removed, and 12 residual HTML tags were eliminated. The deduplicated keyword count fell from 735 to 675. Through these procedures, the consistency of keyword representation was enhanced and the interference of irrelevant terms with co-occurrence relationships and clustering results was reduced.

The CiteSpace parameter settings were configured as follows. Time Slicing covered 2008–2026, with each slice spanning one year (Years Per Slice = 1). The node selection criterion was the g-index (k = 25), and the remaining parameters were set at LRF = 2.5, L/N = 10, LBY = 5, and e = 1.0. For network pruning, the Pruning sliced networks method was adopted. The Pathfinder algorithm was additionally applied to country and institution networks to highlight the backbone structure of the network, but was not applied to keyword networks, so as to avoid excessive simplification of network connections.

Knowledge graphs were constructed in CiteSpace to analyze keyword co-occurrence, keyword clustering, and keyword burst detection in international research on L2 WTC. Cluster labels were extracted using the Log-Likelihood Ratio (LLR) algorithm. The Modularity Q value and Weighted Mean Silhouette S value were reported to evaluate the clustering structure and its internal consistency. A Q value greater than 0.3 indicates a reasonably significant clustering structure, and an S value above 0.7 suggests good internal homogeneity within clusters; these thresholds serve as reference criteria for evaluating clustering results.

4. RESULTS AND DISCUSSION

4.1 Distribution of Publications

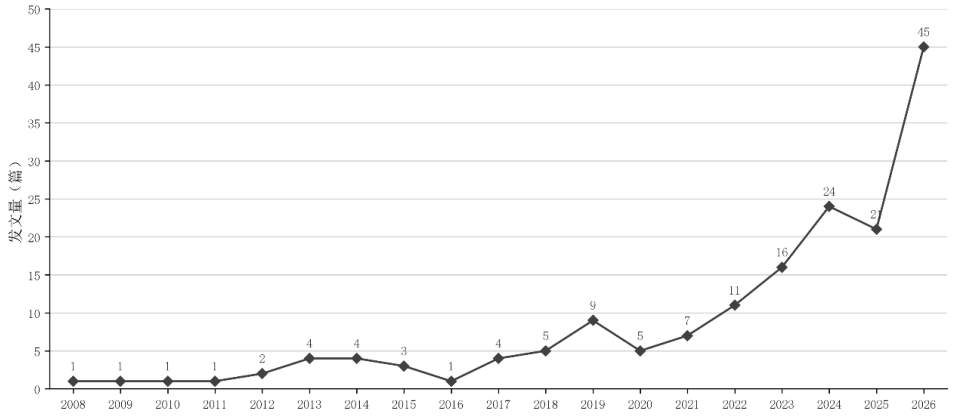


Figure 1. *Annual publication trends in international research on foreign language WTC (2008–2026).*

Figure 1 presents the annual publication output on international foreign language WTC research from 2008 to 2026. The series follows an overall upward trajectory, with the growth rate accelerating noticeably in the later period. Between 2008 and 2018, annual publication output remained at a low level: most years yielded 1 to 5 publications, with an average of approximately 2.4 per year, reflecting the relatively limited attention this topic received during this period. This pattern can be traced to the timing of the introduction of the L2 WTC construct. Once MacIntyre et al. (1998) proposed the heuristic pyramid model of WTC, researchers needed a considerable period to complete theoretical assimilation and methodological preparation, slowing the accumulation of empirical evidence.

A steady upward trajectory began in 2019. That year, 9 publications appeared, approaching double digits for the first time. The figure rose to 11 in 2022, climbed to 16 in 2023, and reached 24 in 2024. In 2025, a slight dip brought the count to 21 publications. The dip may be attributable to fluctuations in publication cycles, or to the fact that some Early Access publications had not yet been assigned to a specific year. The incomplete 2026 data already show 45 publications; extrapolated to a full year, the actual output for this year will be substantially higher than that of 2024.

This rapid increase in publication output corresponds to

the maturation of theoretical perspectives and the expansion of research contexts in this field. Complex dynamic systems theory (CDST), on one front, has enabled researchers to examine fluctuations in WTC at a micro temporal scale, shifting the research object from stable traits to situated states (MacIntyre & Legatto, 2011). The incorporation of positive psychology, on another front, has broadened the scope of affective variables examined: constructs such as foreign language enjoyment, boredom, and grit have successively entered the research agenda (Dewaele & MacIntyre, 2014). Over the past three years, the impact of generative artificial intelligence (AI) technology on foreign language speaking instruction has further stimulated related discussions, as researchers begin to investigate whether learners are willing to engage in interaction within technology-mediated contexts and how technological tools can be employed to enhance their WTC (Zhang et al., 2024). During data processing, it was noted that one Early Access publication had been prematurely assigned to 2027; because the annual series was incomplete, this record was excluded from the trend analysis presented in Figure 1.

4.2 Countries and Institutions

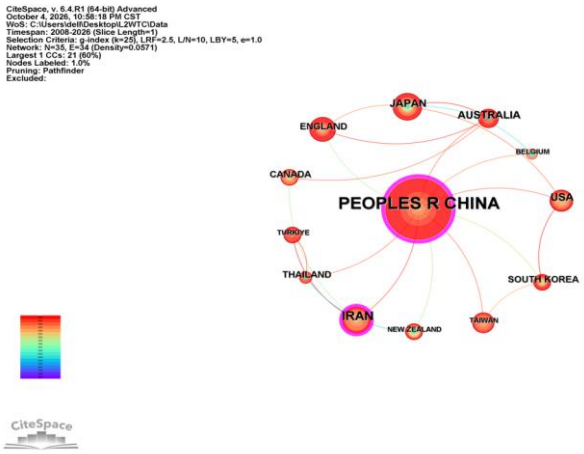


Figure 2. *Knowledge Map of Countries (Regions) in L2 WTC Research*

As shown in Figure 2 and Table 1, the network comprises 35 country nodes and 34 collaboration links, with a density of 0.0571. The largest connected component contains 21 countries, accounting for 60% of all nodes. China ranks first with 72 publications and the highest centrality score (0.49), serving as a bridge connecting the European, North American, and Asia-Pacific subnetworks. Iran (17 publications, centrality = 0.21) constitutes the second hub. Japan (12 publications), Canada (11 publications), and Taiwan, China (11 publications) rank third through fifth, respectively; four of the top five contributing regions are located in Asia.

At the institutional level, publication output is relatively more dispersed. Among the institutions listed in Table 1, Zhejiang University (8 publications), the Education University of Hong Kong (7 publications), and Xi'an Jiaotong-Liverpool University (6 publications) rank as the top three. The Chinese University of Hong Kong, Shantou University, and the University of Kurdistan (Iran) each have 4 publications, while Cape Breton University and Kansai University each have 3. There is a certain discrepancy between publication output and network centrality: Japan, Taiwan, China, and South Korea rank high in publication volume but have near-zero centrality, indicating relatively fixed collaboration partners. Canada, with 11 publications, achieves a centrality score of 0.08, playing a comparatively prominent role in connecting different clusters.

Table 1. *Major Contributing Countries (Regions) and Institutions in L2 WTC Research*

Rank	Region	Count	Centrality	Rank	Institution	Count	Region
1	China	72	0.49	1	Zhejiang University	8	China
2	Iran	17	0.21	2	Education University of Hong Kong	7	China
3	Japan	12	0.02	3	Xi'an Jiaotong-Liverpool University	6	China

Rank	Region	Count	Centrality	Rank	Institution	Count	Region
4	Canada	11	0.08	4	Chinese University of Hong Kong	4	China
5	Taiwan, China	11	0.00	4	Shantou University	4	China
6	USA	10	0.08	4	University of Kurdistan	4	Iran
7	England	9	0.01	7	Cape Breton University	3	Canada
8	Australia	6	0.07	7	Kansai University	3	Japan

4.3 Highly Cited Publications

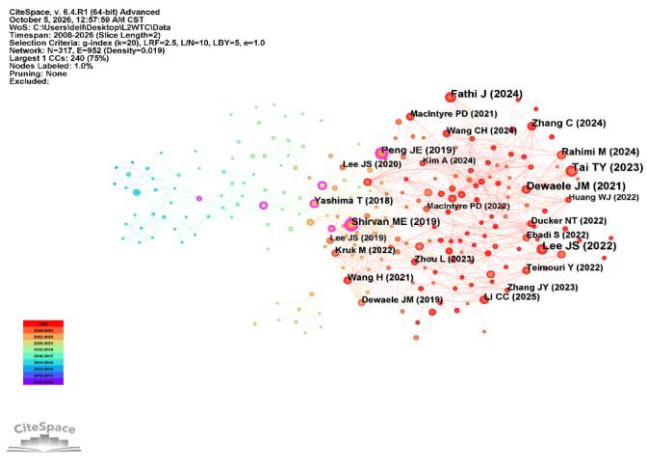


Figure 3. *Knowledge Map of Highly Cited Publications in L2 WTC Research*

Figure 3 displays the document co-citation network of the sample. The network comprises 317 nodes and 952 links, and its density stands at 0.019. Within it, the largest connected component contains 240 publications, or 75% of all nodes. Table 2 presents the top three most frequently cited publications, for which citation counts range from 20 to 23.

Top of the list is Foreign Language Enjoyment as a Mediator between Informal Digital Learning of English and Willingness to Communicate (Lee, 2022). Conducted against the backdrop of informal digital learning of English, the study examined the mediating role of foreign language enjoyment in the relationship between digital learning behavior and WTC. Learners' frequency of engagement with English through digital resources outside the classroom was found to enhance their in-class and out-of-class WTC indirectly, by way of increased foreign language enjoyment. Affective variables are positioned at the interface between digital learning environments and WTC, offering empirical evidence for the mechanisms underlying WTC formation in technology-mediated contexts.

Next in rank is a paper by Tai (2023), which appeared in Interactive Learning Environments. Set in mobile-assisted language learning environments, the study focused on peer feedback and examined its effects on learners' writing performance as well as their perceptions of such feedback. The results showed that the manner in which peer feedback is implemented influences learners' judgments of its value, and that these judgments affect their willingness to engage in language tasks. The citation position of this article signals that technology-mediated forms of interaction have become a topic of interest in WTC research.

The third entry is a paper by Fathi (2024) published in System. The study took the relationship between teacher support and student engagement as its point of departure, and examined the mediating roles of enjoyment and anxiety in this relationship. Teacher support was found to influence student engagement through affective variables. By integrating teacher-related and affective factors within a single analytical framework, the finding addresses the insufficient attention paid to classroom contextual variables in previous research.

The composition of these three highly cited publications points to two trends. Affective variables occupy a central position in WTC research: the two constructs of foreign language enjoyment and foreign language anxiety appear across all three publications, aligning with the affective turn in the field of second language acquisition. Research contexts have expanded from face-to-face settings to digital and mobile environments. As represented by informal digital learning and mobile-assisted learning, technology-mediated contexts are emerging as a new arena for WTC research.

Table 2. *Highly Cited Publications in L2 WTC Research*

Rank	Citation Count	Cited Publication	Author, Year
1	23	Foreign Language Enjoyment as a Mediator between Informal Digital Learning of English and Willingness to Communicate	Lee, 2022
2	23	The Impact of Peer Feedback on EFL Learners' Writing Performance and Their Perceptions in a Mobile-Assisted Language Learning Environment	Tai, 2023
3	20	Teacher Support and Student Engagement in the EFL Classroom: The Mediating Role of Enjoyment and Anxiety	Fathi, 2024

4.4 Research Hotspots: Keyword Co-occurrence and Clustering

4.4.1 Keyword Co-occurrence

Keywords are highly distilled representations of the core content of publications, and their co-occurrence network can reveal the structural connections among research themes within a given field. Figure 4 displays the keyword co-occurrence network of international research on L2 WTC. The network is made up of 345 keyword nodes and 903 co-occurrence links, with a density of 0.0152. Of these, the largest connected component contains 319 nodes, or 92% of the total; a tightly interconnected knowledge network has formed among keywords. Node size reflects the frequency of keyword occurrence, and purple outer rings denote key nodes with high betweenness centrality.

At the absolute center of the network sits willingness to communicate, which Figure 4 renders as the largest node with the thickest purple outer ring; the construct stands as the undisputed core theme of the entire field. Arrayed around this core are motivation, anxiety, foreign language enjoyment, foreign language anxiety, speaking proficiency, artificial intelligence, and emotions—each bearing purple outer rings and forming key hubs that connect different themes. The time color band in the lower left of the figure shows most nodes in red and orange tones. These high-frequency keywords emerged predominantly after 2018, pointing to the rapid diversification of research themes in this field over the past eight years.

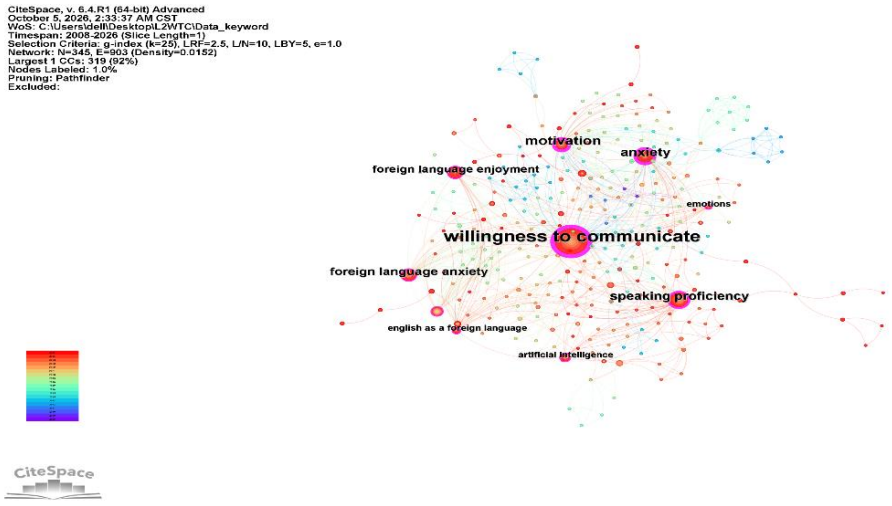


Figure 4. *Knowledge Map of Keyword Co-occurrence in L2 WTC Research*

Following the merging, deduplication, and synonym consolidation of author keywords (DE) and Keywords Plus (ID) drawn from the 166 sample publications, this study yielded 807 keywords in total. Table 3 presents the high-frequency keywords ranked by occurrence, offering an intuitive overview of research hotspots.

Table 3 shows willingness to communicate at the top, with 113 occurrences—an absolute proportion of the total keyword frequency that confirms its status as the undisputed core theme of this field. Around this core, research hotspots fall into three distinct lines of inquiry.

Motivation and affective variables form the first line. Appearing high on the frequency table are motivation (9 occurrences), foreign language anxiety (9 occurrences), anxiety (6 occurrences), affective factors (7 occurrences), and enjoyment (6 occurrences). The distribution points to a consistent premise of WTC research: learners' psychological preparedness is treated as a core explanatory variable. Foreign language anxiety, as a traditional negative emotion, has long received attention. Foreign language enjoyment rapidly entered the research agenda only after the positive psychology turn.

Individual differences and learner characteristics make up the second line. Self-efficacy (6 occurrences), self-confidence (6 occurrences), individual differences (5 occurrences), and grit (5 occurrences) together index stable internal learner traits. Grit itself merits attention: a relatively new construct that entered SLA research only within the past five years, it has already appeared 5 times in this sample. The appearance of grit signals that research constructs are expanding from traditional motivation and self-confidence toward non-cognitive traits with greater temporal depth.

Technology and new research contexts constitute the third line. Artificial intelligence (6 occurrences), chatbots (3 occurrences), virtual reality (4 occurrences), and generative artificial intelligence (3 occurrences) all appear among the high-frequency keywords. Most of these terms emerged after 2023, closely tracking the timeline of generative AI's integration into language learning. Technology-mediated WTC research has moved from early online classrooms to emerging scenarios such as AI conversation partners and virtual reality speaking environments.

Table 3. *High-Frequency Keywords in L2 WTC Research*

Keyword	Frequency	Keyword	Frequency
willingness to communicate	113	self-efficacy	6
motivation	9	artificial intelligence	6
foreign language anxiety	9	enjoyment	6
EFL learners	7	oral proficiency	5
affective factors	7	grit	5
English as a foreign language	7	individual differences	5
anxiety	6	higher education	5

Keyword	Frequency	Keyword	Frequency
self-confidence	6	technology	4

4.4.2 Keyword Clustering

Across the correspondence between cluster labels and high-frequency keywords, willingness to communicate stands out as the core node of the entire network. The term appears in 147 publications in the sample, far outnumbering the second-ranked term, motivation (40 publications). WTC functions both as the outcome variable toward which all clusters collectively point and as the defining construct that distinguishes this field from other branches of SLA. Sharing Cluster #0 with WTC are communicative competence (9 publications) and speaking proficiency (31 publications); together they delineate the research boundaries of this core circle—namely, WTC research centered on oral production competence.

Affective clusters occupy the largest share of the network. Cluster #1 (affective factors) brings together foreign language anxiety (27 publications) and emotions (11 publications); Cluster #5 (social phobia) sits at the other end of affective disorders. The emergence of this cluster label traces to the recent expansion of emotion research. Zhang and Zhang (2022) found that the inhibitory effect of social phobia on WTC is fully mediated by the ideal L2 self, and through this pathway social phobia—originally a concept from clinical psychology—entered the field of L2 WTC research. The positive psychology-oriented cluster sits at #7. Against Cluster #1's emphasis on the inhibitory effects of negative emotions such as anxiety, this cluster foregrounds the facilitative role of positive emotions such as enjoyment and grit.

Individual differences and motivation form another set of adjacent clusters. Cluster #6 (individual differences) centers on anxiety (34 publications) and links to constructs such as self-efficacy and grit. Cluster #3 (self-efficacy) focuses on learners' perceptions of their own communicative competence. Across these clusters, the field moves from overall motivation levels toward more differentiated psychological constructs. Two further clusters concern the classroom context: Cluster #4 (classroom interaction), represented by classroom interaction (3 publications), and Cluster #2 (L2 drama), which points to the application of drama pedagogy in L2 classrooms. Both are limited in scale, and classroom-level pedagogical research has not emerged as a major theme in this field.

At the periphery sit technology and sociocultural clusters. Cluster #8 (technology acceptance) links to keywords such as artificial intelligence (11 publications) and technology (4 publications); technology-mediated contexts entered WTC research relatively late, and the cluster is still accumulating in scale. Cross-cultural and context-related work occupies Cluster #10 (intercultural sensitivity) and Cluster #11 (USA). Although the latter is labeled with a geographic name, it essentially refers to WTC research in the context of studying in the United States or studying abroad. Cluster #9 (action research) carries a teacher-led pedagogical intervention orientation. Small and scattered, these clusters suggest that the related topics have not yet formed stable research communities.

Across the overall distribution, the three constructs of WTC, anxiety, and enjoyment have attracted the greatest scholarly attention. Current research in this field unfolds primarily against the backdrop of individual differences, classroom interaction, and technology acceptance.

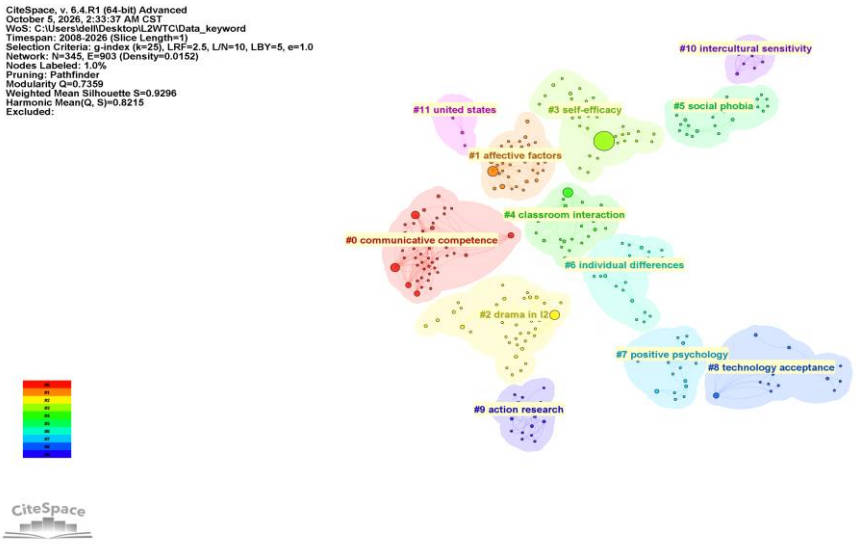


Figure 5. *Knowledge Map of Keyword Clustering in L2 WTC Research*

5. CONCLUSION

Using 166 publications indexed in the Web of Science Core Collection from 2008 to 2026 as the sample, this study employed CiteSpace 6.4.R1 to construct knowledge maps of international research on foreign language willingness to communicate (WTC), systematically analyzing annual publication trends, national and institutional collaboration networks, highly cited publications, as well as keyword co-occurrence, clustering, and burst detection. The results show that publication output in this field has grown steadily overall, with acceleration becoming evident after 2022; as of the search date of October 4, 2026, 45 publications had been included (full-year data are incomplete). China leads the field with 72 publications and a centrality of 0.49, and functions as a bridge connecting Europe, Asia, and North America within the collaboration network. Iran follows in second place with 17 publications and forms a second collaboration hub. Across the keyword analysis, 24 clusters were identified. The modularity Q value stands at 0.7359 and the weighted mean silhouette S value at 0.9296, pointing to a significant clustering structure and strong internal homogeneity. Communicative competence, affective factors, individual differences, and technology acceptance surfaced as the major cluster themes. Burst detection shows that foreign language enjoyment (burst strength = 3.58) and artificial intelligence (burst strength = 2.22) have remained in a burst state since 2024. Emotion and technology emerge as the two current research frontiers.

These findings delineate the knowledge structure and evolutionary trajectory of international research on foreign language WTC. The field has moved from early trait-based research centered on anxiety and motivation, to broader investigations of multiple emotions from a positive psychology perspective, and on into digital and AI-mediated contexts. Domestic researchers can draw on this landscape to grasp international frontiers and identify research topics. The work also carries implications for foreign language speaking instruction—especially for identifying the sources of classroom silence and leveraging technological tools to enhance learners' WTC.

Several limitations qualify the present findings. The sample was drawn solely from SSCI journals in the Web of Science Core Collection; databases such as Scopus and CNKI were not included, leaving Chinese-language publications and some regionally published works uncovered and limiting the representativeness of the sample. A second limitation lies in the method itself: bibliometric analysis describes research output and thematic distribution, but cannot evaluate research designs, sample sizes, or effect sizes of the included publications, nor can it perform quantitative integration. The reliability and effect sizes of existing empirical findings remain difficult to ascertain. Keyword co-occurrence and co-citation networks reflect the most recent publications only imperfectly. Of the 45 publications included from 2026, some are still in the Early Access stage, with incomplete volume/issue information and citation records; their cluster assignment and burst identification will need verification once subsequent data become available. CiteSpace clustering results are sensitive to parameter settings such as time slicing and g-index; network scale and cluster partitioning may shift under different parameter configurations.

Against these limitations, future research opens onto four directions. Data sources can be expanded to include databases such as Scopus and CNKI, and comparative analyses of Chinese and international research can be conducted, rendering a more comprehensive picture of the field. Mechanistic research on WTC formation in technology-mediated contexts warrants deeper pursuit. Of particular interest is whether the effects of AI-based speaking practice tools on WTC prove sustained, and whether such effects transfer to face-to-face authentic communication contexts once technological scaffolding is removed. Longitudinal tracking and dynamic designs deserve strengthening: complex dynamic systems theory (CDST) can be brought to bear on the trajectory of WTC changes during pedagogical interventions, compensating for the predominance of cross-sectional designs in existing research. The scope of research participants and target languages can be broadened. Existing findings concentrate on English learners; future work can extend to other languages and multilingual contexts, and integrate meta-analysis to synthesize and test the effect sizes of core variables.

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