

Article

Mapping the Landscape of Technology-Related Research on Foreign Language Anxiety: A Bibliometric Review (2001–2025)

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Abstract: This study uses bibliometric analysis of journal papers published between 2001 and 2025 to investigate the state of the research on technology-related foreign language anxiety (FLA). 224 articles that were indexed in the Scopus database were included in the data. This study used the Bibliometrix package in R to examine publishing patterns, top journals, authors, and institutions, records of international collaboration, and the thematic structure of the field using bibliometric performance indicators and scientific mapping approaches. The findings indicate a consistent and incredibly rapid rise in publications during the past ten years. The majority of the research field's progress is published by a small number of writers and institutions in a limited number of journals. Although China now accounts for the majority of articles geographically, extensive international collaborative networks are still limited and in the early stages of development. Research focus has clearly changed throughout time, as seen by thematic and keyword analysis. While computer-assisted language learning and technology-enhanced learning environments have historically been the focus of education technology research, more recent literature shows a growing interest in artificial intelligence, immersive technologies, and data-informed digital learning contexts. Foreign language anxiety is the subject of an increasing amount of study, which typically places it in positive psychological contexts and focuses on its relationship to motivation, self-efficacy, and communication willingness. These findings will help better understand the origins of technology FLA research and how it is evolving. They can also provide references for upcoming investigations into the potential effects of digital technologies on language learners' emotions.

Keywords: Foreign Language Learning; Anxiety; Technology; Bibliometric Analysis; Learner Affect

1. Introduction

Language education theory and practices have been significantly impacted by the rapid advancement of digital technology during the past 20 years [1]. Numerous technological tools have transformed how scholars approach, observe, and assess language learning, from the earliest computer-assisted language learning software to the current artificial intelligence-powered applications [2]. Researchers can gather vast amounts of learning data, analyze student behavior, and offer individualized teaching support thanks to digital platforms, online learning environments, mobile apps, and data-driven tools [3]. As a result, technology is now both a teaching tool and a way to take into account the intricate cognitive and emotional aspects of language acquisition [4].

In this scenario, academic researchers and the wider academic community are increasingly interested in the needs and corresponding research of technology from the emotional side of language acquisition [5]. For example,

digital technology can influence the learner's emotional experience involved in language learning tasks by providing feedback and personalized pathways that are immediate [2]. Accordingly, research work on technology has expanded to include learners' emotional states such as anxiety, motivation and engagement along with skill acquisition and performance outcomes [6]. For example, AI-mediated language learning tools and online communication platforms allow learners to practice output and converse asynchronously rather than in person, alleviating them of the need to communicate effectively during the performance. At the same time, as other immersive technologies and generative AI systems are increasingly mainstreamed in language classrooms, their influence on affective responses, motivation and engagement during language learning activities cannot be overlooked. The way AI technologies affect learners' perspective and their influence in terms of effective engagement, creativity, and digital literacy has recently been a topic of research concerning English as a Foreign Language (EFL) [7,8]. New research suggests the increasing role of technology in changing not only language acquisition but also cognitive and affective aspects of this process.

Foreign language anxiety (FLA) has been recognized as an important emotional factor affecting learners' foreign language proficiency, classroom engagement, and willingness to engage in sustained learning as early as the late 1970s [9]. This learning anxiety, often characterized by uneasiness, fear or worry can negatively affect learners' cognitive processes, their willingness to speak and ultimately their results in learning [10]. Although early studies of foreign language anxiety relied primarily on self-report instruments and classroom observations, more recent ones have addressed how anxiety is manifest in technology-mediated learning environments such as online classrooms, digital learning platforms and mobile language learning applications [11].

Studies on technology provide new approaches to the exploration and alleviation of foreign language anxiety. Emergent learning environments such as digital learning platforms, intelligent tutoring systems and online communication tools will all affect learners' emotional responses [12]. Moreover, technological advancement and research in data analysis, machine learning, and learning analytics technology can help researchers identify, predict and analyze anxiety-related patterns from behavioral as well as interaction data [13]. Thus, foreign language anxiety has been one of the significant application directions in technology research of language education [14].

While studies on educational technology and foreign language anxiety gain more attention, the literature suffers from fragmentation in terms of disciplines, types of technologies and research traditions. However, only individual empirical studies have been examined to investigate the effects of specific technological interventions, online learning environments, or digital tools on addressing language anxiety. Yet, systematic overall research of the development path, knowledge structure and thematic evolution of technology-related foreign language anxiety research is still lacking. In particular, some major issues such as what technologies and methodologies dominate this research space, how international collaboration networks come into being or how research topics evolve over time have not been completely explored [15].

Given that digital technology began to be incorporated into language education in the early 21st century with the widespread use of internet learning environments and computer-assisted language learning systems, this study adopts the span from 2001 to 2025 as a focal period. During this time, people shifted gradually from initial web-based language learning platforms through integration with artificial intelligence and immersive technologies, data-driven learning environments [16].

Through the use of bibliometric techniques, this study attempts to provide the information and construct a picture of foreign language anxiety research within technology-based educational systems. Through quantitative analysis of publication patterns, citation structures, collaboration networks, and thematic evolution in addition to evaluation analysis and scientific mapping methodology, this study examines publication trends, influential journals, author-institution distribution patterns, global collaboration matrix, and keyword themes development trajectory in the research field.

Specifically, this study explores the following research questions:

RQ1. What is the trend of the annual publication volume in technology-related foreign language anxiety research?

RQ2. Which journals are the most influential academic platforms in this field?

RQ3. Which scholars have made the most influential contributions to technology-related foreign language anxiety research?

RQ4. Which institutions have made the most outstanding contributions to the research on technology-related foreign language anxiety?

RQ5. What is the global distribution of research output and the pattern of international collaboration in this field?

RQ6. What are the major keyword hotspots in technology-related foreign language anxiety research?

RQ7. What are the characteristics of the thematic evolution of technology-related foreign language anxiety research in different development stages?

2. Literature Review

2.1. Foreign Language Anxiety in Technology-Mediated Learning Contexts

Foreign language anxiety (FLA) has long been regarded as a significant affective factor affecting learners' language performance, participation and persistence [17]. Early studies mainly examined FLA in face-to-face classroom environments, relying on self-assessment tools to capture learners' emotional responses in language learning activities [18]. In this traditional framework, anxiety is usually conceptualized as a relatively stable psychological construct, which is related to speaking, listening and classroom interaction [19].

Researchers are investigating human-machine interaction using technology-mined learning environments, even though classic evaluation methods are applicable to computer-based contexts [20]. According to a published study report, data from mobile phone apps, computer-assisted language teaching (CALL), and online environments suggest that technology may redefine learners' experience of emotion in complicated and even conflicting terms [15, 21]. Many of these studies concentrate on (i) how flexible (as allowed by the medium itself) participation has helped to mitigate some aspects of their anxiety [22], while (ii) others highlight new features, such as unfamiliar interfaces and laborious cognitive processing of information-producing technologies by user cognition. Whether particular technologies or interactive technologies, including those that use artificial intelligence (AI) for engagement in language learning systems, have any impact on the type of anxiety children feel in such situations is a crucial sub-question [23].

The fact that several scientific studies demonstrate that foreign language anxiety cannot be resolved in technology-assisted settings utilizing the same frameworks that have been discovered in classroom settings is therefore highly significant. This is a completely new field of study situated at the intersection of psychology, educational technology, and applied linguistics [24]. However, it is very difficult to draw a clear line about how this research area emerged because the present scales of research have been established in a variety of technologies, learning contexts, and academic styles.

2.2. From CALL to Data-Driven and AI-Enhanced Approaches

An intriguing trend toward methodological diversification is being observed in research on technology-assisted language learning due to increasingly complex digital settings. However, the majority of early research used computer-assisted language teaching interventions and especially looked at learners' anxiety levels (as determined by a questionnaire) in traditional versus technology-based learning environments [25]. Although a more dynamic and processual framework of anxiety with a growing focus on learning was lacking, these investigations offer a preliminary grasp of the phenomena.

Learning management systems, online platforms, and interactive apps have demonstrated potential in gathering increasingly comprehensive behavioral data about learners' behavior, such as task completion patterns, response times, and interaction frequencies [26]. As a result, technology is transformed into a methodological tool that allows for more in-depth analysis of emotional variables in addition to serving as a vehicle of transference for instruction [27]. Even while this change could seem insignificant because it just signifies a transition from stasis (souls) to kinetics (processual and FLA), it has the power to cause drastic changes.

Technical research on foreign language anxiety has recently made significant strides thanks to the new ideas of artificial intelligence and data-driven approaches [28]. Techniques including machine learning, natural language processing, and predictive modeling are being used to evaluate, forecast, and identify patterns in large amounts of data from learners that indicate anxiety [29]. This method makes it easier to combine multimodal data, monitor learners' emotional states in real-time (or almost real-time), and analyze nonlinear relationships [30].

More importantly, learners' interactions with language teaching tools are being accelerated by generative AI and adaptive learning systems. AI-type tools are likely to engage, motivate, activate, and stimulate learning creative events and emotions in the target language learning setting, according to several new investigations of earlier research findings [31]. These advancements point to a change from earlier technology-focused teaching strategies to intelligent, adaptive learning systems. The interactional, transactional, and pedagogical aspects of FLA that can surface in digital learning contexts could be significantly impacted by this change.

2.3. Need for a Macro-Level Synthesis of Technology-Related FLA Research

While some narrative and systematic evaluations of particular technologies, instructional strategies, or student outcomes have been published, most of the reviews that are now accessible use a micro-level viewpoint because they concentrate on a single technology (or its application) [2,13]. The general development trajectory of technology-related foreign language acquisition (FLA) research through time dimension, disciplinary disciplines, and technological paradigms appears to be the subject of few studies. For example, several studies look into how learners' motivation and anxiety are affected by mobile-assisted language learning. Other research examines the effectiveness of digital communication techniques or online learning platforms in reducing speaking anxiety. These evaluations are useful for some types of technology-mediated treatments, but they don't cover the entire range of knowledge availability connected to technology-oriented FLA literature or its overall lifespan trajectory.

Much of the existing literature needs to be further explored. First, the general trajectory of technology-related FLA research at a global level was not clear, and little was known about how outcomes have changed in response to major technological shifts. Second, the literature has only minimally addressed the role of premier journals and leading scholars and institutional research communities in knowledge production within this subfield. Third, the patterns of international cooperation and geographical distribution of research outputs are still not fully explored. Finally, while technology for language learning has progressed from computer-assisted language learning to mobile learning and now AI-enabled and immersive environments, it has been difficult to track how research topics have developed.

To address these research lacunae, an overarching analytical lens at the macro-level could facilitate a systematic investigation of the structure and thematic evolution of this multidisciplinary field of study. Bibliometric analysis offers a relevant methodological trail for these types of research. Using bibliometric approaches to quantitative analysis on publication patterns, citation networks, collaboration networks, keyword co-occurrence structures and theme evolution, it is possible for researchers to draw the knowledge topography and developmental track of a research area [32].

Hence, bibliometric reviews can systematically summarize the current research situation of technology-related foreign language anxiety, integrate scattered research results in diverse disciplines and technology domains, and highlight emerging research issues and theoretical blind spots in this rapidly developing field.

3. Methodology

3.1. Research Design

The study methodically examines and illustrates the scholarly framework and research trajectory of foreign language anxiety technology research since it is a bibliometric review. By quantitatively analyzing vast amounts of academic literature in terms of publishing and citation data, bibliometric analysis is a perfect tool for mapping emerging and multidisciplinary domains.

3.2. Data Source and Search Strategy

Data were extracted from Scopus deliberately selected because of its natively comprehensive coverage of peer-reviewed journals and reliable citation indexing to provide bibliographic metadata. The data was retrieved on 31 Jan 2026, assuring that the search process methodology is transparent and replicable.

Boolean operators were used to connect synonyms to maintain conceptual relevance while maximizing sensitivity of retrieval. A systematic search based on combinations of the keywords technology and foreign language anxiety was employed. As **Table 1** shows, the search terms were applied to the title, abstract, and keyword fields. TITLE-ABS-KEY = (("language learning" or "language acquisition" or "linguistic education" or "language study" or

“language mastery” or “language education” or “language training” or “language improvement”) AND (“anxiety”) AND (“foreign language” or “second language”) AND (“technology” OR “computer-assisted” OR “mobile-assisted” OR “digital” OR “VR” OR “AR” OR “AI” OR “ICT”). The search was restricted to journal articles that were published in English between 2001 and 2025. A total of 224 publications were retained for bibliometric analysis after the application of inclusion and exclusion criteria and the removal of duplicates.

Table 1. Boolean Search Strategy Used in Scopus.

Component	Keywords
Language learning context	“language learning” OR “language acquisition” OR “linguistic education” OR “language study” OR “language mastery” OR “language education” OR “language training” OR “language improvement”
Anxiety construct	“anxiety”
Language type	“foreign language” OR “second language”
Technology dimension	“technology” OR “computer-assisted” OR “mobile-assisted” OR “digital” OR “VR” OR “AR” OR “AI” OR “ICT”

3.3. Inclusion and Exclusion Criteria

The inclusion criteria are as follows: (1) Research on foreign language anxiety or related anxiety in language learning contexts; (2) Literature using digital technology, computer-assisted systems, online environments, or other technology-related methods; (3) Research papers in peer-reviewed journals. (4) In order to provide a broad overview of the research field, empirical studies as well as conceptual/theoretical articles that focused on technology-related foreign language anxiety were evaluated in the context of this review.

Inclusion criteria were studies related to foreign language and educational contexts, while exclusion criteria included general or clinical anxiety and non-educational contexts. The scope of foreign language anxiety research is broad and emergent, despite the final dataset's limited size.

3.4. Data Analysis Procedures

The analysis in this study was performed using the Bibliometrix package of the R language environment. It is an open-source tool for full library mapping and bibliometric analysis of scientific literature that enables systematic assessment of the research field evolution, knowledge structure, and publication performance [33].

The current study performed descriptive bibliometric analysis and scientific mapping analysis using the Bibliometrix package of the R environment. The analysis encompassed important indicators including the annual publication trend, prolific journals, prominent authors and institutions, state research performance, global cooperation pattern, and keyword frequency distribution. The output level, regional distribution characteristics and international cooperation pattern of foreign language anxiety technology research are analyzed in detail.

Moreover, this study conducts a systematic sorting analysis of the non-structured content of existing studies in the field using scientific mapping technology to clarify its conceptual structure and thematic evolution. During the science mapping phase, networks of keyword co-occurrence were built using association strength normalization and sets of thematic clusters discovered via Louvain community detection algorithm applied in the Bibliometrix environment. We determined the main research directions, emerging issues and vertical transfer of specific fields in different developmental stages through keyword hotspots analysis and thematic evolution analysis. These technical means not only achieved the visual display of research network, but also identified dominant and emerging research themes effectively to reveal the evolution trajectory of technology-assisted foreign language anxiety research in a long history.

Although the final dataset of 224 publications may seem relatively small for a period of 25 years, this scale is consistent with the expected development patterns in emergent interdisciplinary research domains. The construct of foreign language anxiety was first explored within traditional classroom contexts during the 1980s and 1990s. However, the widespread integration of digital technologies into language education began in the early 2000s with the proliferation of computer-assisted language learning and internet-based learning environments. Consequently, the relationship between technology and foreign language anxiety was only gradually explored in the 2000s, and it has only been more extensively explored in the past decade as a result of the development of mobile learning, online platforms, and artificial intelligence-driven language learning systems.

In emerging research areas, datasets are frequently relatively small from a bibliometric perspective, particularly when topic-specific search strategies and strict inclusion criteria are implemented. Previous bibliometric studies in specialized subfields of applied linguistics and educational technology have also reported datasets of a similar scope when concentrating on narrowly defined research intersections. The majority of studies were generated in the most recent decade, as evidenced by the publication distribution within the present dataset, which reflects the accelerating integration of digital technologies and emotion-oriented research in language education.

Consequently, the dataset size should be interpreted as representative indicator of the recent rise and rapid expansion of research on foreign language anxiety mediated by technology, rather than a methodological limitation. Moreover, this dataset is large enough to allow for covering the major publishing trends, collaboration shapes and thematic evolutions taking place in this emerging research field.

This study systematically constructs the academic map of technology-related foreign language anxiety research by integrating the performance analysis and scientific mapping methods in the Bibliometrix framework. By integrating performance analysis and science mapping techniques within the Bibliometrix framework, this study constructs a data-driven overview of the publication performance, collaboration patterns, research hotspots, and thematic evolution of technology-related foreign language anxiety research.

4. Results and Discussion

This part presents the results and discussion of the bibliometric analysis of foreign language anxiety technology research. Based on the data set and analysis methods described in methodology, this part systematically examines the research development and structural characteristics of the field from multiple dimensions, such as publication trends, high-yield journals, important authors, top institutions, national contribution, international cooperation, keyword hotspots, and theme evolution. The research results will be explained in conjunction with research questions 1–7, so as to build a comprehensive framework for the panoramic view of the field.

4.1. Annual Publication Trends

As shown in **Figure 1**, the annual number of publications on technology-related foreign language anxiety research from 2001 to 2025 shows a significant growth trend from low to high.

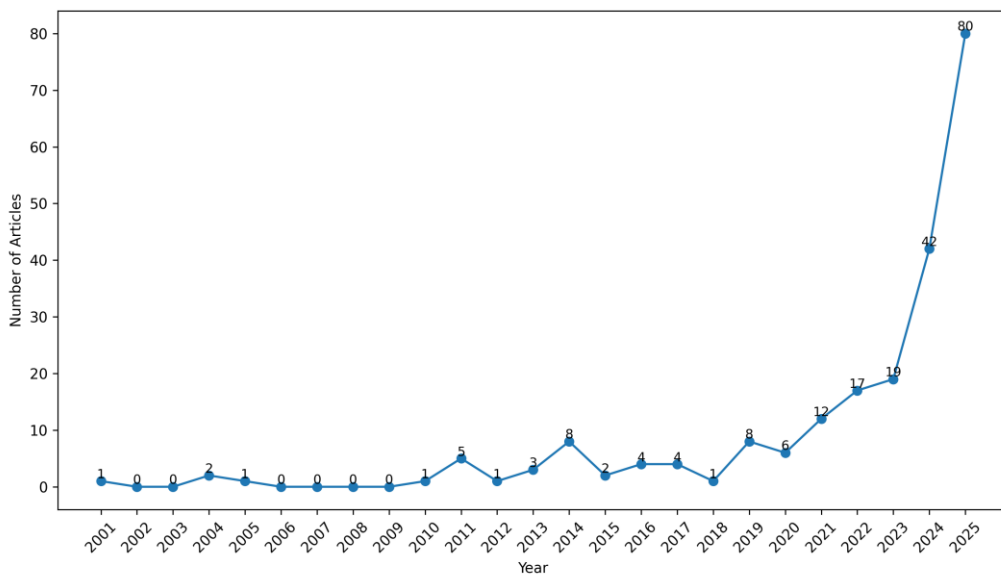


Figure 1. Annual Publication Trend of Technology-Related Research on Foreign Language Anxiety (2001–2025).

From 2001 to 2009, the field of study had not yet formed a stable academic output, and the average annual publication volume was always at a very low level, usually only zero or one paper per year, with only sporadic small fluctuations. This situation shows that foreign language anxiety in the context of technology has not become

a research focus of continuous attention from the academic community, and the academic community's attention during the same period was limited to sporadic exploratory research. Therefore, this stage can be regarded as the germination period of the research field.

From 2010 to 2014, the number of annual publications began to show a small fluctuating growth, and the number of publications gradually increased from 1 to 8, indicating that with the initial development of computer-assisted language learning and online learning environments, researchers began to pay attention to the emotional problems that may be caused by technology intervention in the language learning process [34]. However, the overall research scale was still limited and the field structure was not yet mature at this stage.

From 2015 to 2019, the research results in this field remained relatively stable but at a low level, with an average of 1 to 8 papers published each year, indicating that the relevant research is still in the stage of continuous accumulation and has not yet formed a rapid expansion trend.

After 2020 a critical turning point was reached with an explosive increase in the number of publications. A total of 6 publications were outputted in the year 2020, rising to a total of 19 outputs by the year 2023, ballooning to reach a record high number of outputs at 42 in 2024 and finally hitting a total of 80 documents in the year 2025. Taking 2020 as the base year, the compound annual growth rate (CAGR) of publications from 2020 to 2025 was up to 67.8%, which provides quantitative evidence for explosive trend of this research field. Such rapid growth is directly connected to the global evolution of digital education and implementation of distance and blended teaching models [35]. Language learning context is slowly becoming a research hotspot as technical factors can emotionally affect learners in different situations [36,37].

Illustrating the trends in publication indicates that research on technology-related foreign language anxiety has evolved from a peripheral subject in the early 21st century to an up-and-coming domain of inquiry. The last five years indicate that this eclectic area of study is entering an era of rapid development, during which there seems to be an increasing theoretical focus on the emotional aspects in language learning mediated through technology.

4.2. Productive Journals

By analysing high-yield journals, the study reveals the interdisciplinary extent and channels of dissemination of research on technology and foreign language acquisition. According to **Table 2**, there are ten journals that possess four or more articles in the dataset, suggesting the diversity of such research across a greater number of sources rather than its focus on one core journal.

Table 2. Most Productive Journals in Technology-Related Foreign Language Anxiety Research.

Sources	Articles
Computer-Assisted Language Learning	12
Education and Information Technologies	6
Language Teaching Research	5
CALL-EJ	4
Frontiers in Psychology	4
Interactive Learning Environments	4
International Journal of Applied Linguistics	4
Recall	4
System	4
Theory and Practice in Language Studies	4
Acta Psychologica	3
Asia-Pacific Education Researcher	3
Humanities and Social Sciences Communications	3
IEEE Access	3
Journal of Computer Assisted Learning	3

Among all the cited sources above, the Computer Assisted Language Learning journal is the most prolific one with 12 published papers (which accounted for 24% of total publications). This finding highlights the importance of technology mediation and computer-assisted approach in foreign language anxiety research [4]. Thus, Computer Assisted Language Learning is a specialized journal that not only addresses technology, but also includes the interaction of digital technologies with learning environment and emotional factors [38].

Second place is claimed by the journal “Education and Information Technologies” with six papers. Its scope

is wide, mirroring the increased attention of academia to the intersection between educational technology and socioemotional aspects in establishing effective environments for learning [16]. Confirming its interdisciplinary in that it interweaves the fields of technology, pedagogy and learner experience, this journal offers a natural home for exploring foreign language anxiety through digital and data-driven means.

This area of research is also shaped by a number of leading journals in applied linguistics and language education. The journal *Language Teaching Research* published five papers, and *System*, *RECALL*, and the *International Journal of Applied Linguistics* each published four. These journals also signify that traditional applied linguistics and second language acquisition research disciplines have increasingly accepted technology-related foreign language anxiety studies and are justified in having outlets for their research as long as the pure nature of technical study is no longer adhered to [15,39–41].

Furthermore, they have provided a selection of large number of journals focusing on psychological orientation and mixed aspects. With *Journal Frontiers in Psychology* and *Journal Interactive Learning Environments* 4 aforementioned associated papers, according to database, academic circles are paying attention to the digital or interactive learning environment emotional part completeness. They include journals centering around studies of learner experience, engagement or emotional regulation which further support that investigation of foreign language anxiety as related to technology is interdisciplinary [11,35].

Finally, *Theory and Practice in Language Studies* and *CALL-EJ* both published four articles. While these journals are relatively smaller in scale or geography, their existence indicates there is a broad range of outlets through which research has been published, suggesting that the intersection between technology and FLA is a topic of interest across subfields [42,43].

Excellent journals serve three different purposes. The prevalent theme of technology and foreign language learning journals was significant, which lends credence to the notion of a strong link between research on anxiety related to learning a foreign language and technology-assisted education. Second, an example of the upward dynamics of interdisciplinary research was the acceptance of anxiety research with technology as a topic in applied linguistics publications. Furthermore, showing that the foundations for a single discipline-dominant platform have not yet been established shows that this is still in its early stages of development and is exhibiting a decentralized publication model in both fields rather than being restricted to the development of centralized major core journals. Emerging interdisciplinary subfields frequently have this fragmented nature, which reflects the ongoing convergence of applications from educational psychology, educational technology, and applied linguistics lenses.

4.3. Influential Authors in Technology-Related Foreign Language Anxiety Research

In order to determine the academic contribution and cooperation mode in foreign language anxiety technology research, it may be examined based on the authors' productivity. The distribution of authors in **Table 3** reveals that the great majority of researchers contribute to the research through many publications, while only a small number of writers have numerous publications. This is typical of an unconsolidated field of study where long-term paths of inquiry are still emerging.

Table 3. Most Productive Authors in Technology-Related Foreign Language Anxiety Research.

Authors	Articles	Articles Fractionalized	Total Citations
Chen HHJ	6	3.33	446
Tai T	4	2.00	364
Zhang H	4	1.37	33
Chen Y	3	1.83	115
Hwang G	3	0.83	122
Lee JS	3	2.00	267
Liu C	3	0.67	131
Çelik F	3	1.53	21

Note: Fractionalized articles indicate the weighted contribution of each author based on co-authorship patterns.

According to **Table 3**, the most productive author on this topic is Chen HHJ, who published six articles with a fractionalized contribution score of 3.33. Chen HHJ has the highest citation impact with a total of 446 citations among all scholars. This indicates the notable research productivity and substantial academic influence in the field

of technology-assisted language learning and learner emotional variables [44].

The next most productive authors are Tai T and Zhang H, with four publications each. The collaborative influence of this type is central when there is a low yield (this impact can complement later), e.g., the 2.00 fractionalized contribution score creates 364 citations for Tai T, due to which he has high citation impact with great power together in networks where people work collaboratively and generate his network among the collective research studies. On the other hand, Zhang H has a similar publication record regarding quantity but less academic impact based on the total citation number (33).

Additional contributors, Chen Y, Hwang G, Lee JS, Liu C and Çelik F have each published three articles. Lee JS had a very high citation effect (267 citations) for this cohort, in contrast to Hwang G and Liu C, who had moderate citation impacts of 122 and 131 citations, respectively [45]. These authors' differing fractionalized article scores indicate that they collaborate in different ways and play different roles in multi-author publications.

What's more, most of the contributors are in fact major ones but there are numerous authors with a single paper or two. A long-tail distribution such as this indicates a wide and exploratory scope of interest, encompassing researchers from applied linguistics [46], educational technology [47], psychology [48] and computer-assisted language learning. For many individual scholars, the focused area and subject matter of research on technology-related foreign language anxiety can be seen as part of a larger thread or area of inquiry when scholars appear to mention it within the context of a broader line or notes about their academic interests.

Examining author-level analysis reveals the fundamental characteristics of the field. An indicator for including the relationships between increased research production and early citations in a relatively small set of researchers. Additionally, the contributions of fractionalized authors demonstrate the multidimensionality and convergence of research on technology-associated anxiety related to foreign languages. There seem to be plenty of opportunities for new researchers to establish important research paths because the area is still relatively young and lacks a distinct group of influential experts.

4.4. Institutional Contributions to Technology-Related Foreign Language Anxiety Research

An analysis in this article helps to present an imposing organizational basis for the study of technology-oriented foreign language anxiety through institutional contributions. The comprehensive spread of the research output demonstrated in **Table 4** indicates that this field is not controlled by a select few elite institutions, but rather represents wide institutional participation.

Table 4. Most Productive Institutions in Technology-Related Foreign Language Anxiety Research.

Institution	Articles
National Taiwan Normal University	12
Prince Sattam Bin Abdulaziz University	9
The Education University of Hong Kong	8
Universiti Kebangsaan Malaysia	7
Islamic Azad University	6
Beijing Normal University	5
Zhejiang University	5
Telkom University	4
King Faisal University	3
National Taiwan University of Science and Technology	3
Northern Border University	3
Taipei Medical University	3
The University of Hong Kong	3
Universitas Islam Negeri Maulana Malik Ibrahim Malang	3
Universitat D'Alacant	3
University of Chinese Academy of Sciences	3

National Taiwan Normal University has the largest number of papers (12) among many universities. By having an in-depth knowledge of the subject matter dedicated to Computer-Assisted Language Learning (CALL), this outstanding feat of research can also be credited to its foundation. Taiwan has conducted various CALL studies in digital learning environments as well as in intelligent tutoring systems and mobile-assisted language learning [45,48] which was also supported by several studies. Research in this direction has direct implications for research on

learners' emotional experiences, such as technology-related foreign language anxiety.

Prince Sattam Bin Abdulaziz University ranked second (9) and The Education University of Hong Kong ranked third (8). Such high productivity is greatly aided by the strong research oriented environment of these institutions which notably emphasizes educational technology and language teaching methodologies. More at Hong Kong universities digital technology for language learning and second language pedagogy is becoming dominant. This research ecosystem usually supports the interdisciplinary collaboration between applied linguistics, educational psychology and digital learning technologies.

Universiti Kebangsaan Malaysia, with its seven papers, and Islamic Azad University, with its six, make up a second tier of elite academic institutions. As mobile learning platforms, online learning environments, and digital education technologies are increasingly adopted in Southeast Asia and the Middle East, more institutional publications are emerging from this region. Researchers have already started exploring the dual value of technology-assisted language learning on how effective they are at teaching as well as their emotional impact, fueled by rapid digitalization of the education system leading to a sudden shift towards online learning model virtually overnight.

Chinese universities, such as Beijing Normal University and Zhejiang University, also produce significant research output—five publications for each institution. These are considered some of the best universities with strong research agendas in educational technology and digital learning innovation. Recently, accompanied by the large-scale investments in smart education and artificial intelligence–assisted learning environments made by China, a lot of research has been initiated to investigate both cognitive and affective variables that may influence language learning.

Notably, multiple universities contributed two or three articles each and even more to a lone publication. It is also part of the long-tail distribution, which tells us that although research in technology on foreign language anxiety is less common (special centers around the world), more research becomes a potential part of higher institutions' broader plans. Such trends are common in a burgeoning interdisciplinary field, with early studies emerging from disparate institutional contexts.

Institutional analysis revealed three main characteristics. First, due to a small number of research institutions acting as regional and thematic centers for technology-mediated languages acquisition research, much specialist knowledge is concentrated in these institutions. The field they represent has few independent researchers contributing significantly to its development, though many more study it nowadays than when these centers were first set up. Secondly, the global, transnational nature of the field is reflected in the significant contributions made to it by numerous universities in Asia, the Middle East, Europe and North America. Thirdly, intellectual origin has not produced particularly excessive institutional dominance, so that the research field is still a relatively open and lively one. This provides opportunities for new institutions and research teams to soon play more central roles.

4.5. Country-Level Contributions and International Collaboration Patterns

To examine the global distribution of research output on foreign language anxiety technology, the study conducted a country-level analysis. As shown in **Table 5**, although academic output exhibits a wide geographical distribution, it is extremely uneven, with a few countries accounting for a large proportion of the total publications.

China has a clear lead in this area, with 142 publications, far more than any other country. This prominent position reflects China's continued investment in educational technology research, applied linguistics and foreign language education. The dense output of Chinese research results is consistent with previous research conclusions on efficient institutions and international cooperation, and further consolidates its position as the main hub of global technology-related foreign language anxiety research.

Another group of high-output countries is mainly from the Middle East and Southeast Asia. Saudi Arabia (28), Iran (27), Indonesia (25) and Malaysia (24) all showed strong research strength. In multilingual and English-taught educational environments, these countries are paying more and more attention to optimizing language teaching through technical means to cope with the difficulties of foreign language learning, including language anxiety. The outstanding performance of these countries highlights the continued growth of the non-Western region in shaping the influence of this research field.

A third tier of contributors was made up of a number of countries from both Asia and the West. Turkey and the United States each contributed 20 publications, followed by South Korea (14), the United Kingdom (14) and Japan (13). These countries have well-established research systems in applied linguistics, psychology and educational

technology, suggesting that technology-related foreign language anxiety research has been integrated into a broader and more mature academic tradition.

Table 5. Country-level distribution of publications in technology-related foreign language anxiety research.

Country	Publications
China	142
Saudi Arabia	28
Iran	27
Indonesia	25
Malaysia	24
Turkey	20
United States	20
South Korea	14
United Kingdom	14
Japan	13
Spain	11
Australia	7
Egypt	7
India	6
Jordan	5
Uzbekistan	5
Thailand	4
Hungary	3
New Zealand	3
Oman	3

Note: Only countries with at least three publications are displayed. Countries with fewer publications are discussed in the text.

The results of studies on technology-related foreign-language anxiety are scattered throughout the world using a country-level analysis. Although academic output is spread throughout several nations, as **Table 5** illustrates, it is highly uneven, with the majority originating from a small number of nations.

Additionally, nations like Spain (11), Australia (7), Egypt (7), India (6), Jordan (5), and Uzbekistan (5) have moderate but noteworthy outputs. Even though this is a small output, it adds to the variety of learning environments and learner classifications that have been documented in the literature.

Furthermore, constructive arguments are made for the need for a comprehensive picture of the scope and geographic focus dynamics of international research cooperation in this field. In the section that follows, specific nations from every continent will be examined, along with their global collaboration.

Table 6's columns show how this cooperative network is made up of many minor frequency inter-linkages and one or two major core hubs. It is also dispersed extremely irregularly about its center, as shown in **Figure 2**. The international scientific research partnership is completely dominated by China. Its core position is further demonstrated by the abundance of research output it generates each year, as well as by these richly overlapping centers across the network that extend northward into East Asia, Southeast Asia, the Middle East, Europe, and America.

Table 6. Major Bilateral International Collaborations in Technology-Related Foreign Language Anxiety Research.

From	To	Frequency
China	Hong Kong	6
China	Malaysia	6
Saudi Arabia	Egypt	5
China	Iran	4
Saudi Arabia	Iran	4
China	Saudi Arabia	3
China	United Kingdom	3
United Kingdom	Hong Kong	3
China	New Zealand	2
China	USA	2
India	Bangladesh	2
Iran	Egypt	2
Iran	Turkey	2
United Kingdom	Australia	2

Note: The table reports country-to-country co-authorship frequencies based on corresponding authors' affiliations.

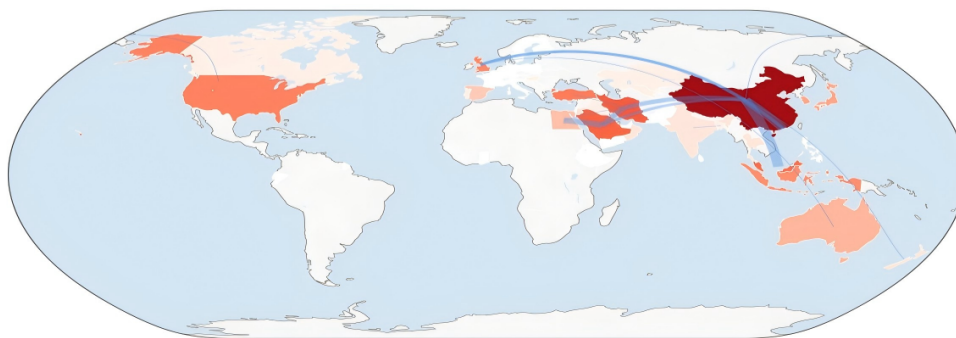


Figure 2. Global Network of International Collaboration in Technology-Related Foreign Language Anxiety Research.
 Note: Country shading reflects relative publication volume, and link thickness indicates the frequency of international collaboration.

China has such a close partnership with Malaysia and Hong Kong that the two have published together six academic books. Not only are the two countries linked geographically and academically in the study of applied linguistics and educational technology, but a shared desire for regional research also forms part of their means digital education is entered into Asia South East Asia. In particular, Chinese policies for the digital transformation of education and development of AI-assisted learning environment have greatly promoted international collaborative research in the field technology-apprenticeship language teaching.

In the United Kingdom, Iran, the United States and Saudi Arabia, China has been closely linked by cooperative research. This relationship is cemented through academic exchange programs, joint research projects, and multimillion-dollar grants funded by collaborating national governments. It allows for insight around the world with learning technology and know-how in online education.

Beyond China-centric models of cooperation are several regional cooperation clusters. With Middle Eastern countries consistently investing heavily in building a digital learning infrastructure, take Saudi Arabia and Egypt or Saudi Arabia and Iran for instance, the closer collaboration of higher education institutions among these countries. Over the last decade or so, a number of countries in the region started to implement national educational reform projects that exchanged traditional language education for slightly updated technological initiatives. This has also produced some regional academic collaboration. Likewise, countries such as India and Bangladesh's neighbours' engagement establishes the importance of geographic distance, shared language environments and regional academia mobility systems on collaborative research. These trends reflect broader ideas about the effectiveness of funding paradigms and national educational trajectories, as well as a more policy-driven, regional perspective in international anxiety research over technology-mediated language studies.

In addition, the collaboration network is characterized by building a strong East–West research corridor that connects particularly East Asian countries with Western research hubs. Over the years this includes major links in countries such as China and the United Kingdom, America, Australia and New Zealand, as well as between the United Kingdom and Hong Kong. These connections, which demonstrate that research in technology-mediated language learning is a global endeavour, also indicate characteristics of expertise and practical knowledge that continue to be transcontinental. These achievements are facilitated through collaboration amongst international public and private institutions that fund appropriate academic partnerships that support our capacity to do better science on an exponentially global scale.

The analysis of both national-level data and the nature of cooperation among countries in this field reveals a distinctive global research configuration of increasing interconnectedness and a great deal of asymmetry. While only a small number of countries primarily China exert a strong control over research output and cooperation networks, many nations are beginning to form cooperative research enterprises at the regional level of policy caliber through academic mobility efforts or investments in digital education. All these observations point to the development of opening up a community for technology-related foreign language anxiety research that is both uneven geographically and structurally, but with considerable capacity to become more profound and lasting international collaboration in the future.

4.6. Keyword Hotspots in Technology-Related Foreign Language Anxiety Research

This study assessed author keyword frequency using the Bibliometrix program to identify the primary research hotspots in technological studies connected to foreign language fear. This study relies on frequency counts of author keywords for hotspot identification. This approach features a distinct framework, presenting results that indicate the absence of the most prevalent research topics in the dataset. Additionally, **Figure 3** generates a word cloud visualization, while high-frequency items are cataloged in **Table 7**.



Figure 3. Keyword Hotspots in Technology-Related Foreign Language Anxiety Research (2001–2025).

Table 7. Top Keyword Hotspots in Technology-Related Foreign Language Anxiety Research.

Keyword	Frequency
Artificial Intelligence	23
Motivation	17
EFL learners	13
Students	10
Second language acquisition	9
Virtual reality	9
Emotions	8
Mobile-assisted language learning	8
Speaking anxiety	8
Willingness	8
English as a second language	7
Self-efficacy	6
Speech recognition	6
Computer-assisted language learning (CALL)	6
Foreign language speaking anxiety	5
Willingness to communicate (WTC)	5
ChatGPT	4
Generative artificial intelligence	4
Automatic speech recognition	4

At the technical level, artificial intelligence emerged as the most often cited keyword, appearing 23 times, underscoring its significance in contemporary research. The technical terms referenced in the context included virtual reality (9 occurrences), mobile-assisted language learning (8 occurrences), computer-assisted language learning (6 occurrences), speech recognition (6 occurrences), automatic speech recognition, AI Chatbot, ChatGPT, and generative artificial intelligence, each mentioned 4 times. The developing technologies, specifically intelligent, immersive, and data-driven, provide a significant first-mover advantage as the research field increasingly shifts from traditional Computer-Assisted Language Learning (CALL) to incorporate these prevalent concepts. This trend is especially apparent in the latest published literature of this study cycle.

From the perspective of emotion, several high-frequency keywords highlight the focus of the field. Motivation (17 occurrences) appeared at the second highest frequency, followed by emotions (8 occurrences), speaking anxiety (8 occurrences) and foreign language speaking anxiety (5 occurrences). The high-frequency co-occurrence of anxiety-related terms and positive emotional concepts (such as motivation, self-efficacy (6 occurrences) and will-

ingness (8 occurrences)) indicates that technology-related research is increasingly adopting a balanced emotional framework, which not only focuses on anxiety relief, but also focuses on improving learners' motivation and confidence.

From the perspective of learners and teaching, keywords such as English learners, students, adult, and young adult indicate that the relevant research mainly focuses on formal education scenarios, especially higher education and adult English teaching. In addition, the existence of terms such as English as a second language, second language acquisition, and 2nd language makes these studies clearly belong to the theoretical framework of applied linguistics and second language acquisition.

In research methods, the frequent occurrence of questionnaires in research methods illustrates that language is often studied as one learns it online, using a self-reporting technique. Keywords such as academic engagement, communication, and speaking skills are emerging, indicating a potential academic interest in the significance of emotional variables for academic performance. This trend signifies that research methodologies are beginning to incorporate dynamic assessment and are progressing towards examining broader model components, including the interaction of academic accomplishment, emotions, and learning.

Based on the interpretation of high-frequency keywords, several conceptual groupings of research topics can be observed in the field. Although clustering-based keyword networks were not applied in the present analysis, the frequency distribution of keywords still reveals several dominant thematic orientations. In general, the hot word analysis identifies three primary tendencies. Initially, the technical research on foreign language anxiety demonstrates substantial technical-driven characteristics, with immersive technology and artificial intelligence occupying the core position. Second, anxiety research is increasingly combined with positive emotions and motivation concepts, reflecting a trend toward a more comprehensive emotional perspective. Third, the coexistence of traditional research methods and emerging technical means indicates that the field is in a transitional stage, while retaining the established methodological basis, it is moving toward a more complex and data-driven research direction.

4.7. Thematic Evolution

This work employs antithesis analysis to delineate the longitudinal growth trajectory of foreign language anxiety technology research into three distinct phases: 2004–2019, 2020–2024, and 2025, as seen in **Figure 4**. The Sankey diagram, together with its accompanying inclusion and stability indicators, illustrates the evolution or convergence of the fundamental research theme throughout time. This indicates that these alterations signify the evolving technical paradigm and a shift in theoretical emphasis. In theme evolution analysis, betweenness centrality was employed to evaluate the bridging function of keywords within the theme network.

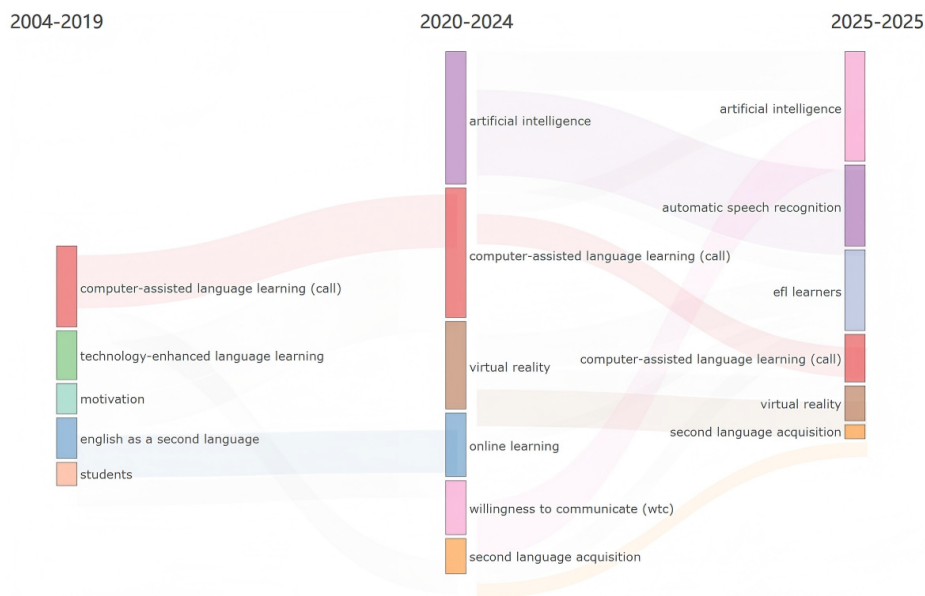


Figure 4. Thematic Evolution of Technology-Related Foreign Language Anxiety Research (2004–2025).

4.7.1. Early Stage (2004–2019): CALL and Technology-Enhanced Foundations

In the early stage of foreign language anxiety technology research (2004–2019), although the basic framework is computer-assisted language learning, and technology-enhanced language learning. Figures are in the topic map in **Figure 5** and **Table 8** and themes even appear to show an elevated place within central districts. While the density is high, it shows that it has scratched the surface and is treated here as a synthesis of common conceptual ideas rather than as closely knit subject matter.

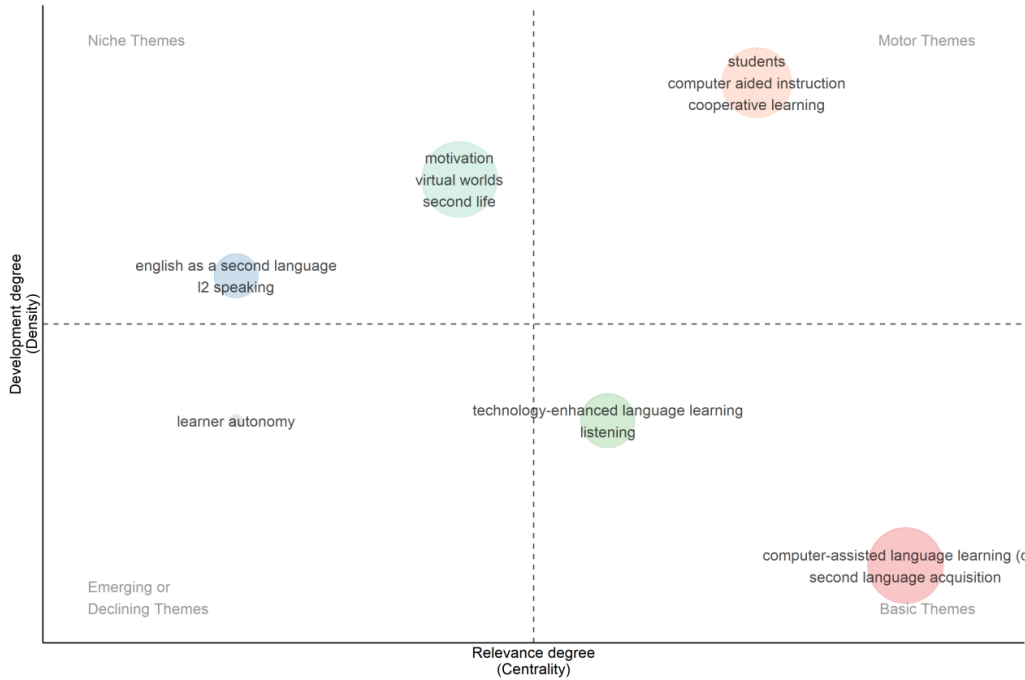


Figure 5. Thematic Map of Technology-Related Foreign Language Anxiety Research (2004–2019).

Table 8. Key Themes and Centrality Measures in the Early Stage (2004–2019).

Keyword	Cluster	Occurrences	Betweenness Centrality
Computer-assisted language learning (CALL)	CALL	5	253.50
Second language acquisition	CALL	3	257.81
Motivation	Motivation	3	154.00
Virtual worlds	Motivation	3	80.00
Students	Students	3	351.00
Technology-enhanced language learning	Technology-Enhanced	3	184.00

Take the cluster centred on computer-assisted language learning (CALL) as an example. It has strong ties with second language acquisition and this is borne out by the relatively high betweenness centrality values of its nodes. The cluster centring on computer-assisted language learning (CALL) is, as network analysis shows, closely connected with second language acquisition. The high betweenness centrality values showed that these two themes played roles in bridging different research fields in a knowledge network. The keywords with high betweenness centrality are eloquent. Such words link a large number of theme clusters and help to spread concepts.

In this context, it is telling that computer-assisted language learning (CALL) and second language acquisition score so heavily on betweenness centrality. The central connecting elements have been these topics more than anything else to date. To elaborate, CALL may be understood as acting like a medium for the supply system technologies and original processes of second language acquisition. Simply put, at this time technology-oriented research centre roared with education support, highlighting experience to come from practice and communication. No breath was spent on developing systems or on artificial intelligence in learning systems.

In addition to computer-assisted language learning, numerous publications within theoretical clusters have been developed. The motivation-centered cluster comprises aspects including “motivation,” “virtual worlds,” and “second life.” It is situated at the junction of sub-themes. Despite the lack of strong secondary cohesiveness at the cluster center, the position of the all-round set remains constrained. The cluster focuses on initial research, investigating the impact of immersive simulation environments on learner motivation and the mitigation of emotional disorders such as anxiety. Nonetheless, these investigations are largely autonomous within the realm of computer-assisted language learning.

Another important student-centered cluster, with “students”, “computer-aided instruction” and “cooperative learning” as its key words, came to occupy the center of the early topics most distracted (btw = 351). This means that this theme plays a connector role between many research themes in the network. This figure indicates the network’s high level is given over to collaborative learning and learner participation in education.

However, the task-based language learning cluster is in a state of transition, there is a relatively prominent core and it has low spatial density. The cluster is closely related to listening ability, which suggests that early research largely concentrated on the application of technology in specific abilities especially in reception domains. Typical research into this field is concerned more with how multimedia and computer-based resources can help enhance a person’s listening comprehension. This could result from easing any vicarious anxiety caused by a lack of input or excessive cognitive processing demands and direct quotes within single quotation marks.

In Summation, the early stage (2004–2019) was a period of laying foundation for the conceptualization of technology as an instructional aid which was primarily applied in technology-enhanced environments and the discipline of computer-assisted language learning. The study reviewed different groups of students, student motivation to learn and skills acquisition strategies. The earliest approaches to the treatment of foreign language anxiety were largely implicit and did not treat it as a distinct object of research [25]. These early research efforts established the conceptual foundation, the methodological basis for later evolutions to more integrated ways of working and technology with both human and emotional attention.

4.7.2. Transitional Stage (2020–2024): Emergence of Artificial Intelligence and Immersive Technologies

The age from 2020 to 2024, a non-linear transition in foreign language anxiety and technology research, was marked with advancements in artificial intelligence (AI) and immersive technology which made it the center of scholarly exploration thereafter. **Figure 6** and **Table 9** clearly demonstrate how research foci have migrated from marginal or basic fields to core topic fields. This not only reflects an increase in relevance, but also indicates that as a result the concept level has matured.

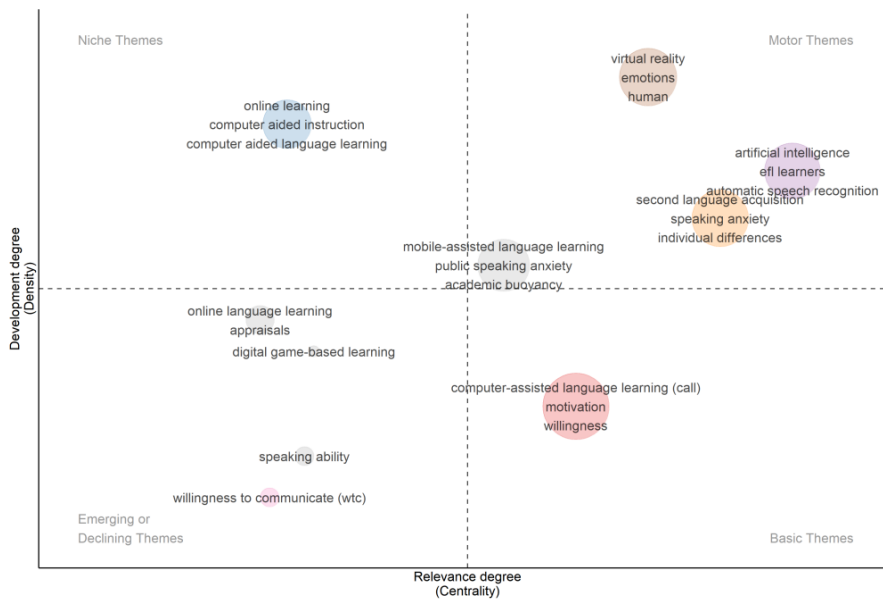


Figure 6. Thematic Map of Technology-Related Foreign Language Anxiety Research (2020–2024).

Table 9. Key Themes and Centrality Measures in the Transitional Stage (2020–2024).

Keyword	Cluster	Occurrences	Betweenness Centrality
Artificial Intelligence	Artificial Intelligence	10	4,074.47
EFL learners	Artificial Intelligence	4	3,473.17
Automatic speech recognition	Artificial Intelligence	2	581.2835723
Chatbots	Artificial Intelligence	2	232.6903106
Second language acquisition	Second Language Acquisition	9	2,862.73
Speaking anxiety	Second Language Acquisition	4	1,017.82
Computer-assisted language learning (CALL)	CALL	7	3,485.29
Motivation	CALL	7	1,589.52
Mobile-assisted language learning	MALL	7	2,047.57
Public speaking anxiety	MALL	3	330.61
Virtual reality	Virtual Reality	6	2,994.52
Emotions	Virtual Reality	4	2,107.33
Online learning	Online Learning	3	103.00
Willingness to communicate (WTC)	Willingness to Communicate	3	1,505.00

The most significant issue cluster at present time is, obviously, AI. This subject or subtopic node possesses the highest betweenness centrality (btw = 4,074.47) observed in this research phase, significantly surpassing others in centrality. This finding indicates that artificial intelligence serves as a robust connector between previously distinct research domains, including computer-assisted language learning (CALL), second language acquisition, and emotional factors related to anxiety. The subjects under the AI cluster are intricately connected to English language learners, automated speech recognition systems, and Chatbots.

As artificial intelligence proliferates, virtual reality takes on a new role as an essential propulsive force. It adds to these two characteristics of high density and being located at the heart of the network. The academic community has started to recognize the importance of emotion-sensitive and embodied learning environments, as shown by such keywords in conjunction with vital concepts like virtual reality technology as “emotions”, “human”, “psychology”, and language development. Furthermore, the integrative role of this cluster in linking technical results with learners' mental states, especially in alleviating anxiety and regulating emotions (btw = 2,994.52), is evident in several contexts.

Second language acquisition at once keeps its original flavor, as a stable and highly central discipline (btw = 2,862.73), and takes on new features including speaking anxiety, individual differences, listening and speaking skills. In this arrangement, it is indicative of a trend toward convergence between SLA research and technology-enhanced studies on operant response acquisition in anxious states of performance, especially those resulting from oral communication.

The popularity of Mobile-Assisted Language Learning (MALL) continues to grow. MALL research examines a mobile environment where learning converges with existing theoretical frameworks; within this context, one may pose inquiries such as the following. This trend shows the growing emphasis on affirmative personalization and contextual cognizance in educational institutions. Simultaneously, associated lines of research are proliferating in their investigations of how mobile technology might transform individuals' emotional reactions to elements present in both formal and informal settings.

In contrast, online learning and willingness to communicate for example are in the “emerging or decelerating” quadrant at this time. They are also neither very high density or central and yet strategically located in the plane of this quadrant. There is a sense that currently they probably cannot make it in being good theoretical company to foreign language anxiety studies and can only keep marching along on parallel lines.

The transition period (2020–2024) signifies a significant paradigm shift in the area, evolving from viewing technology as a mere teaching aid to recognizing it as an intelligent entity with perceptive and emotional reaction capabilities. The incorporation of artificial intelligence, virtual reality, and emotional factors such as anxiety, motivation, and communication willingness signifies a pivotal change in the study goal [5, 19, 34]. This stage has thus evolved into a conceptual bridge linking the foundational computer-assisted language learning phase with the contemporary research paradigm, which is learner-centered and incorporates artificial intelligence, emerging as a characteristic feature of recent advancements in the area [37, 40, 41].

4.7.3. Recent Stage (2025): AI-Centered and Learner-Oriented Convergence

The thematic structure of technology-related research on foreign language anxiety in 2025 reveals a highly concentrated and coherent configuration. As shown in the thematic map **Figure 7**, several clusters are positioned in the motor theme quadrant, indicating both high centrality and high internal density. This pattern suggests that the field has entered a stage of conceptual consolidation.



Figure 7. Thematic Map of Technology-Related Foreign Language Anxiety Research (2025).

As shown in **Table 10**, artificial intelligence is the most central theme cluster in the 2025 research, not only appearing most frequently (13 occurrences) but also achieving a betweenness centrality of 7,076.86. Relevant keywords include motivation (7 occurrences), ChatGPT (3 occurrences), generative artificial intelligence (3 occurrences), AI literacy (2 occurrences), integration (2 occurrences), and willingness to communicate (WTC) (2 occurrences). The prominent status and central positioning of these terms indicate that AI, as a core organizational framework, closely links technological innovation with the emotional and communicative dimensions of foreign language anxiety research.

Table 10. Key Themes and Centrality Measures in the Recent Stage (2025).

Thematic Cluster	Representative Keywords	Occurrences	Betweenness Centrality
Artificial Intelligence	artificial intelligence; motivation; ChatGPT; generative AI; AI literacy; willingness to communicate	13/7/3/3/2/2	7,076.86
EFL Learners	EFL learners; students; speaking anxiety; self-efficacy; mental health	9/6/4/3/3	4,603.62
CALL/MALL	computer-assisted language learning; mobile-assisted language learning; emotions	4/3/4	1,457.66
Second Language Acquisition	second language acquisition; speech recognition; informal digital learning of English	4/4/3	1,621.70
Virtual Reality & Immersive Technologies	virtual reality; AI-assisted language learning; personality traits	3/2/2	2,082.18
Emerging Topics	academic engagement; metaverse; L2 speaking anxiety	3/3/2	1,402.65

Note: This table presents representative keywords for each major thematic cluster identified in 2025. Only high-frequency and theoretically salient terms aligned with the Results section are retained. Betweenness centrality is reported to indicate the structural importance of each theme.

The second major theme focuses on English as a Foreign Language learners. This includes common keywords like students and adults. This thematic cluster also deals with anxiety and psychological factors, such as speaking anxiety and self-efficacy. The high centrality and density of this theme cluster indicate that it has devoted much more emphasis to individual emotional characteristics of learners than other attractively expressive research areas like composition, reading and transformation.

Moreover, despite the structural and functional changes in computer-assisted language learning (CALL), it is

still an important research topic in 2025. Centrality and frequency values of keywords associated with CALL (such as emotion, online and distance learning, mobile-assisted language learning) are moderate.

The core themes of Second Language Acquisition (SLA) research cluster are speech recognition, informal digital English learning, and technology-enhanced language learning. The moderate-to-high coreness of these terms shows that there has been a sustained interaction between second language acquisition theory and research findings concerning involvement anxiety that are related to technology-enhanced fear.

Furthermore in today's trend of AI-assisted language learning as well as personality traits virtual reality research has now become a self-sufficient sub-field. Its internal density is less than that of the power mode for AI and learner-centered clusters; but when it comes to proximity to central axis, it shows a marked importance. New topics such as academic engagement, metaverse, and L2 speaking anxiety are all now located in this quadrant conceived of the pensive-bot quadrant which reflects a trend towards explication into future inventions or ideas.

In 2025, the theme of foreign language anxiety research shifts from former computer-based paradigms to learner-centered. Unlike prior research which emphasized type of CALL tools, the research on the other hand is increasingly stressing the basics of AI, emotional and motivational factors merged.

In summary, between 2004 and 2019, Computer-assisted language learning and technology-enhanced language learning prompted research focused on innovative pedagogical philosophy. Technology served as an auxiliary tool in education, and through instructional design and student engagement, anxiety was indirectly mitigated. During the transition period (2020–2024), the primary study themes encompassed artificial intelligence and immersive technologies, while affective components such as motivation, anxiety, and communication willingness were integrated into this technology-mediated learning environment. This represented a pivotal juncture. By 2025, the field had attained greater maturity. This study should focus on kids' emotional experiences, interests, motivation, and teachers' well-being. This represents a shift from the tools employed for language instruction to the intrinsic emotional sense associated with it, in both the technology development process and project trajectory. Currently, the development process integrates technology and emotional concepts to such an extent that future foreign language learning environments must be adaptable, emotionally resonant, and focused on sustainability.

5. Conclusion

This study does a bibliometric analysis of technology-related studies on foreign language anxiety (FLA). It encompasses efforts in this domain from 2001 to 2025. This domain's foundations, growth trajectory, and evolutionary patterns are successively illustrated through publication trends, encompassing prominent journals, leading authors and institutions, national contributions, international collaborative networks, and keywords that propel advancement, while also profiling central themes within the field.

The results indicate a distinct and sustained increasing trajectory. In the initial phase of the discipline (2001–2009), the overall publication rate was notably low, scattered, and indicative of a confused exploration of its specific derivatives within the preceding area. The total output over the 20s exhibits an increase in absolute figures, however, it remains relatively low. Research output in this field increased rapidly after 2020. The abrupt shift post-2020 signifies that foreign language study has emerged as a central concern in technology-assisted language learning.

The decentralized nature and interdisciplinary characteristics of research in technology-assisted foreign language instruction are evident in its journals, authors, and institutional origins. The domain is not dominated by a singular publishing channel or elite institutions; rather, it encompasses a diverse array of publishing platforms that include representations from several fields beyond the conventional scope of applied linguistics, such as educational technology, psychology, and computer-assisted language acquisition, among others. This scatter is indicative of nascent fields whose trajectories are yet to be established, as ongoing research endeavors develop an integrated system.

Geographic research indicates a growing gap alongside enhanced connectedness in global scientific initiatives. A significant proportion of research findings originates from a restricted number of countries, notably China, whilst other regions produce considerably fewer publications. Simultaneously, the international collaboration landscape indicates strengthening connections across diverse research hubs in East Asia, the Middle East, and Western research centers. These characteristics position technology-related English foreign language anxiety research within a fundamentally asymmetric domain, widely prevalent globally. The domain presents distinct opportunities for fostering international collaboration while concurrently advancing cooperation with more structural equity.

Keyword hotspot analysis indicates significant shifts in research emphasis towards emotionally oriented studies and advanced technology. Currently, following artificial intelligence, technologies such as virtual reality, mobile-assisted language learning, speech recognition, and generative artificial intelligence systems are emerging as the most prominent terms associated with language and anxiety overall. Contemporary notions of anxiety influence are yielding synergistic outcomes with factors such as positive emotions, learning incentives, self-efficacy, and a propensity for communication.

A shift in the fundamental concepts of the field has transpired, as evidenced by the themes of historical transformation. Thematic evolution precisely encapsulates the significant transformation articulated in this study. The text might be regarded as accentuating its topics throughout time. During this period (2004–2019), the primary focus of research was on technology-assisted language instruction and computer-mediated language acquisition. In these circumstances, technology served mainly as an educational instrument and, implicitly and haphazardly, addressed concerns related to worry. A transformation transpired during the transition era of 2020–2024. Artificial intelligence and immersive technology emerged as the primary themes encompassing many performance criteria, motivation, and emotional responses. The discipline will transition to a new learner-centered paradigm of paramount significance by 2025. At that future juncture, this phase will be characterized by AI-driven research that effectively anticipates and examines the psychological experiences, motives, and emotions of language learners. Technology has evolved from a simple pen to an emotionally intelligent chatbot. At these times, it is directly engaged in the language acquisition process.

In conclusion, a series of systematic paradigm shifts in technology-foreign language anxiety research have been facilitated by the current study. The studies have now transitioned from an instrument-based approach to a learner perspective that emphasizes learners as subjects and incorporates artificial intelligence and emotional reactivity. This study outlines the state of the discipline today and establishes some fundamental guidelines for combining theory and empirical research. In fact, the study has produced specific hints about what has to be done in the future by examining the structural features as well as the thematic and geographical distributions of this evolutionary process. Furthermore, as educational technology develops and permeates every aspect of human activity, the studies will need to conduct such in-depth investigations into emotions, which will serve as the foundation for new empirical research and theoretical frameworks. Future studio initiatives will therefore lay the groundwork for creating a language education system that is more inclusive, sustainable, and responsive.

6. Limitations and Future Research Implications

Although this analysis is comprehensive in both bibliometrics and thematic, some limitations are worth mentioning. First, the scope of the data set only goes as far as what is formalized in a single bibliographic database. This limitation may exclude relevant research without having appeared chronologically or geographically among the indexed journals or publications, which may possibly fail to represent contributions from some particular local studies or work directed at practice. Secondly, although the key cloud map and thematic evolution diagram help to show the direction of structural development in this field, they are dependent upon the subject's keyword selection and method of indexing. Such practices vary from one discipline or period to another, thus may leave out part of a predefined experience or emerging theoretical framework within bibliometric model: leading to an incomplete picture. Last, but by no means least has been a major bottleneck in the research. The data on which this latest round of analyses rests comprises only six journals included in the recent trend synchronous occurrence.

Despite the fact that this analysis is thorough in terms of both bibliometrics and themes, a few limitations should be noted. First, the data set's scope is limited to what is contained in a single bibliographic database. This restriction may leave out pertinent research that hasn't been published in the indexed journals or publications either geographically or temporally. Second, the key cloud map and theme evolution diagram depend on the authors' keyword choice and indexing strategy. These methods differ throughout disciplines and eras, which could result in an incomplete image of a developing theoretical framework within a bibliometric model. Third, further research is still needed to fully understand the noteworthy convergence tendency between learner-centered views and artificial intelligence due to the narrow time window of the data used in the most recent analysis phase.

These restrictions also suggest a number of additional avenues for future investigation. In order to validate results found in bibliometric research from multiple directions, many follow-up studies will involve expanding the data sources (e.g., by integrating more databases or adopting methods for qualitative analysis). To determine

whether the recent emergence of research paradigms focused on artificial intelligence and emotional-environmental factors represents a stable trend in the development of language learning or merely acts as an interlude, the studies should perform a longitudinal study of research sequences. Finally, future research could go beyond mapping discipline structures and empirically examine the specific technologies (AI chatbots, speech recognition systems, interactive learning environments, etc.) that impact the symptoms of foreign language anxiety in L2 learners across various educational contexts and groups. As emotions are purposefully incorporated into the teaching environment, such research will enable a better integration of technology with emotion and learning theories, resulting in language teaching contexts that draw from a richer model of the learner.

Author Contributions

Conceptualization, R.M.R.; methodology, H.J.; software, H.J.; validation, R.M.R. and H.J.; formal analysis, H.J.; investigation, R.M.R.; resources, R.M.R.; data curation, H.J.; writing—original draft preparation, H.J.; writing—review and editing, R.M.R. and H.J.; visualization, H.J.; supervision, R.M.R.; funding acquisition, H.J. Both authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of Interest

The authors declare that they have no competing interests.

AI Use Statement

The authors used Quillbot solely for grammar checking, sentence structure refinement, and improving the readability of the English text in this manuscript. The authors take full responsibility for all academic content, including all ideas, data, analyses, and conclusions presented herein. The use of Quillbot was thoroughly reviewed and supervised by the authors.

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