

Immersive technology in English language learning: a bibliometric analysis

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ABSTRACT

This bibliometric analysis, drawing on data from the Web of Science (WoS) core collection, explores the expanding role of immersive technologies in English language education. Virtual reality (VR) and augmented reality (AR) have shown strong potential to improve learner motivation, engagement, and communicative competence, yet their integration into formal English language settings remains uneven. By analyzing 248 peer-reviewed articles published between 2021 and 2025, this study finds significant trends, influential contributors, and emerging areas of interest within the field. The findings show a steady increase in publications and citations, reflecting growing recognition of the educational value of immersive environments. Prominent themes include emotional engagement, lowered language anxiety, and improved performance in vocabulary, speaking, listening, and cultural understanding. Much of the literature underlines authentic and situated learning, VR-based interactive environments, VR-supported problem-based learning, and AR-assisted vocabulary development. The analysis also identifies leading countries, with China and the United States producing the largest share of research, a pattern supported by strong institutional participation worldwide. These insights help guide educators and policymakers as they consider how to bring immersive technologies into English instruction. The study also establishes a foundation for future research on effective, engaging, and sustainable immersive language learning practices. Overall, these findings clarify how research on immersive technologies in English language education has evolved between 2021 and 2025 and identify influential studies and key contributors. They also point to persisting gaps, such as equity, teacher readiness, and cognitive-load-informed design, that warrant further investigation.

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1. INTRODUCTION

Advances in immersive technologies have transformed digital learning environments, particularly within English education. Virtual reality (VR) and augmented reality (AR) are increasingly adopted to support immersive and interactive learning environments that traditional instructional approaches cannot offer. The growing accessibility of head-mounted displays, mobile AR applications, and 360-degree video

platforms has further accelerated their integration into language classrooms, enabling learners to engage with authentic contexts that support communication, collaboration, and situated learning. This pedagogical potential aligns with situated learning perspectives, which emphasize that language acquisition is strengthened when learners engage in authentic, context-rich environments [1].

Recent years have witnessed a substantial rise in empirical studies examining how immersive technologies influence English language learning outcomes. Meta-analytic evidence in [2], [3] demonstrated that VR has statistically significant positive effects on language achievement, engagement, and learning motivation, highlighting its potential as a transformative pedagogical tool. Other studies reinforce this trend, showing that immersive VR environments can provide essential scaffolding, enhance visual attention, and support deeper cognitive processing during English learning tasks [4]. AR-assisted English instruction has also been found to improve learners' attitudes, self-efficacy, and motivation, suggesting strong affective and behavioral benefits [5], [6]. Beyond cognitive gains, immersive technologies afford authentic communicative experiences. VR has been shown to provide emotionally engaging and socially interactive environments for practicing language skills, allowing learners to experiment with identity, negotiation, and interaction in simulated real-life contexts [7], [8]. In VR-supported 3D virtual English learning environments, students benefit from avatar-mediated interaction and immersive spaces that support personalized learning and participatory knowledge construction [9], [10].

The applications of immersive technologies in English as a foreign language (EFL) education are diverse. Research shows that VR can support domain-specific English learning by offering contextualized and interactive environments, as demonstrated in studies on medical English [11]. AR- and game-enhanced approaches have also been shown to promote motivation, collaboration, and vocabulary development through situated language tasks [12], [13]. In higher education, VR has further been used to enhance vocabulary acquisition and writing development, illustrating the potential of immersive tools for more advanced language learning outcomes [14]–[16].

Despite the rapid growth of immersive learning research, existing studies are highly dispersed across various contexts, technologies, skills, and learner groups. Although many studies report positive outcomes, there is no consolidated understanding of how this research field has evolved over time, who the leading contributors are, or which publications exert the greatest academic influence. As the body of research continues to expand, a systematic overview is needed to map the field's intellectual structure and identify emerging trends. Bibliometric analysis provides an objective means to trace research development and reveal underlying intellectual patterns. Therefore, this bibliometric study aims to provide a comprehensive performance analysis of immersive technology research in English language education. Specifically, it examines publication outputs, citation impact, leading authors, core documents, and influential institutions to reveal the field's overall research landscape. The study is guided by the following questions:

- What are the main trends and themes of immersive technology research in English language learning?
- Who and what have most significantly shaped this field?

2. METHOD

2.1. Bibliometric approach

Bibliometric analysis offers a systematic and reliable way to assess scientific output and research influence using quantitative indicators [17], [18]. By applying performance-based metrics, it helps identify publication trends, prominent authors, core journals, and leading institutions and countries, thus clarifying how a research field has developed [19]. In comparison to other narrative reviews, bibliometric analysis can provide an objective and transparent overview of scholarly patterns and their evolution [20], [21].

In this study, bibliometric methods were used to examine the development of immersive technologies, particularly VR and AR, in English language education [22]. The performance analysis considered publication output, citation patterns, annual trends, influential authors, major journals, and contributing countries and institutions. These indicators offer a clearer picture of the field's knowledge structure and show how immersive technologies have evolved in English language teaching and learning, while highlighting potential directions for future research. Relevant peer-reviewed journal articles were deliberately selected according to predefined inclusion criteria. The analysis relies on secondary data retrieved from the Web of Science (WoS) core collection, without involving primary data collection.

2.2. Stage 1: data collection

The criteria for data collection are summarized in Table 1. All records were retrieved from the WoS core collection, selected for its broad disciplinary coverage, rigorous indexing standards, and reliable metadata for bibliometric research [17]. The search focused on publications from 2021 to 2025 and was limited to peer-reviewed journal articles indexed in social sciences citation index (SSCI), science citation

index-expanded (SCI-E), or emerging sources citation index (ESCI). Searches were conducted in the topic field (TS), which includes titles, abstracts, author keywords, and keywords plus. The search string used was: TS=((“immersive technolog*” OR “virtual reality” OR “VR” OR “augmented reality” OR “AR”) AND (“English education” OR “English learning” OR “English teaching” OR “EFL” OR “ESL” OR “English as a foreign language” OR “English as a second language”)). Only English-language articles were included. The dataset was retrieved in 2025, and the use of strict inclusion criteria strengthens the validity and reliability of the findings.

Table 1. Inclusion criteria for bibliometric analysis

WoS database	Core collection
Time period	2021 to 2025
Search field	Topic field
Search keywords	((“immersive technolog*” OR “virtual reality” OR “VR” OR “augmented reality” OR “AR”) AND (“English education” OR “English learning” OR “English teaching” OR “EFL” OR “ESL” OR “English as a foreign language” OR “English as a second language”))
Document type	Article
Language	English
WoS index	SSCI or SCI-E or ESCI

2.3. Stage 2: screening process

The screening and selection process is presented in Figure 1, following the PRISMA framework. A total of 441 records were initially retrieved from the WoS core collection. After applying the publication year criterion (2021–2025), 144 records were removed, leaving 297 for screening. These 297 records were then checked for document type, resulting in the exclusion of 41 non-research items, including editorials, book reviews, and conference papers. The remaining 256 articles proceeded to the eligibility assessment. At this stage, eight records were excluded: two for not being written in English and six for not being indexed in SSCI, SCI-E, or ESCI. In total, 248 studies satisfied all inclusion criteria and were retained for bibliometric analysis. This streamlined and transparent screening procedure ensured that the final dataset consisted solely of peer-reviewed, high-quality, and thematically relevant publications.

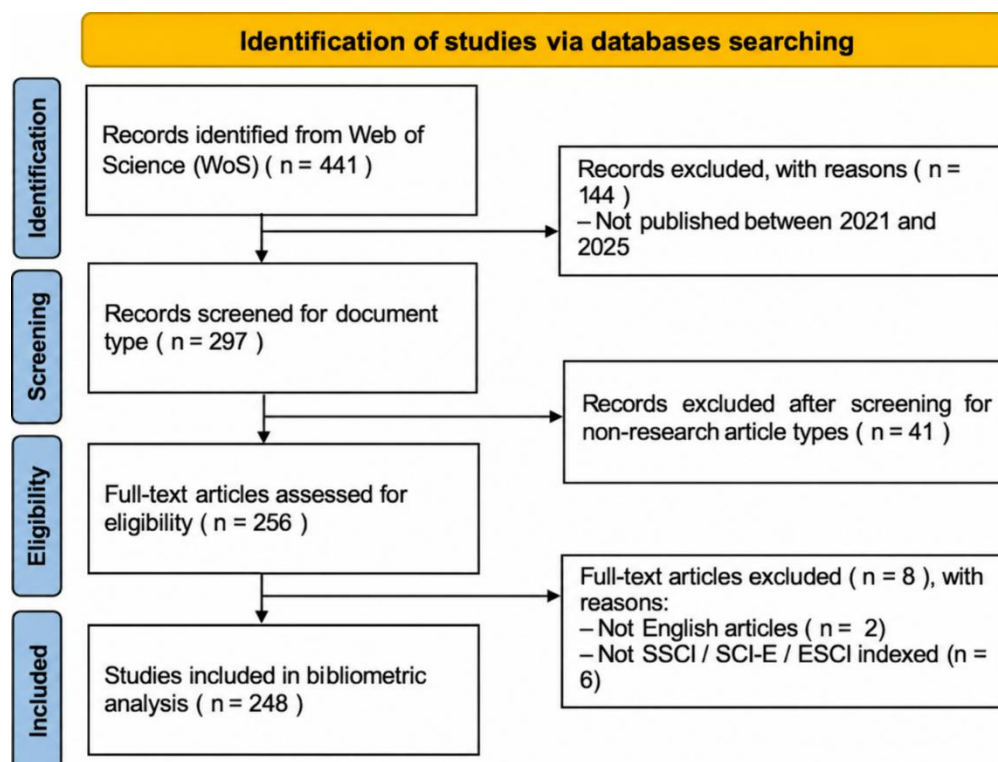


Figure 1. PRISMA flowchart

2.4. Stage 3: data analysis

To analyze publication patterns and research output, performance-based bibliometric techniques were applied using Excel and VOSviewer (version 1.6.20). Specifically, VOSviewer was used to conduct performance analysis and network-based bibliometric analyses, including co-authorship and citation-based visualizations. Excel was used for data cleaning and descriptive statistics, including annual publication counts, citation frequencies, and the distributions of authors, journals, institutions, and countries. VOSviewer supported the visualization of publication and citation patterns. Datawrapper was used only to generate the world map showing the geographical distribution of publications. Key indicators included annual publication growth, citation counts, and H-index values. The analysis also examined the contributions of countries, institutions, and authors to identify major sources of research productivity and impact [17], [23].

3. RESULTS

3.1. Annual trends in publications and citations

Based on data from the WoS core collection, the bibliometric analysis of immersive technology in English education reveals a steady upward trajectory from 2021 to 2025. As shown in Table 2, a total of 248 publications were identified, creating 1,768 citing articles (1,662 excluding self-citations) and 2,323 citations overall (2,031 excluding self-citations). On average, each article received 9.37 citations. The H-index of 24 indicates that at least 24 publications have been cited 24 times or more, highlighting the growing influence of research in this area.

Table 2. General bibliometric indicators from WoS

Metric	Value (2021 to 2025)
Total publications	248
Total citing articles	1,768 (1,662 excluding self-citations)
Total citations	2,323 (2,031 excluding self-citations)
Average citations per item	9.37
H-index	24

Figure 2 shows the annual distribution of publications and citations from 2021 to 2025. The number of publications increased from the mid-30s in 2021 to more than 55 in 2022, followed by slight fluctuations in 2023 and 2024, before rising again in 2025. Citations grew steadily throughout the period, starting from a low base in 2021 and reaching close to 1,000 citations by 2025. Overall, both publication output and citation frequency display a clear upward trajectory, reflecting sustained growth in research on immersive technologies in English language education.

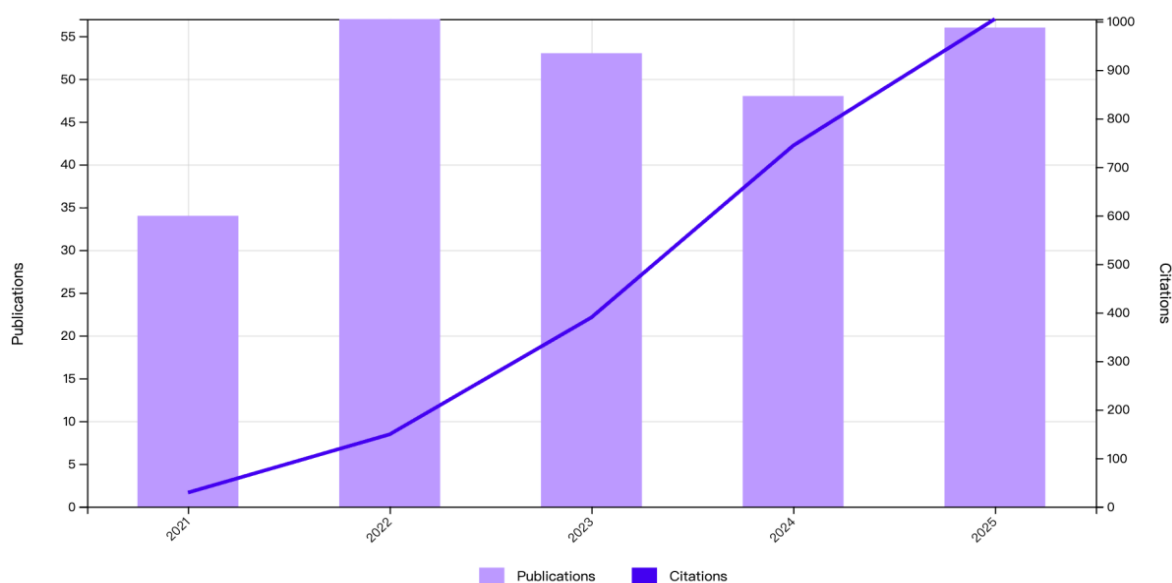


Figure 2. Annual publications and citations (WoS database)

3.2. Top cited documents and their key research themes

This analysis highlights the top 10 most cited documents, as shown in Table 3 [24]–[33]. Study by Chen *et al.* [24] is at the top of the list, with 116 citations and a total link strength (TLS) of 231. Their study examined the impact of VR-supported problem-based learning on English learners' problem-solving skills, vocabulary acquisition, and motivation. It has gained considerable academic attention for its rigorous empirical evidence demonstrating the effectiveness of immersive learning. The top-ranked study is followed by Lin and Wang [25], which has 110 citations and a TLS of 181 and discusses how VR can enhance learners' creative self-efficacy and intrinsic motivation in EFL settings.

The central themes reflected in these highly cited publications include learner motivation, engagement, affective outcomes, and learning effectiveness, which continue to drive research on immersive technologies in English education. Other influential studies, such as Guo and Gao [26] and York *et al.* [28], further extend the discussion. The former examined immersive 3D virtual environments for situational English teaching through emotion-based analysis, while the latter compared VR with voice- and video-based interaction to reduce foreign language anxiety and improve oral performance. These works demonstrate the wide-ranging applications of immersive technologies across English language learning, including situational instruction, oral communication, cultural learning, and experiential language development.

Table 3. Top 10 most cited documents

Author	Titles	Cites	TLS
Chen <i>et al.</i> [24]	Virtual reality in problem-based learning contexts: effects on the problem-solving performance, vocabulary acquisition and motivation of English language learners	116	231
Lin and Wang [25]	Using virtual reality to facilitate learners' creative self-efficacy and intrinsic motivation in an EFL classroom	110	181
Guo and Gao [26]	Metaverse-powered experiential situational English-teaching design: an emotion-based analysis method	86	4
Ma [27]	An immersive context teaching method for college English based on artificial intelligence and machine learning in virtual reality technology	73	3
York <i>et al.</i> [28]	Effect of SCMC on foreign language anxiety and learning experience: a comparison of voice, video, and VR-based oral interaction	71	59
Tai and Chen [29]	The impact of immersive virtual reality on EFL learners' listening comprehension	55	47
Lin <i>et al.</i> [30]	Supporting dyadic learning of English for tourism purposes with scenery-based virtual reality	43	317
Gao <i>et al.</i> [31]	Investigating the effectiveness of virtual reality for culture learning	43	50
Chen <i>et al.</i> [32]	Facilitating EFL learners' active behaviors in speaking: a progressive question prompt-based peer-tutoring approach with VR contexts	36	103
Zhao <i>et al.</i> [33]	Effects of a self-regulated-based gamified virtual reality system on students' English learning performance and affection	28	260

3.3. Journal performance and network analysis

According to the performance data presented in Table 4, Education and Information Technologies stands out as the most influential publication venue, with 19 documents, 304 citations, and the highest TLS of 2,478. This journal serves as the primary outlet for immersive English language learning research, particularly studies integrating educational technology with language pedagogy. Closely following is Interactive Learning Environments, which also shows strong scholarly impact and continues to publish substantial work on VR-, AR-, and simulation-based language learning.

Table 4. Top 10 most cited journals

Journals	Docs	Cites	TLS
Education and Information Technologies	19	304	2,478
Interactive Learning Environments	10	216	1,299
Frontiers in Psychology	10	139	480
Innovation in Language Learning and Teaching	9	32	1,138
Computer Assisted Language Learning	8	115	1,506
Journal of Computer Assisted Learning	8	153	715
Mobile Information Systems	8	54	58
International Journal of Human-Computer Interaction	6	74	733
Sustainability	6	97	687
Journal of Educational Computing Research	5	99	711

Figure 3 further illustrates the collaborative relationships among these major sources. Education and Information Technologies forms the central hub of the network, connecting extensively with journals such as Computer Assisted Language Learning and Frontiers in Psychology. This dense clustering indicates frequent

cross-citation and shared research themes across educational technology, applied linguistics, and cognitive psychology. In contrast, journals such as *Entertainment Computing* and *Advances in Multimedia* form smaller but distinct clusters, highlighting interdisciplinary extensions into computer science and multimedia studies. The table and network map demonstrate that immersive English language education research is anchored in a group of highly connected, technology-oriented journals, reflecting the field's strong interdisciplinary foundation.

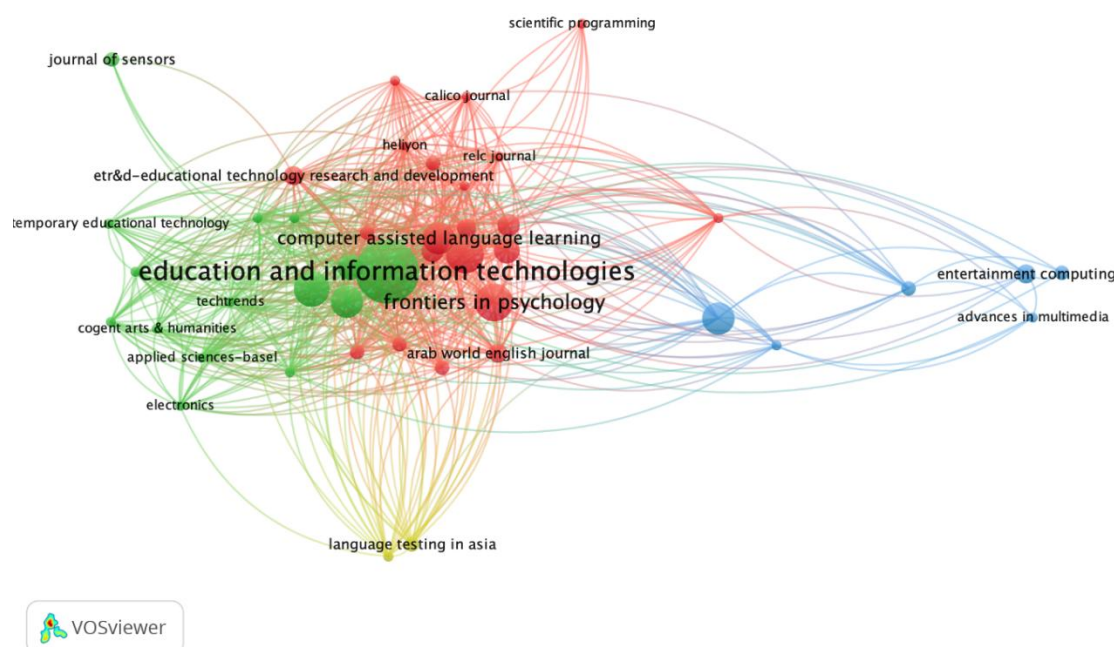


Figure 3. Source collaboration network (VOSviewer visualization)

3.4. Top author performance and co-authorship network

In terms of individual contributions, Table 5 identifies the authors with the highest scholarly impact in the field. Hwang, Gwo-Jen appears as the most productive and influential scholar, with nine publications, 199 citations, and the highest total link strength (TLS=998). Other highly cited and well-connected authors include Di Zou, who has six publications and a strong TLS of 1,229, as well as Jong, Morris Siu-Yung, who also demonstrates substantial network strength.

Figure 4 complements these performance indicators by visualizing the collaboration patterns among these leading authors. The network map shows that Hwang, Gwo-Jen works closely with several co-authors, forming a dense central cluster within the field. Authors such as Lan, Yu-Ju and Jiang, Michael Yi-Chao appear directly linked to Hwang, indicating sustained collaboration on immersive technology-enhanced language learning research. Meanwhile, Bacca-Acosta, Jorge forms a distinct cluster with strong international connections, and Shadiev, Rustam functions as a bridging author connecting multiple groups. Together, the table and network map show that the field is shaped by a small number of highly productive and highly collaborative scholars whose work anchors the broader research landscape.

Table 5. Top 10 most cited authors

Author	Docs	Cites	TLS
Hwang, Gwo-Jen	9	199	998
Tu, Yun-Fang	4	135	720
Yeh, Hui-Chin	4	108	321
Zou, Di	6	84	1,229
Jong, Morris Siu-Yung	4	46	1,139
Khodabandeh, Farzaneh	7	45	475
Shadiev, Rustam	5	37	504
Zou, Bin	3	35	129
Bacca-Acosta, Jorge	4	27	1,433
Kinshuk	4	27	1,361

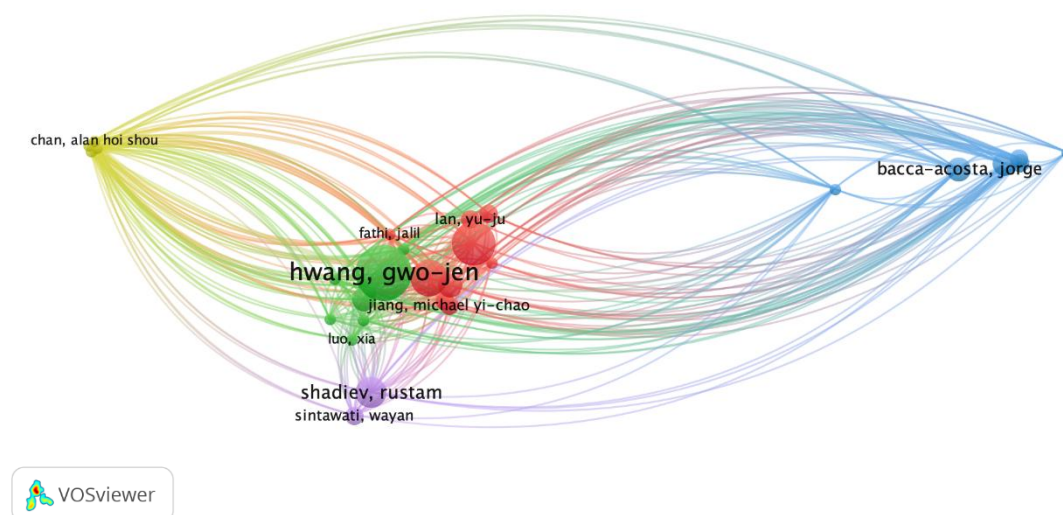


Figure 4. Author co-authorship network (VOSviewer visualization)

3.5. Leading institutions and their collaboration networks

The performance analysis further reveals the institutions that play a central role in advancing immersive English language education research. As depicted in Table 6, the National Taiwan University of Science and Technology leads the field with 12 publications, 258 citations, and a notable TLS of 52, indicating strong visibility and steady collaborative connections. National Taiwan Normal University also shows considerable influence, with nine publications, 219 citations, and a TLS of 41, underscoring Taiwan's strong research capacity in technology-mediated language learning.

Figure 5 illustrates that these institutions are situated within tightly interconnected regional clusters, particularly in East Asia. National Taiwan University of Science and Technology, National Taiwan Normal University, and National Taichung University of Education occupy prominent positions within the same collaborative network, demonstrating frequent partnerships and shared research trajectories. In contrast, universities such as the University of North Texas, the Chinese University of Hong Kong, and the Education University of Hong Kong are positioned within smaller, more dispersed clusters, suggesting developing cross-regional linkages. Taken together, these findings highlight the role of strong regional research hubs while also indicating a gradual expansion of international collaboration.

Table 6. Top 10 most cited institutions

Organization	Docs	Cites	TLS
National Taiwan University of Science and Technology	12	258	52
National Taiwan Normal University	9	219	41
National Taichung University of Education	7	68	31
Wenzhou University	6	154	34
Yuan Ze University	6	126	14
University of North Texas	6	48	6
Zhejiang University	6	23	8
Education University of Hong Kong	5	135	14
Islamic Azad University	5	86	0
Chinese University of Hong Kong	5	72	36

3.6. Country-level performance and collaboration networks

The country-level performance analysis highlights clear geographical patterns in immersive English language education research. As shown in Figure 6, China leads the field with 105 publications and 934 citations, demonstrating its strong and rapidly expanding presence in technology-enhanced language learning. The United States also shows substantial influence, contributing 21 publications and receiving 256 citations, which reflects its long-standing position in educational technology research. Beyond these two major contributors, several other countries present moderate but steadily increasing output, indicating wider global engagement in the field.

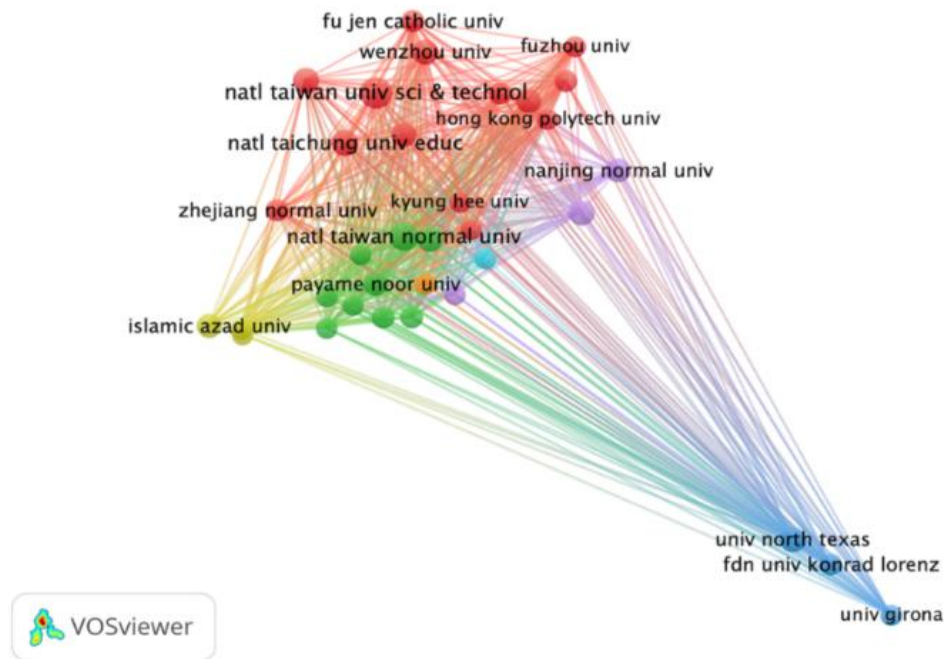


Figure 5. Organization collaboration network (VOSviewer visualization)

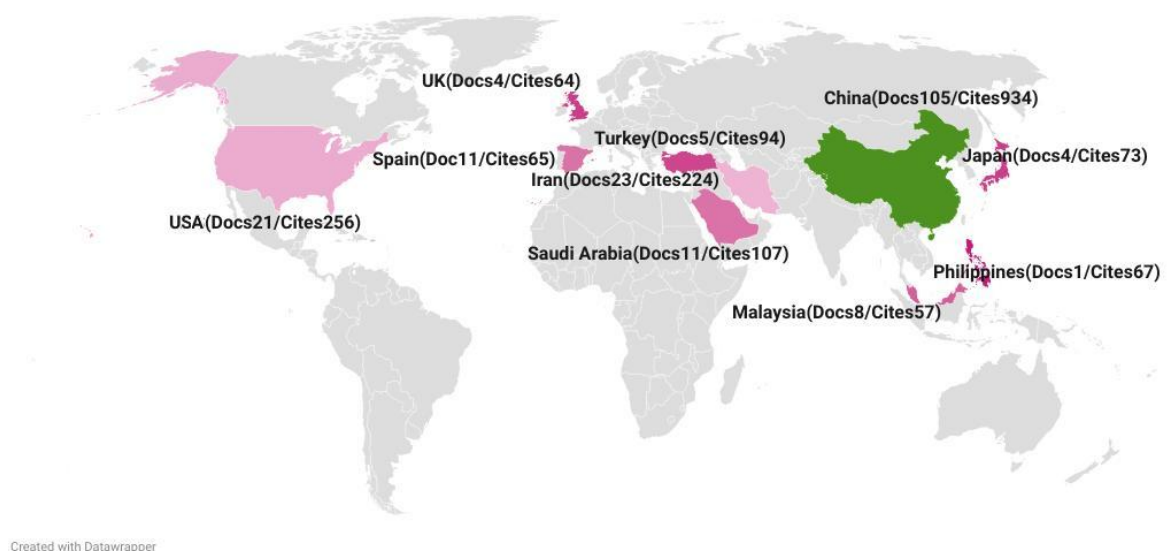


Figure 6. Top 10 most cited countries

Figure 7 provides additional insight into cross-national collaboration. China and the United States occupy central positions in the international collaboration network, maintaining extensive research connections with both regional and global partners. In Asia, several countries cluster closely together, suggesting active collaborative efforts surrounding VR- and AR-based English learning. Meanwhile, European involvement appears in smaller yet well-integrated clusters, pointing to emerging participation in the broader research landscape. Overall, the performance distribution and collaboration map indicate that immersive English language education research is primarily driven by China and the United States, supported by contributions from a wider group of countries. The increasing number of cross-regional linkages also signals a gradual movement toward more globally interconnected research partnerships.

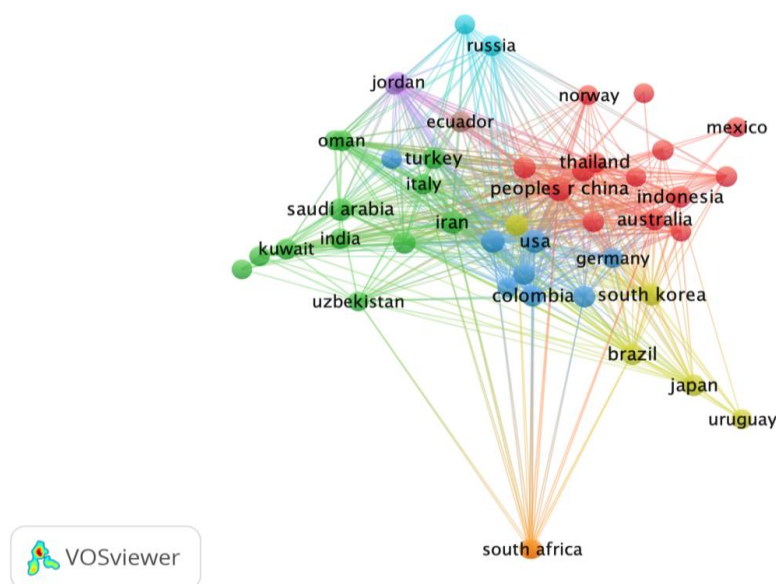


Figure 7. Country collaboration network (VOSviewer visualization)

4. DISCUSSION

The findings of this bibliometric analysis demonstrate that research on immersive technologies in English language education has experienced steady and sustained growth over the past five years. Rising publication and citation rates suggest that VR- and AR-based approaches are moving beyond early experimental use and becoming more firmly embedded within mainstream language education research. This trajectory aligns with empirical work showing that immersive environments can support key components of language learning, including reading comprehension and vocabulary development [34], [35].

A consistent pattern among the most influential publications is the emphasis on motivation, emotional engagement, and willingness to communicate. AR-supported vocabulary and game-based tasks have been found to heighten curiosity and self-efficacy [36], [37], while high-immersion VR environments help reduce foreign language anxiety and enhance confidence in communicative performance [38], [39]. These recurring themes indicate that affective outcomes, traditionally difficult to address through conventional classroom instruction, are becoming central to immersive technology-enhanced language learning.

The performance analysis also reveals uneven geographical distributions. Research output is concentrated in Taiwan, mainland China, and the United States, where institutional support and technological infrastructure are comparatively strong. While this concentration reflects robust regional research ecosystems, it also highlights disparities in access to immersive tools. Similar concerns about unequal digital access have been raised at the global policy level [40], which aligns with the United Nations Sustainable Development Goals (SDG), particularly SDG 4 (quality education) and SDG 10 (reduced inequalities). Emerging studies in rural or resource-limited settings suggest that mobile AR applications may mitigate some of these inequalities by offering more accessible pathways to engagement [41], [42]. However, the limited number of such studies suggests that issues of equity and inclusion remain underexplored in the broader research landscape.

In addition to affective benefits, immersive technologies demonstrate pedagogical value across multiple language domains. VR- and AR-mediated tasks have been shown to support listening comprehension, intercultural competence, and collaborative problem-solving [43], [44]. VR's ability to situate learners within authentic communicative scenarios appears particularly important for strengthening pragmatic awareness and fluency. These findings underscore the versatility of immersive technologies, but they also raise questions about when and for whom these tools provide the greatest benefits.

Despite demonstrated advantages, several challenges limit the broader adoption of immersive technologies. High-immersion environments can generate cognitive overload, particularly when learners must process dense multimodal information [45]. Technical constraints, including device quality, connectivity, and usability, further shape the learning experience and may exacerbate inequities between learners with differing levels of access [46], [47]. These limitations point to the need for more nuanced instructional design that aligns technological affordances with learners' readiness, cognitive capacities, and pedagogical goals.

Future research should therefore explore how learners process visual, auditory, and interactive cues in immersive environments, with particular attention to cognitive absorption and attention allocation [48], [49]. More inclusive research designs are needed to address accessibility for younger learners, students with disabilities, and those in lower-resource contexts. Teacher preparation represents another critical but underexamined area, as effective use of VR and AR requires pedagogical, technical, and classroom-management competencies that are not yet well integrated into professional development programs [50]. Finally, assessment frameworks must evolve to capture experiential and interaction-driven learning processes that traditional assessment tools cannot adequately reflect.

5. CONCLUSION

The bibliometric evidence confirms that immersive technologies have emerged as a steadily growing and increasingly influential area within English language education. Overall, the findings address the research objectives by revealing the major publication trends, dominant research themes, and key contributors shaping immersive technology research in English language learning. Their capacity to enhance learners' motivation, emotional engagement, and key language skills is well supported, yet persistent disparities in access, technological readiness, and instructional integration remain evident.

Moving forward, research and practice must prioritize inclusive design, sustainable implementation strategies, and teacher-oriented support to ensure that VR- and AR-based approaches contribute effectively to diverse learning environments. As immersive technologies advance, their instructional functions are likely to broaden, offering new possibilities for innovation in language teaching and learning. Despite its contributions, several limitations should be noted. First, the analysis was conducted solely using publications indexed in the WoS core collection, which may have resulted in the omission of some relevant studies.

Second, the search strategy and selected time span may have excluded some related studies. In addition, this study relied exclusively on bibliometric methods and did not include empirical investigations of learning outcomes. Future studies may address these issues by drawing on multiple databases, improving search strategies, and integrating bibliometric methods with empirical or qualitative approaches to develop a more comprehensive understanding of immersive technologies in English language learning.

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C : Conceptualization

M : Methodology

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Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

No new primary data were generated in this study. The bibliometric data analyzed were retrieved from the Web of Science Core Collection.

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