Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327

Arab World English Journal (AWEJ) Volume 16. Number 4, December 2025 Pp.378-399
DOI: https://dx.doi.org/10.24093/awej/vol16no4.21

Half a Century of Research on Strategies for Vocabulary Learning: A Scientometric Analysis

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Received: 08/25/2025 Accepted: 11/19/2025 Published:12/10/2025

Abstract

In the past five decades, a significant amount of research has focused on strategies for vocabulary learning, given its crucial role in language acquisition. This study utilized CiteSpace to systematically review 340 studies on strategies for vocabulary learning from 1971 (when they were first indexed) to 2024, in the Social Sciences Citation Index and the Arts & Humanities Citation Index collection. The review focused on three aspects: development stages, key scholarly foundations, and main research streams. The findings reveal that the field of strategies for vocabulary learning research has undergone four distinct phases of development: the embryonic stage (1971-1990), the growth stage (1991-2005), the expansion stage (2006-2015), and the rapid development stage (2016-2024). Notably, there has been a substantial increase in annual publications, particularly since 2006, which can be attributed to the prolific publication of scholarly monographs and the impact of modern technology. The primary focus of strategies for vocabulary learning research lies in motivational belief, mobile technology, and digital game-based learning, with meta-analysis serving as an important research methodology. Furthermore, the findings highlight the interdisciplinary nature of vocabulary learning strategies, with contributions from computer science, psychology, and education.

Keywords: Citespace, scientometric review, strategic learning, strategies for vocabulary learning, technology-assisted language learning

How to cite: Wang, X., Shen, X., & Liu, F. (2025). Half a Century of Research on Strategies for Vocabulary Learning: A Scientometric Analysis. *Arab World English Journal, 16*(4):378-399. https://dx.doi.org/10.24093/awej/vol16no4.21

Introduction

Vocabulary knowledge significantly influences language acquisition due to the irreplaceable role of such knowledge in language skills development, particularly for listening, speaking, reading, and writing skills (Chen et al., 2025; Rueda-Sánchez et al., 2025; Wang-Taylor & Clenton, 2022; Zhang, 2022). However, vocabulary acquisition and learning pose considerable challenges for language learners (Babayiğit & Trenkic, 2025; Mangold et al., 2025; Ueno & Takeuchi, 2025) due to the complex cognitive processes within the multifaceted construct of vocabulary knowledge (González-fernández & Schmitt, 2020; Mujtaba et al., 2021; Wang et al., 2025). Strategies for vocabulary learning that enable self-regulated learning capacity, behavioral engagement, and individual pace choice are crucial for overcoming these difficulties (Chacón-Beltrán, 2018; Gan et al., 2025; Gay, 2022).

Existing research has substantially contributed to conceptualizing and measuring vocabulary learning strategies (Ali, 2020; Shamsan et al., 2021), as well as to examining their relationships with learning outcomes (Al Zahrani & Chaudhary, 2022; Wang & Feng, 2025). However, very few literature reviews focus on strategies for vocabulary learning using scientometrics for a systematic and dynamic analysis; instead, reviews have relied mainly on traditional literature review methods, which are prone to bias. Scientometrics examine emerging trends, thematic patterns, and the intellectual landscape by analyzing metrics and indicators in bibliographic records, including citation connections. Through this approach, researchers can understand how scientific fields evolve, recognize insightful patterns from visually encoded information, and synthesize diverse evidence, ultimately aiming, in Chen's terms, "to capture the state of the art of the domain" (2017, p. 2). In the field of linguistics, scientometric reviews typically include more than 100 articles (Wang et al., 2023). Thus, the present study aims to employ scientometric analysis to review studies on strategies for vocabulary learning. To systematically explore the intellectual landscape of strategies for vocabulary learning, we seek to answer the following research questions:

(1) What are the stages of research in the field of strategies for vocabulary learning?
(2) Which scholars, references, and sources of publications are most influential in the field of strategies for vocabulary learning?
(3) What are the key areas of research on strategies for vocabulary learning?

Literature review

Over the past five decades, significant research attention has focused on strategies for vocabulary learning, with scope changes from vocabulary learning strategies that emphasize outcomes and tasks to strategic vocabulary learning that emphasizes processes and regulation (Chen & Yeh, 2025; Hsu et al., 2024; Wang & Cohen, 2023). Vocabulary learning strategies are task-based learning strategies that help language learners acquire and retain vocabulary knowledge (Gu & Johnson, 1996; Oxford, 1990; Schmitt, 1997). Based on the form, meaning, and use of vocabulary knowledge, Nation (2001) taxonomized vocabulary learning strategies into four categories: planning, resources, process, and skill in use. Strategic vocabulary learning brought the concept of strategic learning from educational psychology into the field of vocabulary research and considers such learning an active and constructive process through which learners first set goals for learning and then monitor, regulate, and control their own cognition, motivation, and behavior (LaBontee, 2019; Murphy et al., 2023; Ziegler, 2015). It has five categories: effort

control, metacognitive control, fatigue control, emotion control, and environment control (Tseng et al., 2006; Tseng & Schmitt, 2008). Although vocabulary learning strategies and strategic vocabulary learning developed in different periods, both act as strategies for vocabulary learning and make complementary contributions to vocabulary knowledge development (Alharbi, 2024; Wang & Cohen, 2021; Wang & Cohen, 2023). Therefore, this study refers to the two as complementary strategies under the umbrella of *strategies for vocabulary learning*.

Given the development of the theoretical framework for strategies for vocabulary learning, instruments for their measurement, and numerous empirical studies have concentrated on three themes. Scales have been developed and validated for observing and describing the strategies, including the Vocabulary Learning Questionnaire (Gu, 2018; Gu & Johnson, 1996) and Self-Regulating Capacity in Vocabulary Learning Scale (Mizumoto & Takeuchi, 2012; Tseng et al., 2006). In empirical studies, researchers have explored the following themes: learners' personal preference on strategies (Fan, 2003; Fang-Chuan Ou & Wen-Chi Vivian, 2015; Rahimi & Allahyari, 2019), the relationship between strategy use and vocabulary learning effectiveness (Chiang et al., 2023; Fan, 2020; Kakihana, 2024; Shi, 2025), and differences in learners' strategy use due to individual difference factors such as gender, motivation, and language proficiency (Clarke, 2018; Lee, 2020; Tam & Kim, 2024). Advancements in educational technology have also led to the investigation of strategies on mobile-assisted vocabulary learning and digital game-based vocabulary learning; with the help of the new devices or platforms, strategies also influence learning approach tactics (Ou-Yang & Wu, 2016; Shi & Tsai, 2024; Wang & Feng, 2025; Zhang et al., 2023, 2024).

Primarily through empirical studies or book chapters, the existing literature has produced key findings in conceptualizing, measuring, and establishing relationships to learning outcomes based on strategies for vocabulary learning, with very few dedicated reviews on the subject. However, reviews are necessary to the development of a discipline because they help transfer tacit knowledge to codified and routinized knowledge (Chen, 2017). The evolution of a scientific discipline has four stages: introducing concepts, developing tools, broadening the scope, and codifying knowledge through systematic reviews (Chen, 2017; Shneider, 2009). By discussing concepts, developing questionnaires, and exploring strategic learning, the extant literature on strategies for vocabulary learning has already progressed through the first three stages. Now is thus an opportune time to conduct a comprehensive review of the field and explore future developments.

Method

Data Sources

For this study, the data sources were articles and reviews from the Social Sciences Citation Index (SSCI) and the Arts & Humanities Citation Index (AHCI), widely recognized as databases with collections of high-quality peer-reviewed articles for literature retrieval and research (Larivière et al., 2006; Larsen & von Ins, 2010). Both citation indexes are part of the Web of Science (WoS) Core Collection managed by Clarivate Analytics. By reviewing literature manually and piloting the WoS search, we found that search terms and keywords for strategies for vocabulary learning have changed alongside the development of research. The terms used in the early stage somewhat differ from those in the later stage, and the field has been widely debated for the past two decades, with scope changes from vocabulary learning strategies to strategic vocabulary learning regulation

(Gu & Johnson, 1996; LaBontee, 2019; Mizumoto & Takeuchi, 2009; Zhang & Lu, 2015). Thus, to ensure scientifically accurate data files, we used the combined phrases "vocabulary learning strateg*[1]" or "self-regulat* AND vocabulary learning" or "vocabulary learning AND strateg*" or "self-regulat* AND vocabulary acquisition" or "vocabulary strateg*" or "vocabulary related strateg*" as the subject keywords for the search. Manzo and Sherk (1971) first proposed some generalizations and strategies to guide vocabulary learning, so we set the time span to 54 years (1971–2024) to facilitate a comprehensive understanding of the research status and evolution from the initial stage of strategies for vocabulary learning research to the present. Then, to further refine the data and ensure its accuracy, we set the language as "English" and the document types as "article" and "review article." The above search formula yielded 340 search results for the SSCI and the AHCI data set.

Data Analysis

In this study, we employed the CiteSpace 6.4.R2 Advanced version to visualize and review literature in the field of vocabulary learning strategies. CiteSpace is an information visualization and analysis tool for bibliometric calculus to help users analyze problems through computer algorithms and interactive visualizations. The tool also visualizes literature information, data, and relationships via scientific mapping based on the needs of researchers, helping them understand the development history, research status, research hotspots, and research frontiers of a field more scientifically and precisely (Chen, 2016). CiteSpace's visual analysis of research dynamics has been widely used in applied linguistics research, including in studies on multiword expressions (Yi et al., 2025), translanguaging (Lu & Gu, 2024), writing assessment (Dong et al., 2024), and language assessment literacy (Wang et al., 2023). Therefore, scientometric review by CiteSpace has been employed to explore three main fields of the current study: research development stages, influential scholars, articles and journals, and key areas. We employed CiteSpace to process and analyze the data

Results

Research Development Stages

The annual number of publications in a field can reflect the academic circle within the field, which is a significant factor for analyzing the development status of a field and predicting its future development trend (Hanssen et al., 2018). As shown in Figure 1, the research dynamics of strategies for vocabulary learning are active and overall show a fluctuating rise. The figure also shows the theoretical base attention via the annual cited line, which further assists the analysis. Generally, the publication of research on strategies for vocabulary learning has gone through four stages: the embryonic stage (1971–1990), the growth stage (1991–2005), the expansion stage (2006–2015), and the rapid development stage (2016–2024).

[1] A wildcard "*" is a special symbol that can be used to represent any set of characters with no limit on the number of characters, including no characters. The wildcard "*" can be used in retrieval to perform an advanced search. Since both "vocabulary learning strategy" and "vocabulary learning strategies" have been used in the literature, we used the wildcard "*" to ensure the rigor and accuracy of the data. We thus used the following subject keywords for the search: "vocabulary learning strateg*".

In the first stage (1971–1990), there were a few publications on strategies for vocabulary learning, which indicates that researchers paid less attention to this field and that strategies for vocabulary learning research was still in its infancy. Researchers at the time developed an interest in language learning strategies (Manzo & Sherk, 1971; Pressley et al., 1982). Within the research on language learning strategies, strategies for vocabulary learning have also been investigated, with researchers mainly focused on examining the learning effects of specific strategies through experiments. In 1990, Batia Laufer, Robin Goulden, Paul Nation, and John Read—prominent figures in the field—published articles on vocabulary in top journals, including in *Applied Linguistics* and *Foreign Language Annals*; the articles are not directly about vocabulary learning strategies but did discuss not only the difficulty and width of vocabulary knowledge, but also discussed how to make strategies a great potential research topic (Goulden et al., 1990; Laufer, 1990).

In the second stage (1991–2005), the number of publications on strategies for vocabulary learning research increased but fluctuated, suggesting researchers' escalating focus on the field. Some significant research has been conducted since 1995. Researchers developed a range of taxonomies for vocabulary learning strategies through interviews, observations, and other qualitative research methods (e.g., Nation 2001; Schmitt, 1997). Concurrently, researchers have carried out numerous empirical studies to explore different issues, including the relationship between vocabulary learning strategies use and learning efficiency (e.g., Gu & Johnson, 1996; Kojic-Sabo & Lightbown, 1999) and the factors influencing the use of strategies (e.g., Catalan, 2003; Gu, 2002). Yet, even though strategies for vocabulary learning research has existed for a long time and became a well-established academic discipline, there was still no acknowledged theory of strategies for vocabulary learning due to the complexity of vocabulary learning. The classification and measurement of strategies for vocabulary learning were also controversial. Many scholars have, as a result, expressed concerns about the validity and rigor of strategy research. For example, Dörnyei (2005) ramped up criticism of vocabulary learning strategies and introduced self-regulated learning into the field of strategies for vocabulary learning research. The emergence of research challenges ultimately ushered in a period of instability in the field.

In the third stage (2006–2015), the increased publication volume of research results remained relatively stable. New research perspectives were introduced into the strategies for vocabulary learning field during this stage, which aroused more academic attention and discussion. Tseng et al. (2006) developed a new measurement instrument based on self-regulated learning (i.e., the Self-Regulating Capacity in Vocabulary Learning Scale) and advocated for vocabulary learning research from the perspective of self-regulation. Since then, the field of strategies for learning vocabulary has been in a state of change as the researchers' views provoked intense discussions. The developments of this period led to a breakthrough in strategies for learning vocabulary research. In addition, Pavii Taka (2008) published *Vocabulary Learning Strategies and Foreign Language Acquisition*, the first book entirely focused on strategies for vocabulary learning. The book provided a detailed review of strategies for vocabulary learning research findings, offering timely, thoughtful, and welcome guidance and assistance to researchers. Moreover, the author's review of future research trends provided proper direction for the development of the field. Collectively, these efforts laid the foundation for the field to grow.

In the fourth stage (2016–2024), following the continuous advancement of the underlying theory and the introduction of new perspectives, strategies for vocabulary learning publications showed rapid and relatively stable growth, except during the period around the COVID-19

pandemic. Notably, the publication skyrocketed from 2021 to 2022 and from 2023 to 2024; the latter saw explosive growth with almost twice the number of articles published than in the previous year. One important event occurred in mid-2016: The American Association for Applied Linguistics (AAAL) announced that vocabulary and lexical studies would become a separate guest strand for AAAL 2017. Since AAAL 2018, the studies have become a permanent fixture. AAAL is one of the most influential and popular annual conferences for applied linguistics, so the shift also attracted more researchers and scholars focused on vocabulary research and strategies for vocabulary learning. In addition, the significant impact of modern technology on learners' strategies for learning vocabulary cannot be ignored during this period. First, the advancement of Massive Open Online Courses (MOOC) lessons, mobile-assisted learning approach, and digital games promoted self-learning on vocabulary and changed learners' strategies. Second, during the COVID-19 period, especially the lockdowns of cities and schools, learners changed how they learned vocabulary. Computer-assisted language learning (CALL) and mobile-assisted language learning (MALL) education technologies, for instance, offered interesting and effective ways to facilitate vocabulary acquisition, replacing monotonous methods such as word lists and rote memorization (Daly, 2022). In addition, learners today grow up in a technologically advanced society, which has altered their learning habits. Technology-integrated curriculum can shape creative teaching processes and stimulate learners' engagement in learning materials, and improve learners' language practice (Liu & Chen, 2023). Finally, the combination of mobile communication technology and modern educational technology has promoted the development of mobile learning. The COVID-19 pandemic resulted in the prevalence of online learning, so the use of mobile applications for vocabulary learning has since become an indispensable part of language learners' study routines (Guo & Li, 2022). Together, these factors have had a significant and positive impact on strategies for modern language learners, resulting in rapid increases in the exploration of strategies for learning vocabulary in new contexts. The rise in attention also indicates the field's substantial potential for development. In the coming years, strategies for learning vocabulary will thus arguably be one of the focused issues in the field of language acquisition research.

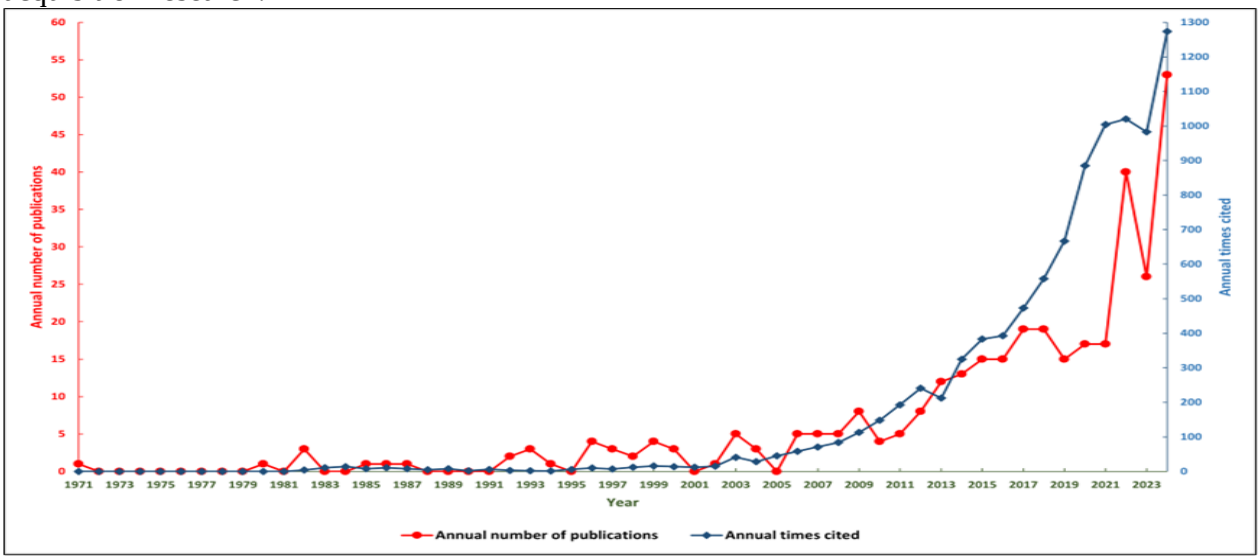


Figure 1. Quantitative distribution of strategies for vocabulary learning literature from 1971 to 2024

ISSN: 2229-9327

Influential Scholars, References, and Sources of Publications

Influential Scholars

Table 1 lists the most-cited authors identified using CiteSpace, broken down by those with the highest citation counts and the strongest citation bursts. While citation counts are accumulative counts of an author's articles, citation bursts are a dynamic index indicating a quick rise in the citation of an author's articles. High citation counts mean an author's articles are fundamental to a field; strong citation bursts attract attention from researchers in the field and indicate an author is pioneering a new area in the field. Paul Nation (Emeritus Professor at Victoria University of Wellington), Norbert Schmitt (Emeritus Professor at University of Nottingham), and Batia Laufer (Emeritus Professor at University of Haifa) are the three most-cited authors based on counts. They are all founders in the field of second language vocabulary acquisition. Meanwhile, Michael Pressley (University of Western Ontario), Richard Atkinson (Emeritus Professor at University of California, San Diego), and Batia Laufer are the three most-cited authors based on bursts, with the latter appearing on both lists. While the top three authors on the citation count list are from the second vocabulary learning field, Michael Pressley and Richard Atkinson are from the cognitive science field and, according to CiteSpace burst analysis, pioneered new fields between 1982 and 2015. Most remaining authors in both lists have conducted long-term research on vocabulary; however, interdisciplinary or cross-field characteristics have also been evident in the authors' research fields. For example, Gordon Bower and Fergus Craik are interdisciplinary scholars from the field of cognitive psychology, which focuses on how semantic processing influences memory; Zoltán Dörnyei and Barry Zimmerman are cross-field scholars from the fields of motivation and self-regulated learning.

Table 1. *Most-cited authors*

Authors with the highest citation counts		Authors with the strongest citation bursts	
Cited authors	Counts	Cited authors	Strength
Paul Nation	159	Michael Pressley	13.65
Norbert Schmitt	120	Richard Atkinson	10.11
Batia Laufer	86	Batia Laufer	9.11
Rebecca Oxford	73	Joel Levin	8.64
Gu Yongqi	61	Andrew Cohen	7.47
Stuart Webb	54	Michael Lawson	6.95
William Nagy	50	Jan Hulstijn	6.53
Joe Barcroft	44	William Nagy	6.51
Wen-Ta Tseng	42	Paul Meara	5.66
Fergus Craik	42	John Read	5.62

Influential References

Table 2 describes the most-cited articles in the CiteSpace network (340 total articles) and the WoS literature. While the CiteSpace data includes articles from SSCI and AHCI from WoS, the WoS literature includes other databases (e.g., SCI, ESCI, etc.) that did not appear in the CiteSpace data. The overlapping number of articles between the two is thus relatively large. However, SSCI and AHCI are core collections of high-quality articles in the social sciences and humanities, so we cultivated lists based on CiteSpace data but provided the WOS counts for reference. All articles (N = 17) with no fewer than five citations in the network were included. These articles represent foundational research in the fields and include empirical studies (N = 11),

meta-analyses (N = 4), and general reviews (N = 2); one of each study type appears in the top three cited studies. Regarding areas of focus, the general review and meta-analysis articles mainly provide insights related to technology-assisted learning, such as mobile-assisted learning (Lin & Lin, 2019; Mahdi, 2018) and digital game-based learning (Zou et al., 2021). The three main topics in the empirical studies were mobile-assisted learning for vocabulary strategies (García Botero et al., 2019), self-directed learning (Chen et al., 2019; García Botero et al., 2019; Tseng et al., 2006), and young learners (Andrä et al., 2020; Dickinson et al., 2019; Hadley et al., 2019; Teng, 2022). Notably, all the empirical articles employ quantitative research methods, including hypothesis testing, experiment design, and causal-comparative research.

Sources of Publications

Academic journals disseminate papers and academic research results. Thus, analyzing journal information helps researchers identify the most authoritative and important journals in the field and focus more on details and information about the research status and research basis. The number of journal publications partially reflects the research frontier and any emerging disciplines in the field. We therefore listed the top 10 journals in the field of vocabulary learning strategies based on the number of publications from 1971 to 2024, as shown in the left column of Table 3. Meanwhile, the cited journals reflect the research base of the field, so we selected the top 10 cited journals for vocabulary learning research from 1971 to 2024, as shown in the right column of Table 3. Five journals appear in both lists: *Language Learning*, *Modern Language Journal*, *System*, *TESOL Quarterly*, and *Language Teaching Research*. This overlap implies that strategies for vocabulary learning research is both a foundational topic and one garnering significant attention in applied linguistics and TESOL journals. In addition, *Computer Assisted Language Learning*, *Frontiers in Psychology*, *Educational Technology Society*, and *Computers & Education* are top journals for the field based on publication data. This finding suggests that research on strategies for vocabulary learning reflects some interdisciplinary focus. In other words, the language and education fields interact with the psychology, computer, and sociology fields alongside the development of technology and society.

Main Research Streams

In research, co-citation is employed to describe the frequency with which two documents are cited together in other documents, a type of analysis considered to be a core profile for a specialty research field that helps elucidate the pattern of linkages among key publications (Small, 1973). The co-citation relationship of literature might change over time, so literature co-citation analysis allows researchers to explore how a field develops and evolves (Chen, 2020). To understand the thematic patterns of strategies for vocabulary learning and their knowledge base, we use co-citation analysis and the clustering function to visualize the co-citation relationship using CiteSpace, whose co-citation analysis function has been shown to be most effective in highlighting co-citation patterns (Chen, 2016). We identified 36 main clusters using CiteSpace, indicating base research themes within the field. Based on our analysis, the 0.96 modularity Q value suggests the clusters in the co-citation network are well-separated, and the 0.98 weighted mean silhouette score suggests the references within each cluster are coherent in the research theme and distinct from other clusters (Newman, 2006). Figure 2 illustrates 19 major clusters, and Table 4 presents the top nine clusters.

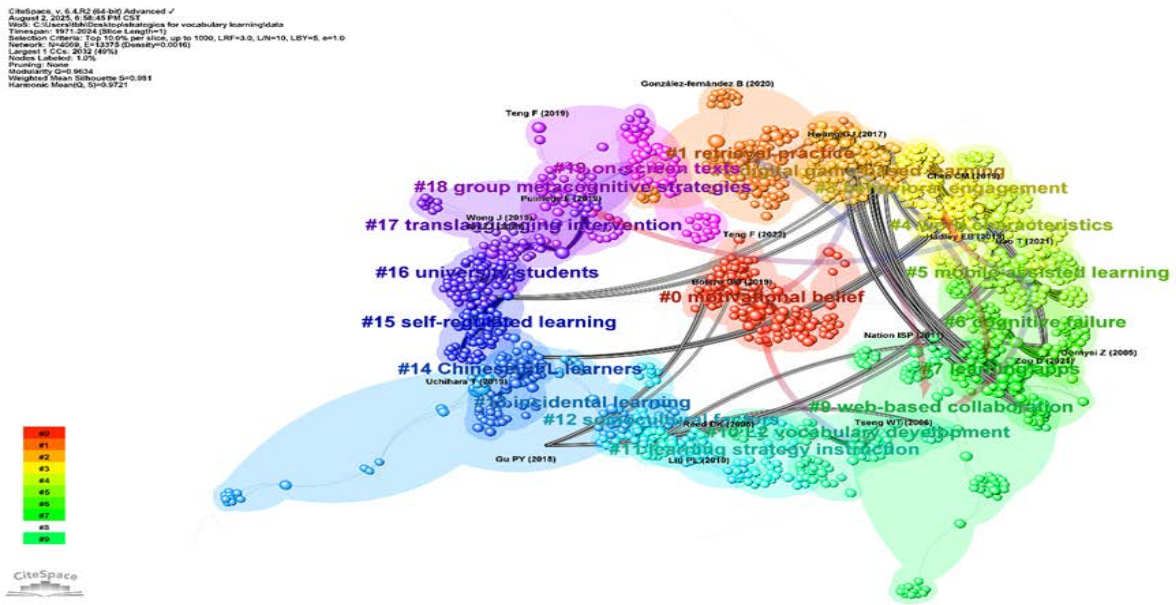


Figure 2. Co-Citation network clustersTable 2. *Most-cited references (1971–2024)*

Number of citations in the network/WoS literature	Cited reference and year	Source	Title	Type of paper
12/75	(Chen et al., 2019)	Computer Assisted Language Learning	An English vocabulary learning app with self-regulated learning mechanism to improve learning performance and motivation	quasi-experimental design
12/156	(Lin & Lin, 2019)	Computer Assisted Language Learning	Mobile-assisted ESL/EFL vocabulary learning: a systematic review and meta-analysis	meta-analysis
11/151	(Zou et al., 2021)	Computer Assisted Language Learning	Digital game-based vocabulary learning: where are we and where are we going?	review
7/147	(Uchihara et al., 2019)	Language Learning	The effects of repetition on incidental vocabulary learning: a meta-analysis of correlational studies	meta-analysis
6/45	(Andrä et al., 2020)	Educational Psychology Review	Learning foreign language vocabulary with gestures and pictures enhances vocabulary memory for several months post-learning in eight-year-old school children	experiment design
6/108	(González-fernández & Schmitt, 2020)	Applied Linguistics	Word knowledge: exploring the relationships and order of acquisition of vocabulary knowledge components	causal-comparative research
5/33	(Dickinson, Nesbitt, et al., 2019)	Early Childhood Research Quarterly	Effects of language on initial reading: direct and indirect associations between code and language from preschool to first grade	hypothesis testing
5/24	(Fan, 2020)	Frontiers in Psychology	Strategy use in second language vocabulary learning and its relationships with the breadth and depth of vocabulary	causal-comparative research

			knowledge: a structural equation modelling study	
5/109	(García Botero et al., 2019)	Computer Assisted Language Learning	Self-directed language learning in a mobile-assisted, out-of-class context: do students walk the talk	causal-comparative research
5/52	(Hadley et al., 2019)	Reading Research Quarterly	Building semantic networks: the impact of a vocabulary intervention on preschoolers' depth of word knowledge	experiment design
5/42	(Hao et al., 2021)	Journal of Research on Educational Effectiveness	Technology-assisted vocabulary learning for EFL learners: a meta-analysis	meta-analysis
5/155	(Hwang et al., 2017)	Computers & Education	Interaction of problem-based gaming and learning anxiety in language students' English listening performance and progressive behavioral patterns	quasi-experiment
5/69	(Mahdi, 2018)	Journal of Educational Computing Research	Effectiveness of mobile devices on vocabulary learning: a meta-analysis	meta-analysis
5/88	(Puimège & Peters, 2019)	Language Learning	Learners' English vocabulary knowledge prior to formal instruction: the role of learner-related and word-related variables	causal-comparative research
5/19	(Teng, 2022)	Language Awareness	Exploring awareness of metacognitive knowledge and acquisition of vocabulary knowledge in primary grades: a latent growth curve modelling approach	causal-comparative research
5/421	(Tseng et al., 2006)	Applied Linguistics	A new approach to assessing strategic learning: the case of self-regulation in vocabulary acquisition	causal-comparative research
5/190	(Zhang & Zou, 2022)	Computer Assisted Language Learning	Types, purposes, and effectiveness of state-of-the-art technologies for second and foreign language learning	review

Table 3. *Most influential journals of strategies for vocabulary learning from 1971 to 2024*

Most Published Journals			Most Cited Journals		
Rank	Journals	Counts	Rank	Journals	Counts
1	Computer Assisted Language Learning	15	1	Language Learning	175
2	Frontiers in Psychology	15	2	Modern Language Journal	158
3	Language Teaching Research	12	3	Journal of Educational Psychology	151
4	Educational Technology Society	11	4	System	137
5	Sage Open	11	5	Applied Linguistics	126
6	Computers & Education	9	6	TESOL Quarterly	115
7	Modern Language Journal	9	7	Reading Research Quarterly	93
8	System	9	8	Language Teaching Research	88
9	Language Learning	8	9	Studies in Second Language Acquisition	80
10	International Journal of Applied Linguistics	6	10	The Review of Educational Research	79
10	Journal of Educational Computing Research	6			
10	Porta Linguarum	6			
10	TESOL Quarterly	6			

ISSN: 2229-9327

The top clusters in Table 4 can be summarized into two main areas. Area 1 established the basic theoretical strategies for vocabulary learning from the perspectives of cognition and behavior. Based on the timeline, Cluster #1 retrieval practice and Cluster #4 word characteristics relate to cognition and appeared earlier in averaged 2016 than clusters about behavior in averaged 2019. Retrieval practice is a learning strategy that enables learners to actively recall information from memory, which ultimately contributes to long-term vocabulary knowledge retention and a deeper understanding (Rowland, 2014; van den Broek et al., 2018). These positive effects are considered testing effects, whose conditions can be flashcards, cloze tasks, dictations, or multimedia environments (Elgort et al., 2018; Goossens et al., 2016; van den Broek et al., 2021). On the other hand, word characteristics describe how words are perceptually accessible to learners and are characterized based on four elements: shape, individuation, concreteness, and imageability (Hadley et al., 2021; Hadley et al., 2016). For most language learners, vocabulary learning represents the initial stage of learning as a foundational reading skill, so researchers have investigated vocabulary learning strategies based on word characteristics and the relevant instructions among pre-schoolers, especially in the first-language context (Dickinson et al., 2019; Dwyer & Schachter, 2020; Hindman et al., 2019). The two clusters marked the transition from theory to practice—from memory-based cognition to in-classroom vocabulary learning (Elgort et al., 2018; van den Broek et al., 2018).

Table 4. *Top clusters based on the CiteSpace analysis*

ClusterID	Label	Size	Silhouette	Mean (year)
0	motivational belief	133	0.949	2019
1	retrieval practice	131	0.979	2016
2	digital game-based learning	124	0.95	2019
3	behavioral engagement	104	0.945	2019
4	word characteristics	97	0.993	2016
5	mobile-assisted learning	85	0.995	2020
6	cognitive failure	84	0.975	2007
7	learning apps	84	0.984	2017
9	web-based collaboration	77	0.986	2015

Regarding Cluster #0 motivational belief and Cluster #3 behavioral engagement in the same average year of 2019, Area 1 establishes both from the perspective of behavior, with motivational belief being the largest among all clusters. Cluster #0 motivational belief marked a shift in strategy for vocabulary learning research to the field of psychology. That shift has led to research on the role of self-efficacy and motivation in vocabulary size and depth (Lee et al., 2022), and the second language context is one of the most obvious settings for empirical studies (Guo et al., 2022; Li & Wang, 2024). Behavior engagement emphasizes the learning process instead of final outcomes—for example, by focusing on how learners self-regulate their vocabulary learning strategies to achieve learning goals (Lei et al., 2022) and considering behavior a dynamic development influenced by social and technological contexts (Hwang & Fu, 2019; Wei, 2023).

Area 2 focused on the role of technology in vocabulary learning strategies, and the shifts over time illustrate how the clusters capture changing attitudes toward technology in the scholarship—primarily a shift from rejection and limited applications to widespread acceptance and use. In addition, the average year of these clusters demonstrated the shift from web-based to mobile-assisted technology development. Cluster #6 cognitive failure appeared the earliest in averaged 2007, and focuses on learners' tiredness, exhaustion, and helplessness in technology-assisted learning. With the development of technology use in vocabulary learning, learners'

internet cognitive failure gained attention in the later stages of research on this topic, with cognitive failure being found to be negatively related to learners' self-regulation in vocabulary learning (Hong et al., 2015). Cluster #9 web-based collaboration was the second in average 2015. Sarah Hsueh-Jui et al. (2014) explored how English as a foreign language (EFL) learners' web-based collaboration affects vocabulary improvements, finding that willingness to engage in web-based collaboration was positively related to learners' vocabulary knowledge. Meanwhile, Cluster #7 learning apps appeared in 2017, and Cluster #5 mobile-assisted learning was the latest in average 2020. These two clusters focus on mobile-assisted vocabulary learning research on smartphones and tablets, which exerted a far-reaching influence on vocabulary learning strategies. *Baicizhan*, *Kingsoft Vocabulary*, *New Oriental Fun Vocabulary*, and *Shanbay* were some of the apps mentioned in research, and learner age was deemed a crucial factor for game design and application (Guo et al., 2022; Li, 2021; Yu, 2018). Among the clusters, Cluster #2 digital game-based learning acted as the fourth in time sequences in average 2019. To increase students' engagement in learning and improve learning motivation, problem-based games and competitive gaming scenarios have been employed (Hwang et al., 2017; Wei et al., 2018).

Burst detection investigates instances where the citation frequency of a particular document experiences a sudden and significant increase within a short period, which helps identify unanticipated but widely distributed documents and reveals the evolution of research hotspots and frontier trends (Chen, 2006; Kleinberg, 2003). Different from other fields in applied linguistics, monographs burst frequently in the field of vocabulary development research due to their unique nature and role being increasingly noticed by scholarship in applied linguistics. Three monographs and seven articles with the strongest bursts detected are shown in Table 5. Specifically, Nation (2001), Nation and Webb (2011), and Webb and Nation (2017) are the three monographs that laid the fundamentals of vocabulary learning strategies, including conceptualization, taxonomy, principles for teaching, and instruments for measure. The other seven documents are research articles: Sandberg et al. (2014) in Cluster #7 learning apps and Hadley et al. (2016) in Cluster #4 word characteristics are from the top clusters, while Oxford and Scarcella (1994), Fan (2003), Huang et al. (2012), Smith et al. (2013), and Lin and Lin (2019) are from relatively small clusters. The documents in both top clusters and bursts indicate that the documents are both theoretical foundations and emerging trends, while articles only in the top burst imply their main contribution is pioneering new fields in vocabulary learning strategies. For example, Smith et al. (2013) investigated vocabulary learning experiences with inference-based computer games embedded in eBooks and the advantages of the approach compared to traditional learning, offering a new orientation from the perspectives of both research and technology.

Table 5. *Documents with the strongest bursts*

Bursts	Author	Title	Source/Publisher	Cluster ID
2.86	Webb & Nation (2017)	How vocabulary is learned	Oxford University Press	13
2.70	Lin and Lin (2019)	Mobile-assisted ESL/EFL vocabulary learning: A systematic review and meta-analysis	Computer Assisted Language Learning	365
2.45	Smith et al. (2013)	Play games or study? Computer games in eBooks to learn English vocabulary	Computers & Education	171
2.43	Nation & Webb (2011)	Researching and analysing vocabulary	Heinle Cengage Learning	9

2.41	Sandberg et al. (2014)	The added value of a gaming context and intelligent adaptation for a mobile learning application for vocabulary learning	Computers & Education	7
2.31	Huang et al. (2012)	A ubiquitous English vocabulary learning system: Evidence of active/passive attitudes vs. usefulness/ease-of-use	Computers & Education	21
2.10	Hadley et al. (2016)	Examining the acquisition of vocabulary knowledge depth among preschool students	Reading Research Quarterly	4
2.05	Nation (2001)	Learning vocabulary in another language	Cambridge University Press	81
2.02	Oxford & Scarcella (1994)	Second language vocabulary learning among adults: State of the art in vocabulary instruction	System	113
2.02	Fan (2003)	Frequency of use, perceived usefulness, and actual usefulness of second language vocabulary strategies: A study of Hong Kong learners	The Modern Language Journal	250

Discussion

A total of 340 documents in the field of vocabulary learning strategies were analyzed using bibliometric analysis. First, we examined the stages of research on vocabulary learning strategies. Based on the annual publication numbers (Figure 1), the curve representing the trend of publication volume started soaring in 2016 after a long period of ups and downs. The increase reflects how the development of strategies for vocabulary learning research started to flourish after a long period of volatile exploration. Arguably, then, scholars' efforts in the exploratory phase laid the foundation for the current spurt of strategies for vocabulary learning research. During the growth stage (1991–2005), scholars' contributions to the taxonomy of strategies established the theoretical basis for the study of strategies for vocabulary learning and drove its development. The subsequent publication of the book *Vocabulary Learning Strategies and Foreign Language Acquisition* during the expansion phase (2006–2015) made significant contributions to the development of the field. The book not only reviews past research on strategies for vocabulary learning but also highlights future research directions. At the same time, the introduction of self-regulated learning has brought new perspectives to strategies for vocabulary learning research.

Second, the disciplinary nature of strategies for vocabulary learning research has also been found in influential authors' works, articles, and journals, and analyses of key topic analyses. Based on the analysis of journals, strategies for vocabulary learning research has obvious interdisciplinary characteristics, including those aligned with the linguistics, psychology, computer, technology, education, and other disciplines. The language, education, and linguistics disciplines are the basic fields within strategies for vocabulary learning research, while the psychology and computer disciplines are frontier fields. Collectively, these results reveal a clear interdisciplinary trend in research on vocabulary learning strategies. The introduction of self-regulated learning has also led to a strong connection between educational psychology and strategies for vocabulary learning research. Over the past two decades, the rapid expansion of digital technology has provided new tools and resources to meet learners' diverse vocabulary learning needs as well (Boroughani et al., 2023). Technology has become one of the most important tools for vocabulary learning, so the strategies used by learners have also changed (An et al., 2020). As a result, researchers have begun to explore the characteristics and efficiency of

learners' use of vocabulary learning strategies in the context of technology-assisted learning, which has led to more interaction between disciplines such as computer science and artificial intelligence. For instance, Hsu et al. (2024) investigated the effects of artificial intelligence (AI) image recognition technology on the vocabulary acquisition, learning anxiety, and learning behaviors of English language learners. An et al. (2020) developed and validated the Technology-Based Self-Regulated English Learning Strategies Scale, an evaluation tool used to assess EFL students' technology-based self-regulated English language learning experience.

Third, key topics within and the knowledge base of strategies for vocabulary learning research were also examined. The co-citation strategies for vocabulary learning network clusters (Figure 2) revealed that #0 motivational belief, #1 retrieval practice, #2 digital game-based learning, #3 behavioral engagement, #4 word characteristics, #5 mobile-assisted learning, #6 cognitive failure, #7 learning apps, and #9 web-based collaboration have formed a core research network. Strategies for vocabulary learning research presents significant features in terms of research object, research content, and research methods. The research mainly focuses on primary language learners as the research object. Meanwhile, due to the high number of Chinese English language learners (Huang et al., 2021), scholars have also explored extensive strategies for vocabulary learning research on this group. In addition, in terms of research content, mobile technology and teacher beliefs are important concerns. The rapid development of technology and its increasing integration with education have made mobile technology an integral part of strategies for vocabulary learning research (An et al., 2020). In second language vocabulary research, other topics of significant interest are how to support learners in learning vocabulary and how teachers can be better prepared to teach vocabulary (Chung, 2018). Researchers have thus studied teaching beliefs to gain insights into vocabulary instruction and teacher development to assess how to benefit vocabulary learners best. In terms of research methods, the many benefits of meta-analysis, including increased statistical power and improved accuracy, have led to this method being used in numerous strategies for vocabulary learning studies (Chan & Arvey, 2012). As shown in Table 5, the book *How vocabulary is learned* leads the way in co-citation bursts. In the book, Webb and Nation (2017) capitalized on research and theory to provide comprehensive and authoritative coverage of important elements of vocabulary instruction, providing clear and practical information for teachers and learners. The book thus serves as an important guide to research in the field of strategies for vocabulary learning.

Conclusion

This study employed the visualization tool CiteSpace to analyze strategies for vocabulary learning literature from the SSCI and AHCI databases, focusing on research trends, influential authors, articles, and journals, and key topic areas. Currently, discussions about vocabulary learning strategies and strategic learning are deepening, and the interdisciplinary integration between technology and education continues to expand. The findings thus suggest that the vigorous development stage of strategies for vocabulary learning research will persist in the long term. Among the selected articles, the most frequently researched subjects were motivational belief, mobile technology, meta-analysis, and digital game-based learning. Additionally, while not key clusters, social and cultural factors have emerged as a new area, and the strategies for vocabulary learning research indicates an expansion toward translanguaging acquisition. Overall, this study highlights the knowledge structure and research dynamics in this field by adopting

scientometric and visual analytic tools, providing valuable references for future strategies for vocabulary learning research.

Funding: This research was funded by the NPU Research Scheme for Education and Teaching Reform, grant number 2024JGWZ09.
Acknowledgments: Not applicable.
Conflicts of Interest: The authors declare no conflict of interest.
Authenticity: This manuscript is an original work.
Artificial Intelligence Statement: The authors of this manuscript used AI only as basic writing support tools, such as for checking grammar, vocabulary, and spelling.

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