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Research Trends and Hotspots of Digital Game-Based Vocabulary Learning (2008-2023):
A Scientometrics Review

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ABSTRACT

Digital games have gained significant attention in the field of language education. Among various educational applications, research on digital game-based vocabulary learning (DGBVL) has seen a marked increase in interest and exploration. This study presents a scientometric review based on bibliometric data from the Scopus and Web of Science Core databases. Using specific selection criteria, 364 studies published between 2008 and 2023 were identified for analysis. The findings revealed the following: (a) research on DGBVL has demonstrated considerable growth in recent years, highlighting its high potential; (b) the United States, Taiwan, Mainland China, and Hong Kong emerged as the most prolific contributors to publications in this area; and (c) major research clusters include vocabulary learning, classroom teaching improvement, WhatsApp, augmented reality (AR), and other related topics. This review offers valuable insights for scholars and researchers in DGBVL, fostering further advancements in this field.

KEYWORDS

Game-Based Learning, Digital Game, Vocabulary Acquisition, CiteSpace, Review

INTRODUCTION

Vocabulary has long been recognized as a cornerstone of language skill development, particularly for students learning a second language (L2). Under comparable conditions, individuals with extensive vocabularies exhibit greater proficiency across various language skills than those with a limited lexicon (Krashen, 1989). Despite its importance, vocabulary learning often presents challenges, largely due to the limitations of decontextualized classroom instruction (Lee et al., 2023). This approach can impede learners' ability to grasp the multidimensional aspects of words, including their form, meaning, and usage (Richards, 1976). Vocabulary acquisition is a complex, incremental process that necessitates repeated exposure to reinforce understanding and retention (Schmitt, 2008). However,

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traditional language teaching methods frequently result in slower progress and restricted opportunities for language practice, as L2 learners have limited exposure to the target language (Xiong et al., 2024). This contrasts sharply with learners in immersive L2 environments, who benefit from continuous exposure and greater opportunities for practice (Lee, 2022; Tsai & Tsai, 2018). Limited exposure to the target language can significantly hinder vocabulary acquisition and retention among L2 learners.

Research suggests that vocabulary learning and memory retention are enhanced in environments that impose a higher cognitive load and provide frequent exposure to vocabulary (Teng, 2022; Yanagisawa & Webb, 2022). However, vocabulary acquisition is often regarded as one of the more tedious and time-intensive aspects of language learning, which can diminish students' interest and motivation (Zhang & Yu, 2021). This lack of engagement can result in elevated affective filters, further hindering the language acquisition process (Krashen, 1982). As a result, in traditional learning settings, students frequently exhibit passivity or boredom during vocabulary instruction, which ultimately leads to suboptimal learning outcomes despite considerable effort and time investment.

The emergence of innovative technologies has significantly transformed the field of English education, offering unprecedented opportunities to develop accessible, personalized, and contextually enriched instructional materials. These advancements hold the potential to substantially enhance the interactive experience of English as a Foreign Language (EFL) learning (Annamalai et al., 2022; Dooly et al., 2023). Among these technologies, the ubiquity of digital games stands out, with their influence extending to all facets of human life, including education. Digital game-based learning (DGBL) represents an educational approach that incorporates digital games into the learning process (Prensky, 2001). Prensky (2007) identified essential components of digital games, including objectives, entertainment, challenges, and interactive or competitive elements.

DGBL adopts task-oriented and student-centered activities within simulated environments to create immersive learning experiences (Xu et al., 2019). In these settings, learners participate in competitive activities governed by clear rules while working toward educational objectives (Tay et al., 2022). This approach not only fosters cognitive skills and facilitates knowledge construction but also enhances learner motivation through active engagement (Chen & Liu, 2021; Talan et al., 2020). The application of digital games to vocabulary learning has been the subject of extensive research in the field of digital game-based vocabulary learning (DGBVL). Growing evidence highlights the advantages of well-designed digital games, including improved vocabulary acquisition (Jia et al., 2024; Kazu & Kuvvetli, 2023; Sundqvist, 2019), increased motivation and engagement (Alawadhi & Abu-Ayyash, 2021; Lee, 2019; Reynolds et al., 2021), and reduced learner anxiety (Yang et al., 2022). For instance, Enayat and Haghighatpasand (2017) demonstrated the positive impact of adventure digital games on both immediate receptive and delayed productive vocabulary recall, showcasing their potential as supplementary tools for enhancing lexical learning.

Zhang et al. (2023) highlighted that the effectiveness of DGBVL lies in learners' active engagement within the learning environment. This aspect is achieved by stimulating intense curiosity through compelling narratives, immersing learners in virtual environments, and enhancing their sense of accomplishment through challenges and rewards. While existing research has reported positive outcomes, the field still lacks a comprehensive and integrated understanding of its broader landscape. To address this gap, the present study utilized CiteSpace, a science mapping software, to conduct a scientometric review based on bibliometric data spanning 2008 to 2023. This approach extends beyond traditional reviews by employing rigorous data-driven analysis to identify key research domains and trace the evolving trends within DGBVL.

PREVIOUS STUDIES REVIEWS

Extensive research has explored digital game-based language learning (DGBLL), yet relatively little attention has been given to the vocabulary acquisition process within this context. For example, Xu et al. (2019) conducted a scoping review examining the role of digital game-based technology in

English language learning. The study explored the current landscape of using digital games to enhance English language acquisition, focusing on participant demographics, methodological approaches, gaming features, and the relationship between game availability and gaming characteristics. The review revealed that vocabulary is the most frequently practiced language skill in DGBLL, followed by overall English language proficiency, pragmatics, grammar, writing, and speaking. Quantitative methodologies, particularly those relying on researcher-designed tests, dominate as the primary approach for evaluating the effectiveness of digital game-based interventions. Additionally, while commercial games offer superior elements of engaging gameplay, the integration of these features into educational digital games remains inconsistent.

Several reviews have examined specific aspects of DGBLL. For instance, Jabbari and Eslami (2018) conducted a review focusing on massively multiplayer online games (MMOGs), particularly commercially available off-the-shelf MMOGs, to assess their impact on L2 learning. Analyzing 31 empirical studies, the review emphasized the predominance of qualitative research exploring L2-related motivational and affective factors, vocabulary acquisition, and learners' communicative competence. The authors proposed a model illustrating the interconnections between MMOG settings, social and affective affordances, L2 learning opportunities, and resulting learning outcomes. Their findings suggested that MMOGs provide supportive, low-anxiety environments that foster L2 vocabulary development and communicative skills by promoting increased socialization and offering enriched learning opportunities.

Similarly, Yang et al. (2024) conducted a systematic review focusing on K-12 learners, analyzing SSCI articles published between 2009 and 2022 to examine the theoretical foundations, instructional strategies, and empirical evidence related to game-based language learning (GBLL). The review identified cognitive and social theories, such as flow theory, situated learning, and sociocultural theory, as the predominant theoretical frameworks underpinning GBLL studies. Primary school students were the most frequently studied group, with a strong emphasis on EFL learning. Quantitative research methods dominated, and tutorial games emerged as the most commonly employed genre in GBLL interventions. The findings highlighted several benefits, including enhanced language skills and communicative competence. However, challenges included technical issues, unproductive collaborations, task complexity, and high cognitive load.

While individual reviews have deepened our understanding of DGBVL, further research is required to address existing gaps. For example, Zou et al. (2019) conducted a systematic review of 21 publications on DGBVL, summarizing ten game types, commonly utilized frameworks, and key research findings. Their study demonstrated that digital games support vocabulary acquisition, boost learner motivation and engagement, foster interaction, and alleviate anxiety. The review also highlighted the effectiveness of explicit learning activities, such as repeated exposure to target vocabulary through structured exercises, in promoting vocabulary retention. Key factors influencing successful vocabulary learning include noticing, retrieval, and generative use. Additionally, motivation emerged as a critical determinant of vocabulary acquisition, with higher motivation strongly correlating with improved learning outcomes.

Thompson and Von Gillern's (2020) Bayesian meta-analysis compared the efficacy of video game-based activities with non-video game activities in L2 acquisition. Drawing from 19 studies and analyzing 20 standardized mean-difference effect sizes, the study evaluated various aspects, including overall mean effects, subgroup analyses across different variables, and the potential for publication bias. The results indicated a moderately large overall effect, favoring video game-based learning groups. However, substantial heterogeneity in effect sizes was observed, with significant variability across studies. Subgroup analyses produced mixed outcomes in accounting for this variability. Importantly, publication bias tests consistently indicated a low risk, reinforcing the reliability of the findings. These results suggest that digital games can serve as an effective tool for vocabulary development and contribute meaningfully to English education.

Tsai and Tsai's (2018) meta-analysis reviewed 26 studies on DGBVL published between 2001 and 2017. The study evaluated four experimental conditions: (1) comparing experimental groups playing digital games to control groups engaged in alternative activities, (2) assessing digital games with modified features versus base versions, (3) contrasting DGBL with traditional methods, and (4) analyzing participant groups based on non-game-related variables. The results varied across these conditions. Condition 1 demonstrated a substantial effect size, Condition 2 showed a moderate effect, Condition 3 ranged from moderate to significant effects, and Condition 4 yielded nonsignificant results. By linking learning mechanisms with empirical evidence, the study assessed the efficacy of digital games for L2 vocabulary acquisition. Through a detailed analysis of research methodologies and comprehensive effect size calculations, the study enhances our understanding of the contexts in which digital games support L2 vocabulary learning. Moreover, it identifies critical moderator variables that account for variations in findings across studies.

Chen et al. (2016) conducted a meta-analysis of 10 studies, using Csikszentmihalyi's (1990) flow theory as the guiding framework. The findings revealed that the effectiveness of DGBL on vocabulary acquisition varied based on game design features but was not influenced by learners' age or linguistic background. The study identified the "challenge" component of flow theory as a pivotal factor, with adventure games outperforming non-adventure games in fostering vocabulary learning. This review significantly advanced the field by highlighting the nuanced effects of DGBL on vocabulary acquisition, emphasizing the critical role of game design features, and providing valuable insights into the motivational aspects of DGBL through the lens of flow theory. However, as the review was conducted over five years ago, it does not account for the latest advancements or emerging technologies in this rapidly evolving area of research.

Collectively, prior studies have provided valuable insights into the use of digital games for vocabulary learning. However, a notable gap persists in the form of a scarcity of scientometric reviews on DGBVL. Building upon the evolving body of DGBVL research, this study aims to extend beyond the scope of previous reviews. To address this gap, the present study employs CiteSpace to conduct a scientometric review of relevant literature on DGBVL, to elucidate the current state of research and identify emerging trends. This investigation is guided by the following research questions:

RQ1: What was the annual trend of DGBVL research?
RQ2: Which nations/regions, and institutions were prolific?
RQ3: What were the primary topics in this field, and how have they evolved?

METHODS

Search Strategy

Given the objective of this review, relevant literature was sourced from the Web of Science Core Collection and Scopus databases to ensure high-quality and pertinent resources. Web of Science and Scopus are two preeminent academic repositories. Scopus, one of the most extensive curated abstract and citation databases, includes a wide array of global and regional scientific journals, conference proceedings, and books, with strict curation processes ensuring quality (Baas et al., 2020). Similarly, the Web of Science database is widely recognized for its authority and reputation within the academic community (Birkle et al., 2020). As the longest-standing, extensively utilized, and highly esteemed repository of research publications and citations, the Web of Science is a cornerstone of academic databases (Birkle et al., 2020). It encompasses numerous leading and widely cited studies and journals, making it a principal source for scientometric review studies (e.g., Alice Chen et al., 2021; Liu et al., 2021; Sun & Xiao, 2021).

The publications included in this review span January 2008 to December 2023, covering over 15 years of scholarly output. This period was chosen to reflect the significant technological advancements of the past decade and a half, which have profoundly influenced the research landscape in this field. The focus on recent literature aims to capture the latest trends and developments, offering valuable insights into the current state of the discipline. The topic search employed terms related to vocabulary learning and digital games, derived from the definition of DGBVL and prior reviews in this domain. To ensure comprehensive search results, alternative expressions for key terms were included. Boolean operators were used to refine the search: "AND" was applied between the three sets of search terms, while "OR" was used within each set.

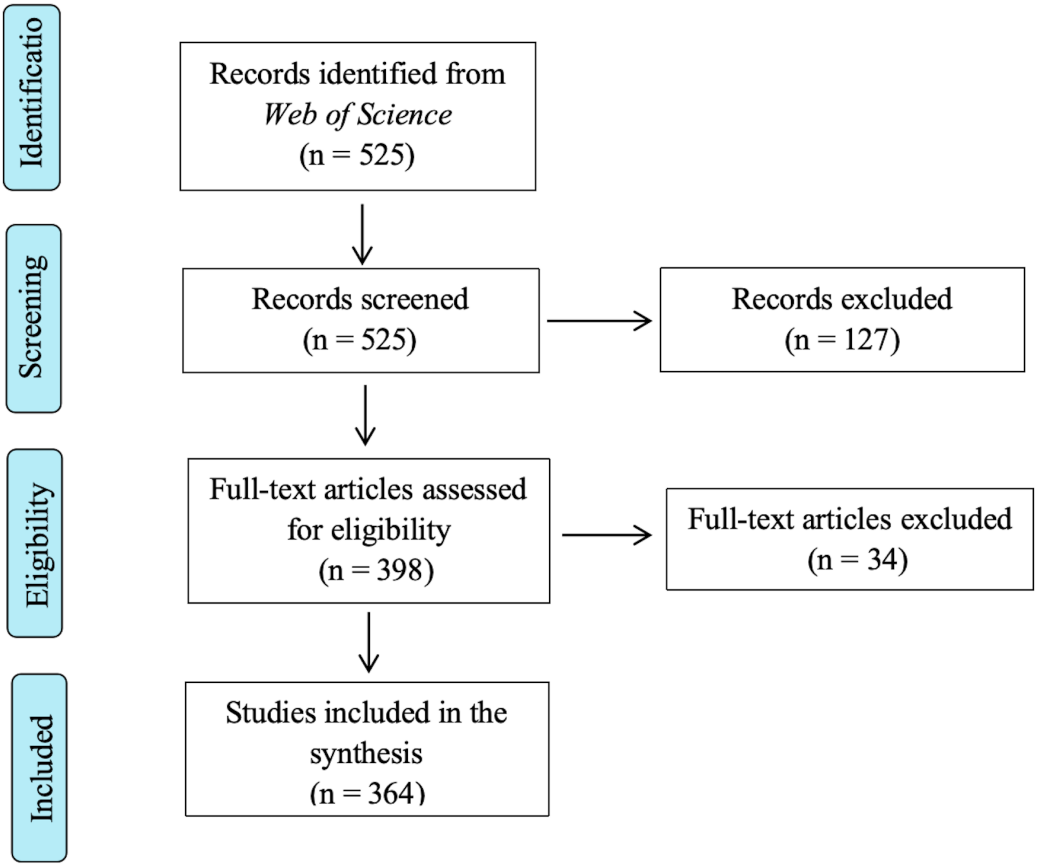
The search process employed specific keywords and Boolean operators to ensure a comprehensive and targeted review. Digital game-related terms included: "game-based," "video game," "computer game," "digital game," "mobile game," "serious game," "educational game," and "online game." Vocabulary learning-related terms encompassed: "vocabulary learning," "vocabulary acquisition," "word acquisition," and "word learning." Language learning-related terms included: "second language," "foreign language," "language learning," "language education," "EFL," and "L2." Boolean operators "AND" and "OR" were used to combine these terms, ensuring a thorough and relevant search.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) studies had to be original empirical research articles, including journal publications and relevant conference proceedings; (2) written in English; (3) published between January 2008 and December 2023; and (4) focused on the use of digital games for vocabulary learning. The exclusion criteria were as follows: (1) studies were excluded if they were non-empirical papers, such as review studies, news items, or book chapters; (2) written in languages other than English; (3) published before 2008; (4) focused on the use of digital games in disciplines unrelated to vocabulary learning; or (5) involved participants with special needs.

A total of 525 articles were initially identified through the literature search. Titles and abstracts were screened to assess relevance, and in cases of ambiguity, the full texts were reviewed. After applying the inclusion and exclusion criteria, 398 articles remained for further analysis. A comprehensive evaluation of the full texts resulted in the exclusion of 34 articles that did not focus on digital games. Ultimately, 364 articles were included in this review. The detailed selection process is depicted in Figure 1, highlighting the sequential steps of screening and inclusion.

Figure 1. Flow diagram of the data collection procedure



Data Analysis

This study utilized CiteSpace 6.1.R6, a scientometric analysis tool developed by Chaomei Chen at Drexel University, for data analysis. CiteSpace is widely recognized for its utility in data mining and visualization (Chen, 2016), enabling the representation of knowledge correlations, research hot spots, emerging frontiers, and future trends within a specific field (Chen, 2005).

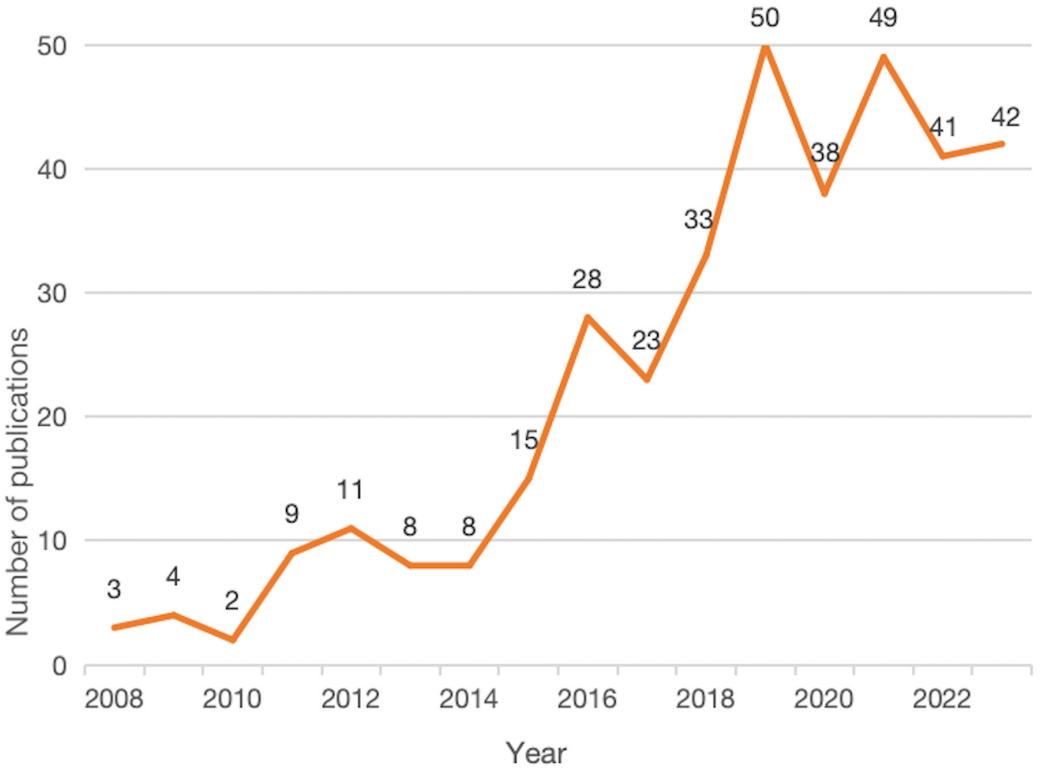
The main steps of the analysis were as follows. First, a descriptive analysis was conducted to identify annual trends and examine the number of publications from various countries, regions, and institutions. This step provided a foundational understanding of the evolution of the research landscape, highlighting the geographical and institutional distribution of scholarly output and offering a broad perspective on the field's development. Next, a co-citation analysis was performed to explore research hotspots and evolutionary trends within the field. This analysis uncovered the interconnectedness of ideas, identified influential works, and highlighted emerging themes, thereby pinpointing critical areas for further exploration and contributing to a deeper understanding of the field's dynamics and patterns of knowledge dissemination.

RESULTS

RQ1: What was the Annual Trend of DGBVL Research?

Figure 2 illustrates the number of DGBVL publications from 2008 to 2023, highlighting a fluctuating yet upward trend. The annual publications increased significantly, rising from three in 2008 to 42 in 2023. Before 2010, the number of DGBVL studies was limited; however, research interest began to grow steadily after 2010. From 2015 onward, the field experienced rapid growth, peaking at 50 publications in 2019. Since then, the momentum has remained strong, with a steady pace of growth. This emerging area has demonstrated substantial and consistent development over the past several years and is projected to continue evolving.

Figure 2. The number of publications about DGBVL by year



RQ2: Which Nations/Regions, and Institutions Were Prolific?

Figure 3 presents the top 10 countries and regions ranked by the number of published articles in DGBVL research. These countries and regions collectively contributed 253 articles, accounting for nearly 70% of the total publications. The United States led with 50 articles, followed by the Taiwan region with 46 articles, and the region comprising Mainland China, Hong Kong, and Macao with 41 articles. Spain, Malaysia, and Indonesia contributed 24, 20, and 16 articles, respectively. United Kingdom and Turkey each produced 15 articles, while Iran and Australia contributed 14 and 12 articles, respectively.

Figure 3. Top 10 countries/regions for publications in the field of DGBVL

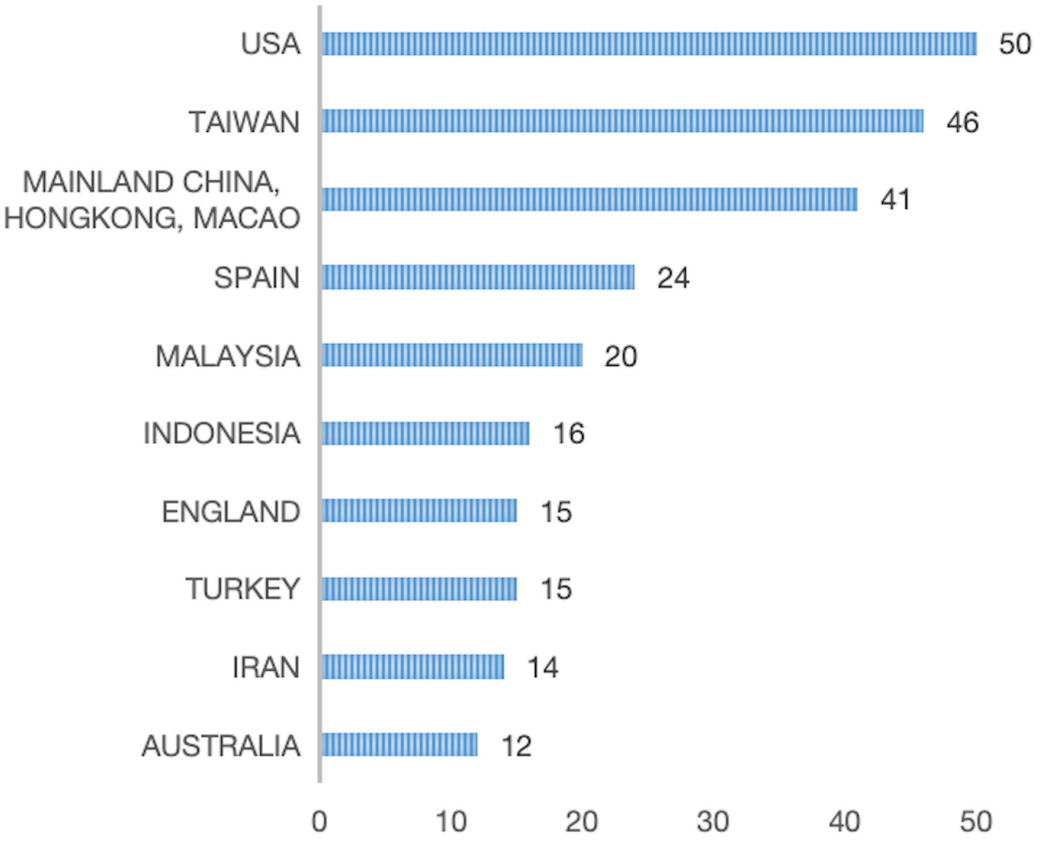
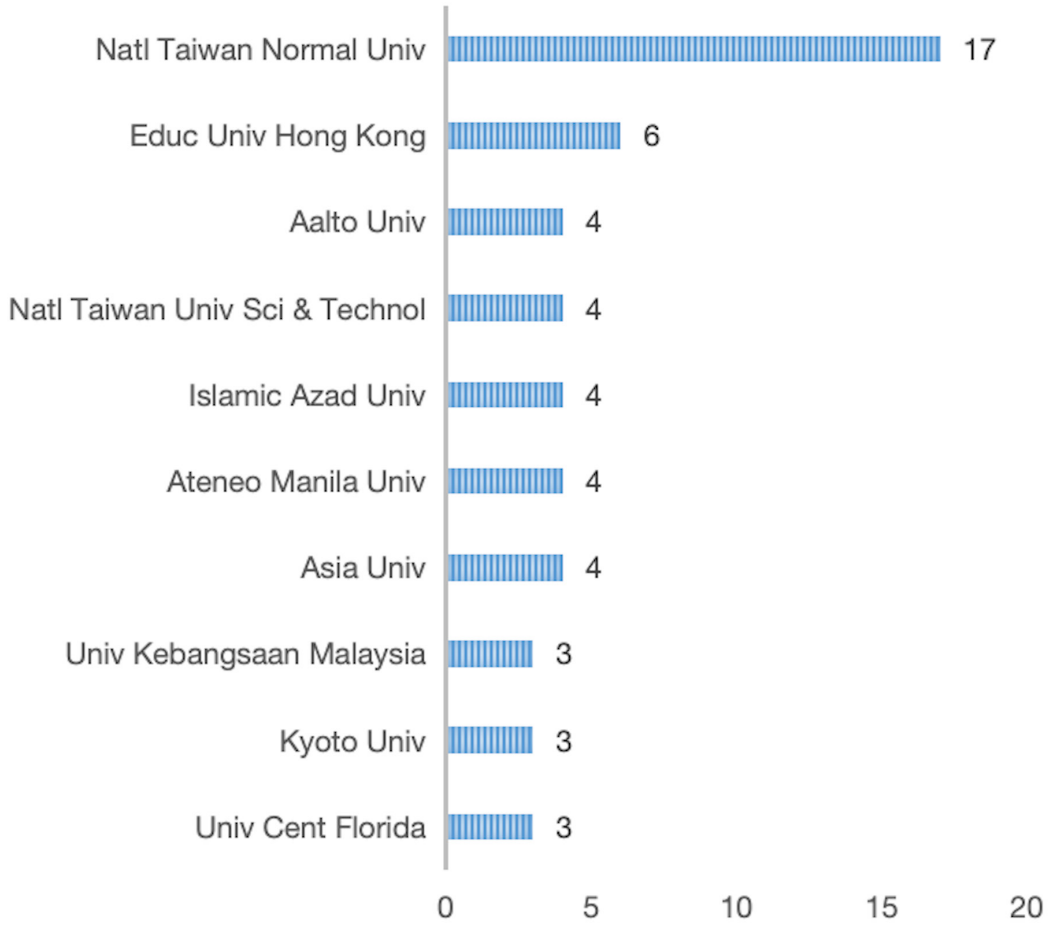


Figure 4 displays the top 10 institutions ranked by the number of publications, collectively contributing 14.29% of the total articles. Among these, the National Taiwan Normal University was the most prolific, with 17 publications. Other notable contributors included The Education University of Hong Kong, with six articles, and both Aalto University and the National Taiwan University of Science and Technology, with four articles each. Notably, eight of the top 10 research institutions were located in Asia, underscoring the dominant role of Asian institutions in DGBVL research.

Figure 4. Top 10 institutions for publications in the field of DGBVL



Note. Natl = national; Univ = university; Sci = science; Technol = technology; Cent = central.

RQ3: What Were the Primary Topics in This Field, and How Have They Evolved?

Figure 5 displays a co-citation network generated by CiteSpace, consisting of 539 nodes and 1,241 links. The clusters within the network are labeled using the Log-Likelihood Ratio algorithm, which identifies the primary research specializations represented by the nodes within each cluster (Chen et al., 2010). Two key metrics in CiteSpace are used to evaluate the network: modularity and silhouette values. Modularity, which measures the degree of network clustering, indicates a well-structured network when higher values are observed. The silhouette value, on the other hand, assesses cluster homogeneity, with values approaching one signifying greater consistency within clusters (Chen, 2016). In this analysis, the co-citation network demonstrated a modularity value of 0.8965 and a mean silhouette value of 0.9486, reflecting a well-clustered structure with high reliability and homogeneity.

Figure 5. The co-citation network (modularity = 0.8965, silhouette = 0.9486)

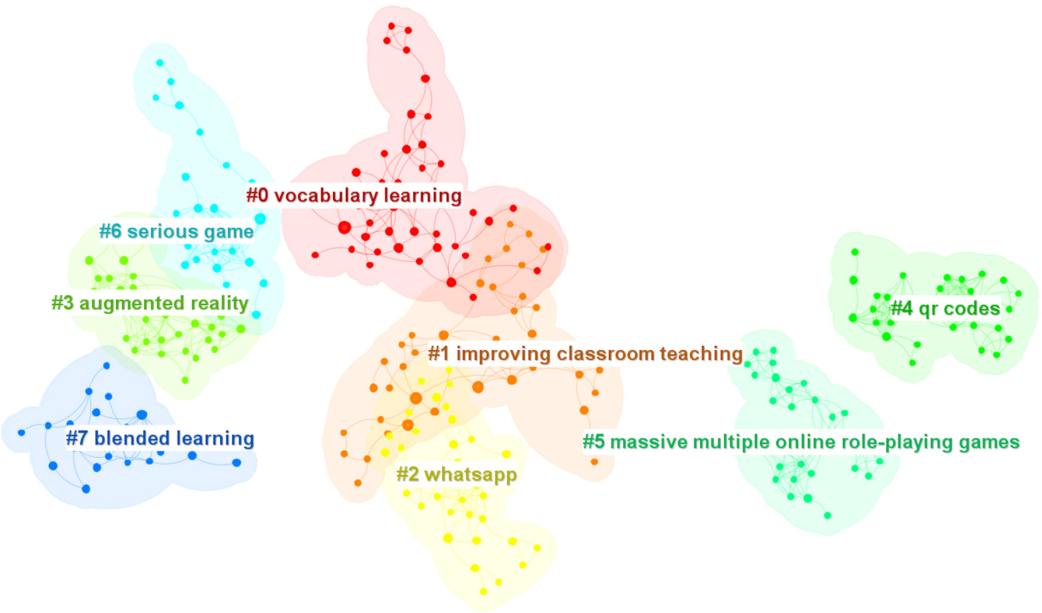
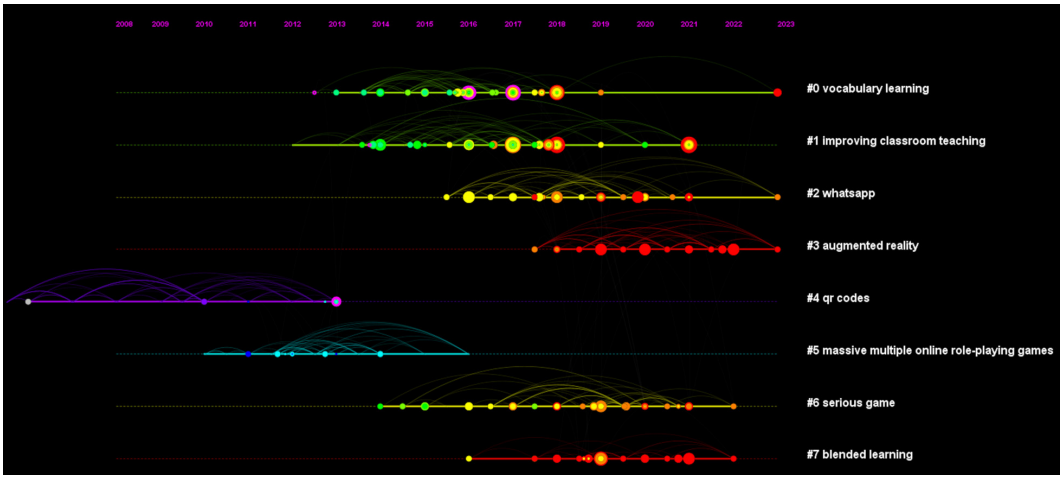


Figure 5 illustrates the co-citation network, highlighting the eight most prominent and representative clusters. These clusters are labeled as follows: #0 vocabulary learning, #1 improving classroom teaching, #2 WhatsApp, #3 augmented reality (AR), #4 QR codes, #5 massive multiplayer online role-playing games (MMORPGs), #6 serious game, and #7 blended learning.

Figure 6 presents the timeline view of the co-citation network, where the length of each line represents the lifespan of its corresponding cluster (Chen, 2016). Cluster #0 exhibited the longest lifespan, while Cluster #3 was the most recent and Cluster #4 the earliest. Additionally, clusters #0 and #1 emerged as the most prominent, as they contained the largest nodes, indicating their centrality and influence within the network. The content of the four major clusters was analyzed, with a focus on the top two highly cited papers within each cluster.

Figure 6 The timeline view of the co-citation network (modularity = 0.8965, silhouette = 0.9486)



Note. Cluster #0: Vocabulary learning.

The cluster, centered on the learning process and learning performance, encompasses 43 articles with a silhouette value of 0.909 and an average publication year of 2015. The high silhouette value indicates strong cohesion among the articles, reflecting a high degree of thematic consistency within the cluster. This coherence suggests a shared focus across the research studies. The articles in this cluster primarily explored flow theory and the characteristics of high- and low-achieving learners, highlighting researchers' significant interest in understanding learners' cognitive processes and achievement levels. The importance of this research lies in its ability to shed light on learners' psychological states, learning experiences, and performance differentials, providing valuable insights for educational practitioners (Hung et al., 2018; Hwang et al., 2017).

Cluster #1: Improving Classroom Teaching

This cluster has a silhouette value of 0.928 and an average publication year of 2016. It consists of 41 articles focused on educational improvement, pedagogical issues, teaching and learning strategies, and vocabulary-related variables. The emphasis on teaching and learning strategies aligns closely with the innovative potential of DGBVL. Incorporating gaming elements into educational practices is highlighted as a means to create more engaging, interactive, and effective learning experiences. This approach demonstrates the promise of integrating teaching strategies with digital gaming components, opening new possibilities and opportunities in education. It provides students with more inspiring and dynamic learning environments (Franciosi, 2017; Hwang & Wang, 2016).

Cluster #2: WhatsApp

Cluster #2 comprises 35 publications, with an average publication year of 2018 and a silhouette value of 0.961, reflecting high homogeneity among the cluster members. This cluster focuses on learning environments, such as out-of-school learning and scaffolding, as well as the use of technology in education, particularly platforms like WhatsApp and expert systems. The emphasis on utilizing technology, such as WhatsApp, highlights the growing interest in leveraging popular communication tools to enhance educational practices and extend learning beyond traditional classroom boundaries. This cluster provides valuable insights into how technologies like WhatsApp can enrich educational experiences and transform technology-enhanced learning environments (Wichadee & Pattanapichet, 2018).

Cluster #3: Augmented Reality

Cluster #3 has a silhouette value of 0.942, encompassing 34 articles with a mean publication year of 2020, positioning it as a prominent and contemporary area of study. This cluster examines the interplay between technology and educational methodologies, focusing on themes such as contextual learning approaches, AI, English language performance, and intercultural competence. An emerging trend within this cluster highlights the integration of advanced technologies into DGBVL research, including VR, AR, mixed reality (MR), extended reality (XR), the metaverse, and AI. These innovations offer opportunities for creating immersive learning environments that enhance vocabulary acquisition outcomes (Alfadil, 2020). The research within this cluster spans both theoretical frameworks for DGBVL and practical applications in educational contexts. For example, Parmaxi and Demetriou (2020) explored the benefits of AR in mobile-based language learning, emphasizing its advantages for language acquisition. Similarly, Wu (2019) demonstrated the positive impact of the mobile AR game Pokémon Go on learners' motivation, learning satisfaction, and learning outcomes in L2 acquisition.

Cluster #4: QR Codes

Cluster #4 comprises 32 publications, with an average publication year of 2009 and a silhouette value of 1, indicating a high degree of homogeneity among its members. This cluster focuses on creating immersive and interactive learning environments tailored to diverse learning styles and preferences. Key themes include vocabulary retention, computer-assisted learning, Web 2.0 interactivity, and edutainment. By leveraging the rapid accessibility of QR code technology, the capabilities of computer-assisted learning tools, the interactivity of Web 2.0 platforms, and the entertainment aspects of edutainment, this approach aims to enhance vocabulary acquisition and retention (Chen, 2021). It achieves these outcomes through the use of visual aids, interactive exercises, personalized learning experiences, and engaging elements designed to sustain learner motivation and foster effective learning.

Cluster #5: Massive Multiple Online Role-Playing Games

Cluster #5 includes 29 articles, with an average publication year of 2012 and a silhouette value of 0.971, reflecting a high degree of homogeneity. Researchers in this cluster have shown significant interest in exploring the use of MMORPGs to enhance vocabulary acquisition. As a genre, MMORPGs offer opportunities for social interaction, collaboration, and skill development, alongside vocabulary learning. This cluster delves into the intersection of topics such as educational data mining, behavioral mechanisms, and virtual worlds. Educational data mining techniques are employed to analyze learners' performance and behavior within these games, providing valuable insights into how they engage with game elements. Understanding behavioral mechanisms helps inform game design by incorporating incentive systems, optimizing vocabulary learning strategies, and improving learner motivation and engagement (Rahimi et al., 2021).

Cluster #6: Serious Game

Cluster #6 has a silhouette value of 0.946 and comprises 27 articles, with an average publication year of 2018. The primary themes explored in this cluster include heuristic evaluation, requirement elicitation, and think-aloud protocols in the context of DGBVL. This cluster investigates the effectiveness of serious or educational games in enhancing vocabulary acquisition and proficiency (Kara, 2022). It emphasizes the use of user experience evaluation techniques, stakeholder needs assessment, and cognitive strategies to optimize DGBVL practices. The overarching objective is to design engaging and effective games that improve learners' vocabulary retention and foster sustained learning outcomes.

Cluster #7: Blended Learning

Cluster #7 has a silhouette value of 0.909 and comprises 42 articles, with an average publication year of 2019. This cluster focuses on learning modes and platforms within the context of DGBVL. Researchers in this cluster have demonstrated an interest in enhancing learning engagement by integrating mobile technologies with blended learning strategies. These approaches aim to combine the flexibility and accessibility of mobile technologies with the structured elements of traditional and DGBL environments to optimize vocabulary acquisition and learner engagement.

In summary, research on DGBVL has experienced significant growth over time, encompassing a broadening range of topics and an increasing emphasis on integrating advanced technologies into vocabulary learning. This evolution highlights a shift toward more interactive and engaging learning methodologies that capitalize on the potential of cutting-edge technological innovations.

DISCUSSION

This study analyzed 364 studies published between 2008 and 2023 to provide a comprehensive overview of DGBVL research using bibliometric methods. Descriptive and co-citation analyses were conducted to examine the annual progression of publications, and their distribution across various countries, regions, and institutions, as well as to identify key research focal points and evolutionary trends within the field. These findings contribute valuable insights, enhancing researchers' understanding of the current status and emerging trends in DGBVL research.

The trend analysis of publications reveals a sustained increase in DGBVL research, affirming its position as a promising and evolving field, consistent with the findings of Zou et al. (2019). With the continued advancement of cutting-edge technologies, such as AI, research interest in this domain is anticipated to expand further in the coming years. The analysis of publication sources reveals regional disparities in DGBVL research, with the majority of studies originating from Asia, a trend consistent with Acquah and Katz (2020). This dominance may be attributed to Asia's leading position and significant advancements in educational technology, supported by extensive experience in the field (Bedenlier et al., 2020). Additionally, regional differences in publishing cultures and the incentives or pressures associated with academic publication contribute to this variation. Many Asian countries and regions invest heavily in related research, resulting in the widespread application and study of digital games as an innovative learning tool and technology. However, it is essential to emphasize the need for more non-Asian studies in this area. Expanding research beyond Asia can provide a more comprehensive understanding of the effectiveness of DGBVL across diverse educational contexts and regions.

The co-citation analysis revealed a stable research topic structure within the field of DGBVL. The findings indicate that the effectiveness of DGBVL continues to receive sustained attention and remains a prominent and relevant topic in current research. The sustained academic interest in DGBVL can be attributed to its innovative integration of technology and gamification within language education, offering engaging and immersive learning experiences. While the focus on its positive effects remains prominent, the acknowledgment of potential challenges, such as increased English learning anxiety (Chen & Lee, 2018; Yang et al., 2020), continues to drive scholarly discussions and further investigations in the field.

Integrating a robust theoretical foundation is crucial for understanding the complex mechanisms underlying the effectiveness of DGBVL and for guiding the development and application of these educational tools (Guan et al., 2022). The findings highlight two influential theories—flow theory and the contextual learning approach—as pivotal frameworks in this field. Flow theory provides valuable insights into designing optimal learning experiences that balance challenge and skill levels, fostering learner engagement and intrinsic motivation (Li et al., 2019). In contrast, the contextual learning approach emphasizes embedding learning within meaningful and authentic contexts, facilitating deeper comprehension and the transfer of knowledge throughout the gaming process (Lin et al., 2020).

From a practical perspective, these theories offer significant implications for teaching. Educators can leverage flow theory to design DGBVL activities that maintain an equilibrium between challenge and skill, enabling students to achieve a state of flow that maximizes engagement and learning outcomes. Additionally, by grounding vocabulary learning in authentic contexts, as suggested by the contextual learning approach, teachers can enhance understanding and promote the transfer of knowledge to real-life scenarios (Bilgin & Tokel, 2018).

In the current educational landscape, the learning environment—encompassing both classroom and extramural learning—has become a prevalent research theme. The findings indicate that blended learning has emerged as a significant research focus in recent years. This shift may be attributed, in part, to the profound impact of the COVID-19 pandemic. Blended learning, which combines traditional face-to-face instruction with digital tools and resources, has demonstrated its potential to enhance the flexibility and adaptability of educational delivery (Wang et al., 2019). This approach not only accommodates diverse learning styles but also addresses the needs of learners across both physical and virtual learning environments.

The adoption of digital games holds significant potential as an educational tool for enriching learning experiences and fostering engagement, particularly in distance learning environments (Kazu & Kuvvetli, 2023). Educators are encouraged to integrate digital games into their teaching practices to enhance the effectiveness and appeal of language learning activities. By leveraging the interactive and dynamic nature of digital games, educators can design immersive learning experiences that capture learners' interest and encourage active participation in language acquisition (Tao & Zou, 2021). The engaging presentation of vocabulary in DGBVL provides learners with opportunities to develop language skills in an interactive and immersive environment (Wu, 2018). Additionally, real-time feedback mechanisms and progress-tracking features within digital games allow educators to monitor student performance effectively and offer targeted support as needed (Li et al., 2022; Wu et al., 2024).

The research landscape in DGBVL has prominently highlighted MMORPGs and serious games as primary areas of interest. The findings reflect a significant focus on MMORPGs from 2010 to 2016, mirroring the prevailing research trends during that period. In contrast, serious games have gained prominence from 2014 to 2022, marking a shift towards more pedagogically oriented gaming experiences. This transition may be attributed to the evolving game industry, where new types of games, such as simulation and serious games, continue to emerge (Zou et al., 2019). Furthermore, the mixed results reported in MMORPG research (Jabbari & Peterson, 2023) may have encouraged researchers to explore serious games as a more focused alternative for educational purposes. The dynamic research focus on MMORPGs and serious games underscores the evolving nature of educational game design and implementation. It also highlights the importance of critically assessing the effectiveness and educational value of digital games within learning environments. Understanding these shifting research trends provides valuable insights for educators aiming to integrate DGBVL into their teaching practices (Sundqvist, 2019). Educators are encouraged to evaluate the suitability of various game types based on their specific learning objectives and students' needs, ensuring that digital games align effectively with pedagogical goals.

From a technological perspective, current research is at the forefront of investigating cutting-edge advancements such as VR, AR, MR, and AI within Cluster #3. These emerging technologies are transforming the landscape of DGBVL, creating a new realm of educational gaming brimming with potential (Wu et al., 2024). This trend is driven by a pursuit of enhanced gaming experiences and improved linguistic learning outcomes, as exemplified by the recent special issue titled *Digital Gameplay and XR Learning: Affordances, Frameworks, and Effectiveness in Computers & Education: X Reality*. These advancements are paving the way for immersive and interactive educational experiences that hold promise for the future of language learning.

Immersive technologies such as VR, AR, and MR allow the replication of specific scenarios, providing learners with immersive experiences in real-world language practices within rich and meaningful environments (Hung & Yeh, 2023). These technologies present complex vocabulary

and concepts in engaging formats, facilitating effective vocabulary acquisition while enriching the overall learning experience (Lai & Chen, 2021; Lee & Wu, 2024). For example, AR integrates virtual concepts into real-world settings using three-dimensional objects or animations, enabling learners to visualize abstract ideas tangibly (Zhang et al., 2020). Similarly, VR immerses learners in content-rich virtual environments, offering opportunities for deep engagement and practice in authentic contexts (Wu et al., 2023).

Furthermore, AR and VR offer significant potential for enhancing learning environments and expanding learning spaces, while AI introduces a new dimension to personalized virtual interactions (Godwin-Jones, 2023). Advances in natural language processing (NLP) have opened new avenues for supporting interactions with non-playing characters and enriching interactive storytelling. For instance, Riot Games has effectively utilized NLP-trained models to identify and mitigate undesirable behavior in player chat channels, demonstrating the practical application of these technologies in fostering positive interaction within digital environments (Maher, 2016).

The integration of modern technologies provides educators with powerful tools to innovate their pedagogical strategies. By incorporating emerging technologies such as VR and AI into educational settings, teachers can personalize instruction to enhance students' vocabulary acquisition (Chen & Yuan, 2023; Zhang et al., 2024). This tailored approach not only fosters greater student engagement but also improves the overall effectiveness of teaching practices (Shih, 2020). Educators who develop expertise in these technologies and seamlessly integrate them into their teaching can design dynamic learning experiences that cater to diverse learning preferences. This empowers students with the skills needed to thrive in an increasingly interconnected and rapidly evolving global society.

CONCLUSION

Over the past decades, DGBVL has garnered sustained attention from numerous researchers. This study provides scholars and educators with a comprehensive overview of the trends and topics within DGBVL research. By analyzing 364 studies published between 2008 and 2023 through bibliometric methods, this research contributes to the expansion of existing DGBVL studies and identifies emerging areas of interest. The findings offer valuable pedagogical implications, enabling researchers and educators to deepen their understanding of the current state-of-the-art and future directions in the field. By highlighting key trends and innovative approaches, this study supports the continued development and integration of DGBVL in educational practices.

This study has certain limitations. First, the data collection was limited to the Web of Science Core Database and Scopus, which may have excluded valuable research from other databases. To address this limitation, future studies should consider incorporating a broader range of data sources to ensure a more comprehensive analysis. Second, despite rigorous efforts to select appropriate keywords, there remains the possibility that some relevant articles were overlooked. Lastly, automated search processes may have introduced potential errors in the results.

Despite these limitations, this review offers a detailed and comprehensive analysis of research trends and topics in DGBVL through 2023. The findings provide valuable insights for scholars, facilitating the expansion of existing studies and inspiring the exploration of innovative and relevant areas that merit further investigation.

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