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Research Trends of Digital Game-based Learning for Technical Vocabulary Acquisition: A Systematic Decennial Literature Review (2014-2024)

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Abstract
The approach of digital game-based learning has gained prominence as an effective strategy for technical vocabulary acquisition in foreign language education. But its acquisition presents persistent challenges due to its specificity, contextual dependence, and limited exposure in general language input. In response, this systematic review investigates how digital game-based learning has been utilized to support technical vocabulary acquisition in foreign language education. The study explores trends in this field by examining the evolution of research from 2010 to 2024, the types of digital games employed, the technical domains targeted, the learner variables and outcomes investigated, and the gaps and emerging directions in existing literature. Following the PRISMA framework, 17 empirical studies were selected and analyzed. Findings reveal a marked increase in research since 2020, with most studies reporting positive effects on vocabulary performance, learner motivation, and attitudes. The reviewed literature highlights the effectiveness of game-based approaches, particularly in higher education contexts and English for specific purposes. However, notable limitations persist, including the dominance of English-language settings, a narrow focus on certain technical fields, small sample sizes, and a lack of longitudinal designs. This review underscores the pedagogical potential of integrating game-based learning into technical vocabulary instruction and calls for more theory-driven, diversified, and context-sensitive research. Future studies are encouraged to explore how game design features interact with cognitive and motivational learner variables and to expand the application of such approaches across varied languages, disciplines, and educational settings.

Keywords: Digital game-based learning, foreign language education, foreign language for specific purposes, systematic review, technical vocabulary

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Introduction

Technical vocabulary refers to the lexical terms that are predominantly used in professional texts or specific disciplinary fields, while remaining rare or entirely absent in general contexts (Chung & Nation, 2003). These terms are essential in Foreign Language for Specific Purposes (FLSP) contexts, where learners must comprehend and produce professional materials (Le & Miller, 2023). However, acquiring such vocabulary is challenging due to its low frequency, high specificity, and limited contextual exposure (Ardasheva & Tretter, 2017). To address this issue, Digital Game-Based Learning (DGBL) has emerged as a promising instructional approach. Serious games, games designed explicitly for educational purposes, offer immersive, interactive, and repeatable learning environments (Plass et al., 2020). Unlike commercial games that are adapted for learning, serious games are purposefully aligned with instructional goals and assessment criteria (Soyoof et al., 2024). Studies have shown that DGBL can increase learners' motivation, create rich contextual input, and support long-term vocabulary retention (e.g., Abdullah Alhebshi & Gamlo, 2022; Ali & Ghazali, 2016; Bendebbache & Azeroual, 2022). These effects can be interpreted through Self-Determination Theory, which emphasizes the role of autonomy and competence in sustaining engagement (Ryan et al., 2006). Additionally, the multimodal nature of games, including visual, auditory and textual input, can reduce extraneous cognitive load and promote dual coding, as proposed by Cognitive Load Theory (Frumuselu, 2018; Sweller, 1994).

DGBL has been successfully applied across multiple disciplines and language skills, including reading (Babaie, 2022), listening (Moniza Ray & Ajit, 2024), speaking (Pratiwi et al., 2024), and grammar (Castillo-Cuesta, 2020). Vocabulary learning, in particular, has been a common focus due to its incremental nature and need for repeated exposure (Schmitt & Schmitt, 2020). However, most studies focus on general vocabulary. Despite the growing importance of technical vocabulary in FLSP, few studies have systematically examined how DGBL can support its acquisition (Alharbi, 2023; Gómez-Ortiz et al., 2023; Shi et al., 2024).

To clarify how Digital Game-Based Vocabulary Learning (DGBVL) fits within the broader scholarly landscape, Figure One presents a conceptual model adapted from Hung et al. (2018), showing the relationship between DGBL, Digital Game-Based Language Learning (DGBLL), and general Game-Based Learning (GBL). This structure informs the scope and orientation of this review.

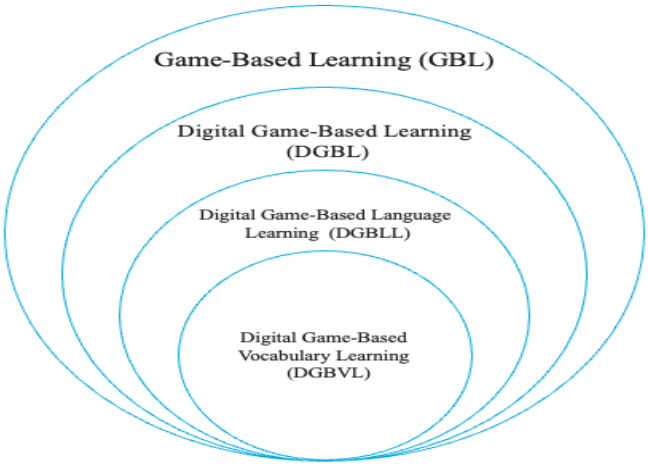


Figure 1. DGBVL and its relations to other research contexts (adapted from p. 92)

The aim of this study is to conduct a systematic review of empirical research on DGBL for technical vocabulary acquisition in foreign language contexts. The literature review synthesizes existing evidence, identifies dominant patterns and underexplored areas, and informs future research as well as practice. This review is significant in addressing the fragmented understanding of how DGBL supports technical vocabulary learning and in guiding the development of theory-informed, context-sensitive interventions in FLSP education.

Specifically, this study is guided by the following research questions:

(1) What are the trends in the application of DGBL for technical vocabulary acquisition from 2010 to 2024?
(2) What types of digital games have been used for technical vocabulary acquisition?
(3) In which technical fields has DGBL been applied to assist students in acquiring technical vocabulary?
(4) What variables have been considered in DGBL research on technical vocabulary acquisition, and what are the associated research outcomes?
(5) What are the research gaps and emerging trends in this field?

Literature review

Technical vocabulary

The definition of technical vocabulary remains imprecise in many existing studies, with the terms "technical vocabulary", "specialized vocabulary", and "academic vocabulary" often being used interchangeably. For instance, in their empirical studies, some researchers (Jia et al., 2023; Yi-ju et al., 2020) have referred to it as academic vocabulary in their empirical studies, while some others have categorized it as specialized vocabulary (Ali & Muhammad, 2019), professional vocabulary (Mustaeva et al., 2022) and discipline-specific vocabulary (Kohnke & Ting, 2021). Despite terminological variations, researchers generally agree that technical vocabulary occupies a substantial proportion of professional discourse, with coverage rates often exceeding 30%, demonstrating its central role in comprehending specialized content (e.g., Drayton & Coxhead, 2023; Lei & Liu, 2016).

Nation (2001) provided a more systematic classification of vocabulary based on its usage, dividing it into four categories: high-frequency vocabulary, low-frequency vocabulary, academic vocabulary, and technical vocabulary. High-frequency vocabulary refers to words that appear regularly in various texts and daily conversations. These are typically taught in English classes of general schools. Academic vocabulary, on the other hand, consists of words widely used across different disciplines but with limited occurrences in non-academic contexts (Beck et al., 2013; Othman, 2024). Technical vocabulary, in contrast, is tightly linked to specific disciplines and conveys specialized knowledge, as it often includes both subject-specific uses of general words and entirely field-exclusive terms (Chung & Nation, 2004; Liu & Lei, 2019). For example, the term "pilot" from high-frequency word lists generally refers to a person who operates the flying controls of an aircraft. However, in an academic context, it denotes a preliminary test or study conducted before a larger-scale study.

Unlike general or academic vocabulary, technical terms usually require deeper contextualization for proper understanding and use. They tend to lack synonymic alternatives, present high domain dependence, and require precise comprehension to avoid miscommunication. This creates higher learning demands for foreign language learners in technical disciplines. Several researchers argue that foreign language learners need to understand at least 95% of the words in a

text to achieve adequate comprehension and 98% for full comprehension (Coxhead & Demecheleer, 2018; Hsueh-Chao & Nation, 2000). A study by Chung and Nation (2003) revealed that technical terms account for 31.2% of the vocabulary in anatomy texts. The research of Lei and Liu (2016) found that technical vocabulary in medical profession (including high-frequency words with specialized medical meanings and low-frequency technical medical terms) constitutes 31.75% of tokens in a medical research article corpus and 30.44% in a medical textbook corpus. Similarly, Drayton and Coxhead (2023) reviewed several related studies and concluded that technical terms are used less frequently in spoken language than in written language with written language coverage around also 30%. The coverage rates are summarized in the Table One:

Table 1. *Coverage of Technical vocabulary in spoken and written corpora*

Technical Vocabulary List	Spoken Corpus	Written Corpus
Carpentry	10.69%	38.35%
Plumbing	11.59%	34.48%
Fabrication	9.18%	30.47%
Automotive	12.75%	37.44%

Note 1. Adopted from (Drayton & Coxhead, 2023, p. 54)

It is evident through these previous studies that technical articles typically contain around 30% technical terms, making these terms essential for understanding the content (Woodward-Kron, 2008). Therefore, general foreign language proficiency is insufficient for effective technical communication (Drayton & Coxhead, 2023).

The importance of technical vocabulary in language for specific purposes

Many researchers have consistently emphasized that vocabulary constitutes one of the most critical components of language acquisition since the lexical information plays a pivotal role in guiding learners toward accurate syntactic structures (e.g., Calvo-Ferrer, 2021; Teng et al., 2024). As some other researchers have asserted (e.g., Hestiana & Anita, 2022; Javis, 1998), without vocabulary, there is no meaning. Furthermore, research has shown a positive correlation between vocabulary size and learners' proficiency in oral and written communication, as well as their listening and reading comprehension (Aravind & Rajasekaran, 2021; Bulut & Yıldız, 2024), since vocabulary errors are often a source of misunderstandings which can disrupt the fluency of communication (Lin & Qian, 2019; Simonnet et al., 2025). Rivers (1983) argued that in the context of basic communicative competence, the acquisition of meaning relies more on vocabulary than on grammar. Empirical evidence suggests that learners are more prone to making vocabulary errors than grammatical ones (Song, 2018; Teng et al., 2024). All other factors being equal, learners with larger vocabularies demonstrate superior proficiency in a wider range of language skills compared to those with smaller vocabulary (Stewart et al., 2021). Moreover, encountering unfamiliar and novel vocabulary items poses a significant challenge in foreign language learning (Banu et al., 2025; Boyinbode, 2018), particularly when reading scientific or technical texts.

Binon and Verlinde (2003) emphasize that, regardless of the method or approach we adopt or prefer, vocabulary remains a key component that permeates the entire field, which is especially unique and indispensable in the context of FLSP. Although specialized vocabulary may not constitute the core content of FLSP, understanding such vocabulary is crucial, as it directly influences students' comprehension and production of academic texts. Technical vocabulary extends beyond being "simple words" as it embodies concepts and ideas unique to specific

disciplines (Barcroft, 2018). It also serves as a linguistic tool essential for articulating key practices within these fields (Chung & Nation, 2003).

The challenges in acquiring technical vocabulary

The acquisition of technical vocabulary poses a significant challenge for students across all academic subjects (Shi et al., 2024; Wright & Peltier, 2016). One of the primary reasons is that most language learners perceive learning new words as a monotonous and passive activity that requires deliberate attention to subtle nuances of meaning, which diminishes their interest in and the effectiveness of foreign language acquisition (Wu, 2018). This challenge is particularly pronounced when learners engage with scientific texts, where they often struggle with word recognition and reading fluency (Kaldenberg et al., 2015), since these texts require them to simultaneously process complex scientific concepts and unfamiliar language. These terms are specific to the subject and are characterized by a large number of abstract concepts as well as domain-specific meaning that may differ significantly from their usage in daily contexts (Carrier, 2013; Kamaşak et al., 2021). This cognitive overload can hinder students' ability to fully comprehend both the scientific content and language nuances (Castellano-Risco et al., 2020), thereby making the acquisition of technical vocabulary increasingly difficult and tedious. The second challenge lies in the limited teaching time in class with the result of insufficient opportunities for repetition, which is an essential factor for effective vocabulary retention. Without regular review and repeated practice, newly acquired vocabulary tends to gradually fade from memory (Zou et al., 2021). The third challenge in acquiring technical vocabulary for learners is the rapid emergence of new terms driven by advancements in various fields and technologies, which necessitates their ongoing efforts to learn and adapt to newly introduced terms (Liu & Lei, 2019).

From the perspective of language teacher, teaching technical vocabulary has also presented considerable challenges. First, many teachers of foreign languages usually lack a thorough comprehension of the specialized disciplines, which makes it difficult for them to provide relevant contexts that help learners understand the meanings and usage of technical terms (Shi et al., 2024). Second, technical vocabulary in professional fields can be highly specialized and complex, making it challenging for teachers to simplify and explain these concepts effectively to learners who are nor familiar with the subject matter (Miroshnychenko, 2024). Third, teachers often face the challenge of identifying appropriate resources to support the effective teaching of these terms, such as specialized textbooks, multimedia materials, or industry-specific content (Miroshnychenko, 2024). This issue is particularly critical given the rapid development of specialized fields, which makes it difficult to access resources that reflect the latest developments and trends. Finally, the limited time available in the curriculum presents another major obstacle for language educators (Huei et al., 2021). Balancing the teaching of technical vocabulary with other language skills, such as grammar, speaking, listening, and writing, within a constrained timeframe is a formidable task. Therefore, finding engaging and effective methods for teaching technical vocabulary has become a pressing necessity. These challenges, both from the perspective of learners and teachers, constitute the primary obstacles to the acquisition of technical vocabulary.

Trends of DGBL in vocabulary acquisition

As a crucial component of second language acquisition, vocabulary learning has been significantly influenced by the emergence of new technologies. Technological activities can

enhance the motivation of second language learners, offering increased exposure to the target language through oral and multimedia formats, as well as providing learners with more opportunities to engage with the target language using various technological tools (Al-Rashidi, 2025; Hao et al., 2021). Compared to traditional methods, the use of computer-assisted strategies, such as digital games, often has a positive impact on second language vocabulary acquisition. To enhance effective vocabulary acquisition through computer-assisted methods, educational researchers have employed a strategy known as DGBVL, which involves learning vocabulary through serious games (Chen et al., 2018; Othman, 2024). The DGBVL approach integrates gamified elements, such as competitive rules, rewards, feedback, and scoring, into vocabulary learning. This approach aims to improve both short-term and long-term vocabulary acquisition outcomes (Buil et al., 2018), thereby increasing motivation, academic performance, and engagement, while reducing anxiety, fostering satisfaction and autonomy, as well as encouraging learner interaction (Zou et al., 2021). Chang and Chang (2023) reviewed experimental studies on DGBL in foreign language vocabulary acquisition conducted between 2008 and 2020. As illustrated in Figure Two, the annual number of publications steadily increased during this period, with an average annual growth of 23.83%, and this is consistent with the finds of Zou et al. (2021). Based on a follow-up search in the Scopus database using the same searching keywords as those employed by Chang and Chang (2023), it revealed that the number of publications in 2021, 2022, 2023 and 2024 reached 28, 20, 33 and 34, respectively. This indicates a slight but consistent growth compared to the year before 2020.

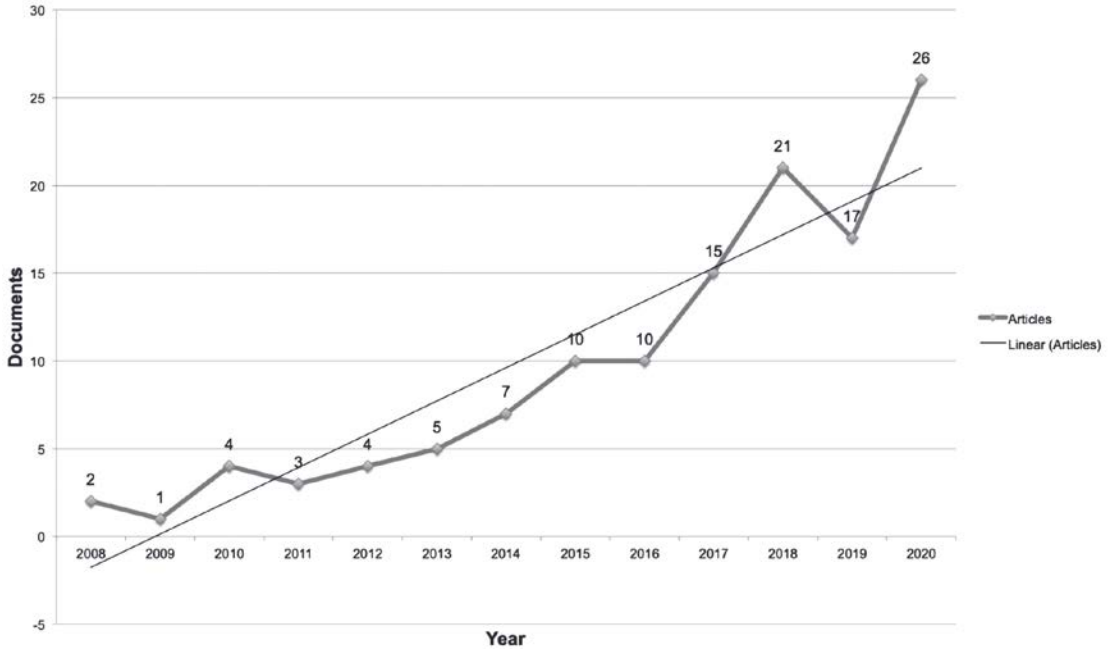


Figure 2. Annual scientific publications of DGBL in vocabulary acquisition (Chang & Chang, 2023, p. 11)

The study of Alfehaid (2019) on online vocabulary games revealed that 97% of teachers strongly agreed on the benefits of online games for vocabulary learning. According to a psychological analysis based on semi-structured interviews conducted by Fu et al. (2021) with 55 Chinese university students, 62% of participants reported that the DGBVL approach provided an enjoyable learning experience, enhanced their sense of autonomy, and further encouraged consistent and regular vocabulary learning behaviors. Additionally, the positive feedback

mechanisms within games minimized the negative impact of making mistakes, enabling learners to approach errors in a more constructive manner within a virtual environment, as well as allowing them to explore diverse learning paths and problem-solving strategies without experiencing the anxiety often associated with mistakes in traditional classroom settings (Vnucko & Klimova, 2023). Such learning activities, by fostering positive emotions in learners, can subsequently improve memory and support the retention of vocabulary. In a comprehensive review, Rasti-Behbahani (2021) identified seven recurring features that contribute to the effectiveness of DGBVL: high motivation, repeated exposure, timely feedback, immersive virtual environments, dual coding through multimodal input, interactivity, and learner control. These features align well with the cognitive and emotional needs of learners, particularly in vocabulary learning contexts that demand sustained engagement and contextualized practice.

Furthermore, numerous empirical studies have demonstrated the effectiveness and benefits of games in supporting vocabulary acquisition. In an empirical study involving 54 Spanish students, Calvo-Ferrer and Belda-Medina (2021) demonstrated that the intentional input provided by DGBVL methods significantly enhances vocabulary retention and facilitates incidental vocabulary acquisition. The researchers also highlighted the critical role of vocabulary repetition and contextual application within digital learning environments as key factors contributing to these outcomes. Similarly, Chen and Hsu (2020) conducted a study involving 66 non-English major students at a university in Taiwan, revealing that serious games are an effective tool for acquiring vocabulary and academic content. Their findings also demonstrated that the effectiveness of vocabulary learning is primarily attributed to repeated exposure to target vocabulary and the immersive nature of the game environment. Roohani and Vincheh (2023) investigated the effectiveness of various teaching strategies for phrasal verbs, including digital games, social media platforms (e.g., Telegram), and traditional classroom settings with 150 English learners from a language institute, demonstrating that all three methods enhanced learners' vocabulary acquisition, with the GBL approach having the most significant impact. Karimi and Nasouri (2024) designed a digital text-based game tailored for students at a private language institute in Iran. Their experimental study demonstrated that this innovative approach not only enhanced learner engagement and participation but also promoted a deeper state of flow, a psychological condition characterized by focused immersion and enjoyment in the task. Chowdhury et al. (2024) conducted an empirical investigation involving 13 Bangladeshi elementary students who utilized the Scratch programming platform to create their own games as a means of facilitating incidental vocabulary acquisition. The results emphasized the potential of DGBL environments to foster a low-anxiety, enjoyable learning atmosphere, which in turn enhanced leaners' intrinsic motivation and supported meaningful vocabulary development. The studies highlighted here represent only a small selection of the existing body of research. A comprehensive review of the current literature reveals that, based on various types of games, this approach exerts significant and multifaceted impacts on learners' subjective psychological states, such as engagement, motivation, and flow, as well as on objective dimensions as the academic performance. These effects have been consistently observed among students across diverse age groups, nationalities, and academic disciplines, underscoring the versatility and broad applicability of this instructional approach.

While innovative technologies have been widely applied in the teaching and learning of general vocabulary, technical vocabulary instruction still relies heavily on traditional pedagogical techniques. For example, Gaffas (2024) investigated the use of vocabulary notebooks for learning medical terminology, indicating that students who utilized vocabulary notebooks showed

significant advantages in long-term vocabulary retention compared to those who did not receive intervention. Some empirical studies (e.g., Xodabande et al., 2024; Yüksel et al., 2020) demonstrated that flashcards are more effective than traditional vocabulary lists in enhancing the flexibility of learning technical vocabulary anytime and anywhere, while significantly improving students' learning outcomes. Del Moral et al. (2024) incorporated group role-playing activities into traditional health science classrooms to teach medical terminology with the results that this approach significantly increased students' engagement and improved their vocabulary acquisition. Moreover, some researchers have integrated some other approaches such as metaverse-based flipped classrooms (Celik & Baturay, 2024), video-based lectures (Shi et al., 2024) into traditional classrooms to assist students in learning technical vocabulary. These studies indicate that the teaching and learning of technical vocabulary have gradually gained attention from both educators and researchers. However, the integration of advanced technologies such as DGBL, artificial intelligence, and adaptive learning systems into technical vocabulary instruction remains insufficiently explored. Given the proven effectiveness of these emerging technologies in general vocabulary acquisition, researchers argue that DGBL is particularly effective for teaching complex systems, such as scientific or social issues, by employing a "situated cognition" approach. This method could place learners in immersive environments that require the application of specific knowledge and skills to solve problems and achieve objectives on one hand; on another hand, it fosters exploration and experimentation within a safe and interactive settings for leaners (Pitarch, 2024). Moreover, some online games offer adaptive mechanisms that dynamically adjust the difficulty of language content based on learners' proficiency levels, thereby enabling personalized and self-paced progression and enhancing the overall impact of DGBL as a versatile and transformative pedagogical tool (Plass et al., 2015).

Despite growing interest in the application of DGBL for technical vocabulary acquisition and calls for synthesizing existing academic findings to advance this field, no comprehensive review has yet been conducted to consolidate the available evidence and analyze its implications. In particular, there is a lack of systematic understanding regarding the types of digital games employed for technical vocabulary instruction, the specific learner groups and disciplinary domains targeted, and the range of learning outcomes observed. Moreover, the connections between game design elements and learner variables, such as motivation, anxiety, and cognitive engagement, remain underexplored in the context of technical vocabulary learning. To address this gap, the present study aims to systematically review empirical research on the application of DGBVL in the technical aspect, providing an overview of the development of this research topic, the types of games employed, and the learner groups that can benefit from this approach.

Methodology

In this section, based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines, the specific review methods, including the search strategy, inclusion criteria, and exclusion criteria, will be discussed in detail to facilitate the achievement of the research objectives.

Identification

This study follows the PRISMA 2020 checklist (Figure Three) to guide the data retrieval and literature screening process, ensuring the quality of the systematic review (Page et al., 2021). The literature search spans from 2014 to December 2024 and utilizes six databases: Web of

Science (WoS), Scopus, ScienceDirect, Google Scholar, Springer, and Taylor & Francis. The initial search was conducted across five databases, excluding Google Scholar, by using the keywords "digital game-based learning" OR "game-based learning" OR "video game" OR "serious game" OR "educational game" OR "digital game" AND "technical vocabulary" OR "specialized vocabulary" OR "academic vocabulary" OR "professional vocabulary" OR "terminology". This search resulted in the identification of 284 publications. To ensure comprehensive coverage, a manual search by applying the similar keywords was carried out on Google Scholar, targeting publications not indexed in the other databases. This process generated an additional seven publications. In total, 291 publications were initially identified. Following a thorough duplicate screening process, nine duplicated articles were removed. Consequently, 282 unique publications for subsequent analyses.

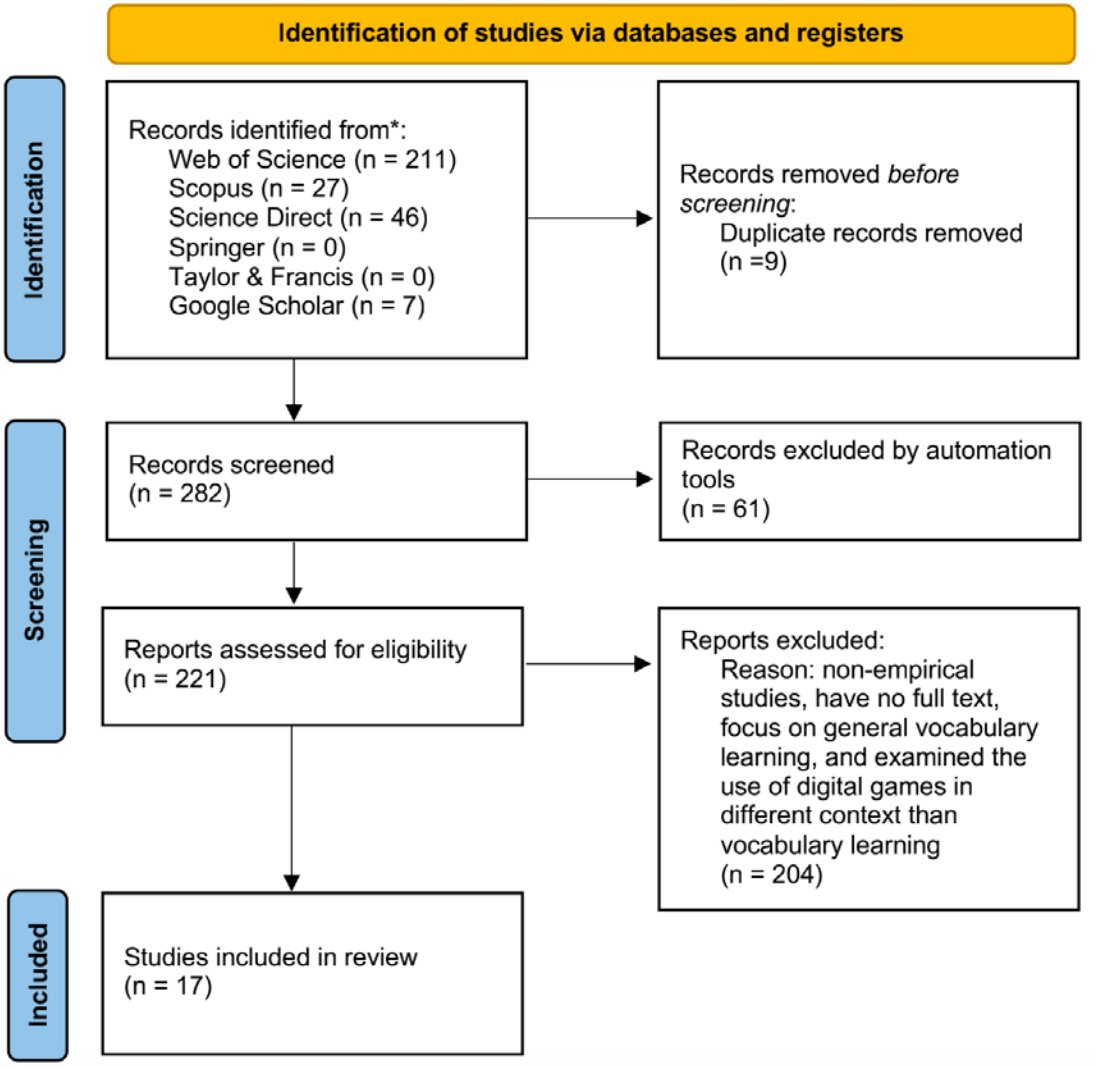


Figure 3. PRISMA flow diagram for screening and selecting studies

Screening and eligibility criteria

The screening phase aims to exclude publications that are not relevant to the objectives of this study. This process relies largely on automated filtering tools provided by the databases,

applying specific criteria such as publication year, type of publications, and language of the text (as outlined in Table 2). Although the concept of DGBL was first coined by Prensky in 2001, the current study focuses on analyzing research from the past decade (2014-2024) to account for the rapid advancements in educational technology. Notably, a review of earlier studies revealed that the volume of relevant research on DGBVL before 2014 was minimal (Vnucko & Klimova, 2023). To ensure comprehensive coverage of the topic, the inclusion criteria were broadened to encompass a range of publication types, including peer-reviewed journal articles, conference papers, and book chapters, which need to exceed five pages in length. The writing language is restricted to English to maintain consistency and accessibility in the analysis. Following the automated screening process, 61 publications were excluded as they did not meet the predefined criteria. This step resulted in a total of 221 publications deemed eligible for further evaluation in the subsequent phase of final eligibility.

The final stage of the systematic review process is eligibility determination, which involves a manual evaluation of the remaining publications from the previous screening phase. At this stage, the full texts and the abstracts are carefully examined to ensure alignment with the precise focus of the study. The primary inclusion criteria for this phase (as detailed in Table Two) require that eligible publications must present empirical research on the application of DGBL in technical vocabulary acquisition. Furthermore, only studies with accessible full texts were included. Specifically, studies were removed if they: (1) did not focus particularly on technical vocabulary acquisition, (2) were not empirical study, or (3) did not employ DGBL as a learning approach. This systematic manual evaluation ensured that only studies directly contributing to the research objectives and aligned with the scope of the review remained. As a result, a total of 204 publications were excluded from the analysis, leaving 17 studies that met the eligibility criteria and were deemed suitable for further review.

Table 2. *Inclusion and exclusion criteria*

Stage	Methods	Criteria	Inclusion	Exclusion
Screening	Automatic tools	Timespan	2014-2024	< 2014
		Sources	Article, conference paper, book chapter (more than 5 pages)	Thesis, books, reviews
		Language	English	Non-English
Eligibility	Manual evaluation	Research objective	Technical vocabulary acquisition	Other types of vocabulary or language learning
		Type of study	Empirical study	Non-empirical study
		Learning approach	DGBL	Non-DGBL

Results

This section presents the findings of 17 empirical studies published between 2014 and 2024 that investigated the application of DGBL in technical vocabulary acquisition, as summarized in Appendix One. The analysis highlights key aspects of these studies, including the distribution of publications over time, the types of games employed, the variables examined, and the outcomes reported.

Trends of the integration of DGBL in technical vocabulary from 2014 to 2024

Based on the data presented in Appendix A, a figure was generated (Figure Four) illustrating the annual publication trends for studies on the application of DGBL in technical vocabulary acquisition from 2014 to 2024. The figure illustrates a slow developmental pace in this research area prior to 2020, with an average annual publication rate of only one paper. Notably, no publications were recorded in 2018, reflecting minimal study activity during this period. However, a marked increase is observed from 2021 to 2024, with the average annual publication rate rising to 2.5 studies, which is 2.5 times increase compared to the period before 2020. The year 2024 stands out with four publications, representing the peak in this timeline. This upward trend suggests a growing interest in the integration of DGBL into technical vocabulary acquisition.

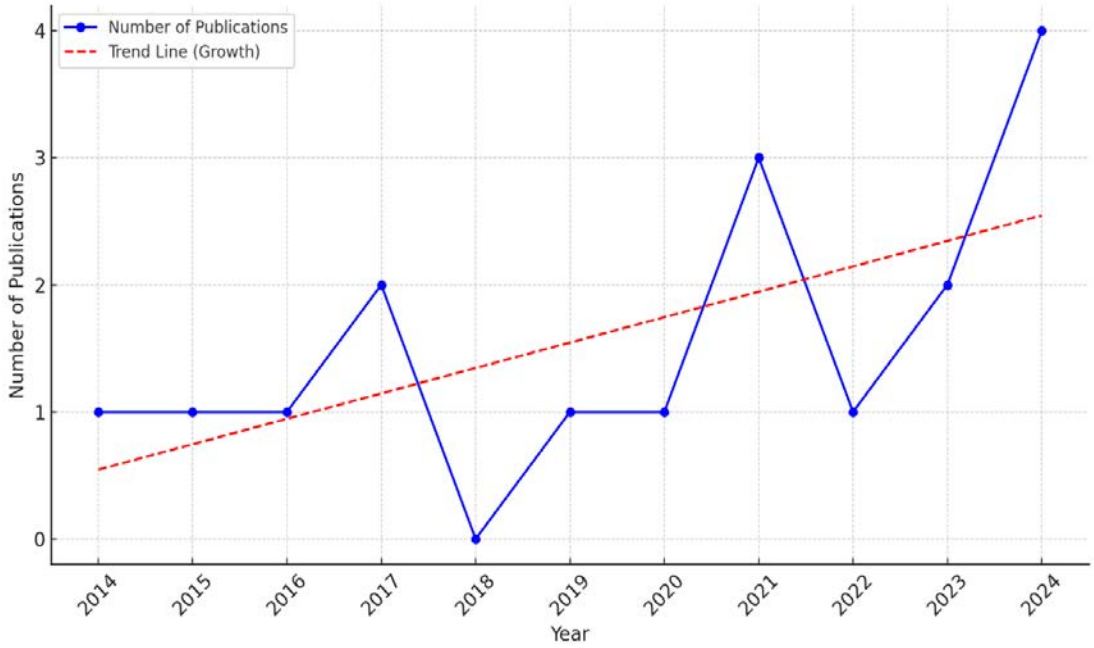


Figure 4. Annual scientific publications of DGBL in technical vocabulary acquisition

Compared to the application of DGBL in general vocabulary acquisition (as illustrated in Figure Five), it is evident that research on its application in technical vocabulary acquisition has lagged behind in terms of both growth rate and publication volume. The disparity demonstrates that the integration of DGBL into technical vocabulary learning has yet to achieve the same level of attention and implementation as its general vocabulary counterpart. However, starting from 2020, there has been an acceleration in research focused on the application of DGBL for both general and technical vocabulary acquisition. This progression highlights a growing recognition of the potential of DGBL approach to revolutionize language learning practices, driven by advancements in educational technology and gamified techniques, warranting further exploration and discussion.



Figure 5. Comparison of DGBL in technical and general vocabulary acquisition

Geographical distribution of publications

The geographical distribution of the 17 publications, as shown in Figure Six, is predominantly concentrated in Asia, Europe, and North America, reflecting significant regional differences in this research subject. Asia (N=12, 71%) emerges as the most active region, contributing the highest proportion of studies, followed by Europe (N=4, 24%). In North America, only the United States, has contributed to this field, with a single study (6%) published in 2015. Notably, China (N=5, 29%) stands out as the leading country in this field, producing the largest number of studies on the application of DGBL in technical vocabulary acquisition, followed by Malaysia (N=3, 18%). Turkey and Spain share the third position, each contributing two publications (12%). Other countries, including France, Ukraine, Kazakhstan, and Iran, have each produced a single study, matching the output of the United States. This distribution highlights a clear regional disparity, with Asia taking the current lead in advancing research on the employment of DGBL in technical vocabulary.

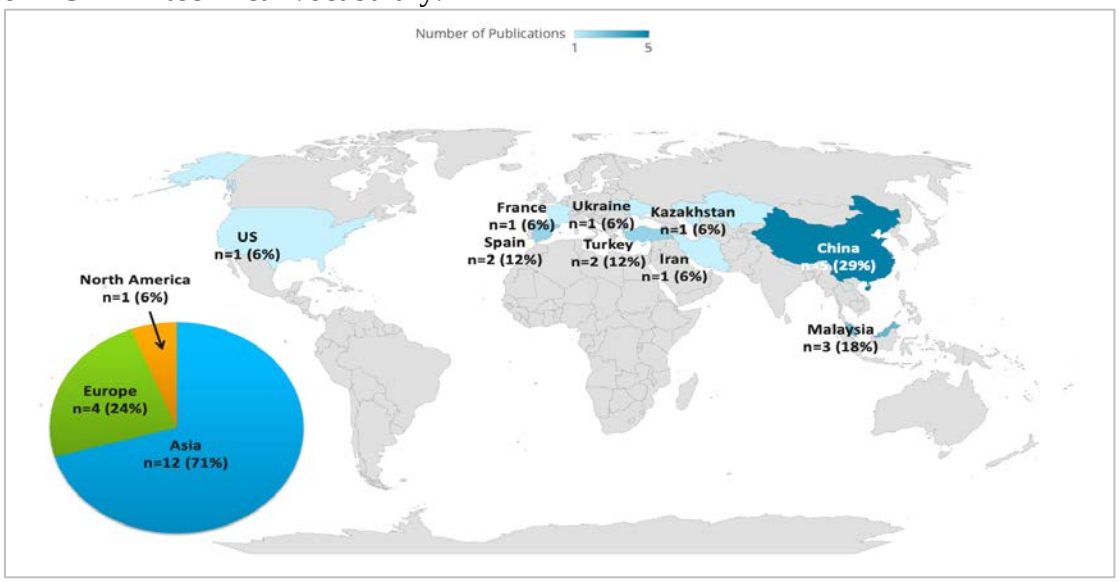


Figure 6. Geographical distribution of publications for DGBL in technical vocabulary acquisition

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Target languages and games techniques

Among the 17 studies examined, the primary target language, as in much other research on language acquisition, is predominantly English. Sixteen out of the total studies (94%) investigate the application of DGBL in English technical vocabulary acquisition. The only exception is a study conducted by Neville (2015), which explores the employment of DGBL in learning German technical vocabulary. This finding aligns with the conclusion of other researchers (e.g., Hwang et al., 2023; Xu et al., 2020) in their literature review on DGBLL, which also highlight English as the most popular target language in this domain. This imbalance underscores that the current focus on English reflects its global prominence as a lingua franca, but it also emphasizes the limited attention given to other languages.

The types of games employed in these empirical studies (as illustrated in Figure Seven) can be analyzed from two perspectives: whether the games were specifically designed, and the forms of the games employed. First of all, among the 17 studies analyzed, four utilized games specifically developed for particular target audiences and specialized technical vocabulary. In the study of Wu et al. (2020), the designed program was based on the Bingo game prototype to facilitate medical vocabulary learning by strengthening the mapping between word forms and meanings. This research incorporated multimedia elements such as music, visuals, pronunciation, and animations to enhance engagement and effectiveness. The research of Kohnke and Ting (2021) employed a vocabulary learning app developed by Hong Kong Polytechnic University, tailored for students across seven professional fields, including textiles and fashion, design, business, nursing, engineering, tourism, as well as hospitality management. The app featured four difficulty levels for each discipline, with each level comprising 15 items. It also applied an adaptive system to help students build personalized vocabulary banks by revisiting unfamiliar or incorrectly answered words. Another study by Kaldarova et al. (2023) introduced a developed 2D video game to help primary students acquire computer science terminology. Lastly, Jia et al. (2023) designed an AR game based on flashcard and matching exercises to teach key digestive system terms. In contrast, the remaining 13 studies relied on existing platforms or commercially available games, reflecting a predominant preference for readily accessible resources over custom-designed solutions.

Second, in terms of game forms, only Jia et al. (2023) employed a developed AR game as the learning platform for the experimental group, comparing its effectiveness with two control groups, one using the online Quizlet and the other utilizing physical flashcards with puzzles. In the other 16 studies, 7 incorporated video games spanning 2D (Lu & Chang, 2016), 3D (Pitarch, 2024), and Kinect-based (Urun et al., 2017) forms, while 9 employed specialized vocabulary games, such as Quizlet (Bakhmat & Chaikovska, 2021) and Kahoot! (García-Pinar, 2024), as well as other tools like chatbots (Hsu & Chen, 2024). This demonstrates that, despite the relatively small number of studies on DGBL in technical vocabulary acquisition, the types of games applied are comparatively diverse.

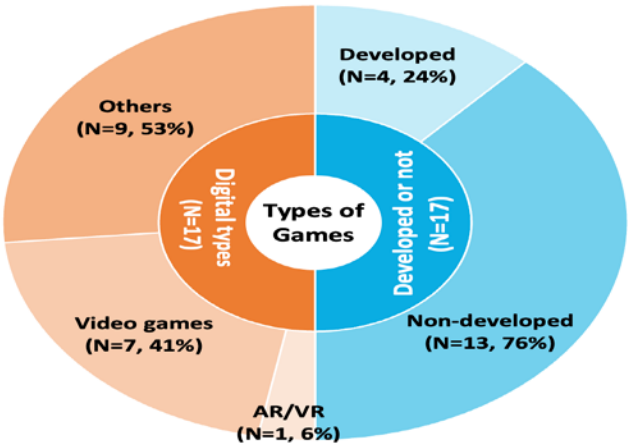


Figure 7. The types of games employed in reviewed studies

The game mechanics employed across the reviewed studies can be broadly categorized into five types: competitive, exploratory, collaborative, adaptive/self-paced, and feedback-based. Competitive games, such as matching or puzzle-based games (e.g., Jia et al., 2023; Chen et al., 2020), were often associated with enhanced motivation and improved retention. Exploratory mechanics, as found in 3D and narrative-driven games (e.g., Pitarch, 2024), promoted immersion and engagement. A few studies (e.g., Urun et al., 2017; García-Pinar, 2024) adopted collaborative elements, encouraging peer interaction and enhancing social motivation. Others integrated adaptive features (e.g., Kohnke & Ting, 2021) to provide personalized learning paths, while several studies emphasized immediate and low-stress feedback (e.g., Wu et al., 2020) to create emotionally supportive environments. This diversity of game mechanics suggests that DGBL approaches to technical vocabulary acquisition are not monolithic but vary according to learning goals, technological resources, and instructional contexts.

Research fields of technical vocabulary

Of those 17 studies reviewed, the range of domains involved in the implementation of DGBL for technical vocabulary acquisition remains relatively narrow as shown in Figure Eight. The majority of studies focus on engineering vocabulary (N=7), followed by medical (including nursing) terminology (N=5), with commercial vocabulary ranking third with three studies. Other fields, such as recycling and waste management, military, aviation, textiles and clothing, design, hotel management, as well as computer science, are each representing by only one research. The percentage of studies is not indicated because, as mentioned above, seven distinct professional disciplines were covered in the research of Kohnke and Ting (2021). Notably, many commonly academic fields (e.g., physics, chemistry, and biology) remain unexplored in this field. Moreover, among these studies, only the research of Kaldarova et al. (2023), which focused on computer science vocabulary acquisition, targeted primary school students. All other studies involved participants from higher education. This indicates that the scope of existing research remains relatively narrow, both in terms of the demographic groups studied and technical fields addressed.

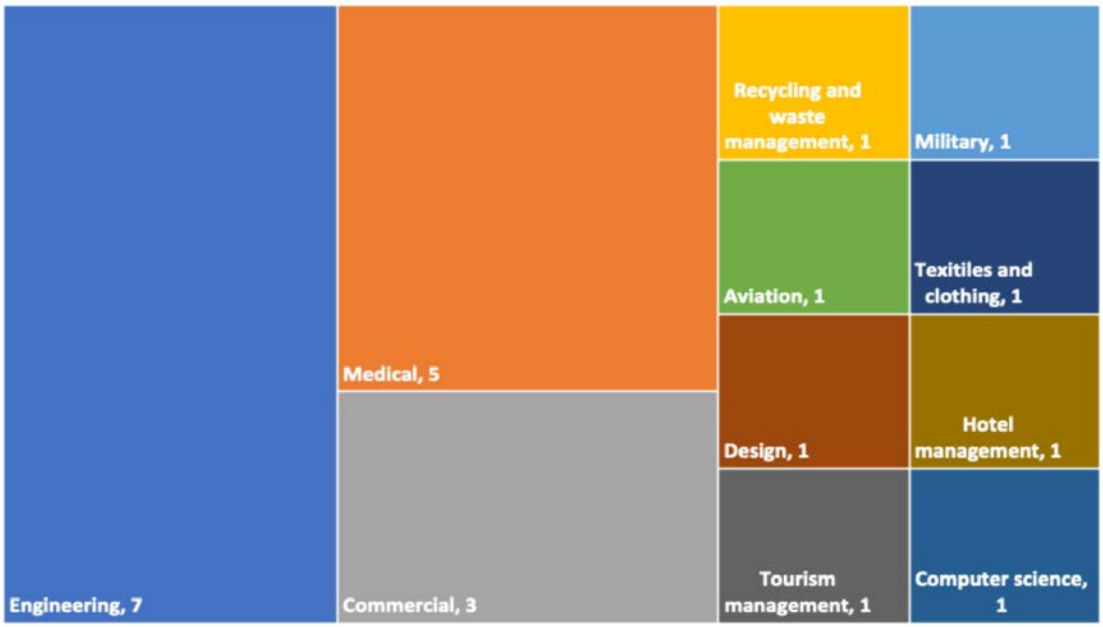


Figure 8. Fields of technical vocabulary in reviewed studies

Research outcomes

Figure Nine illustrates the variables examined in the reviewed studies. Notably, performance is the most frequently studies variables, with 14 out of 17 research addressing vocabulary acquisition results. Among these, only the study of Jia et al. (2023) explored the impact of DGBL on both short-term and long-term vocabulary retention, providing rare yet valuable insight into the sustained effect of DGBL on technical vocabulary learning. However, the limited inclusion of delayed post-tests across other studies suggests that long-term retention remains an underexplored area in this field. The second most commonly examined variables are students' attitudes toward this learning method and improvement of their motivation. However, no studies have specifically investigated the effects of DGBL on intrinsic and extrinsic motivation in technical vocabulary acquisition. Moreover, studies on factors related to acceptance rank forth, with two studies addressing this variable. Other research variables, such as cultural immersion, participation, metacognitive awareness, engagement, and satisfaction, are each represented by a single study.

Regarding research outcomes, three studies reported either inconclusive or negative results. For instance, in the study of Neville (2015), the primary aim was to determine whether immersion in a 3D-DGBLL environment enhanced participants' ability to produce written L2 narratives. However, because the 3D game was not specifically designed to reflect local contexts, the experimental group reported a lower sense of cultural immersion compared to the text-based control group, which was closely tied to local culture. Furthermore, the study of Ali and Muhammad (2019) found no significant differences in perceived usefulness or attitudes between male and female students when using games to learn technical vocabulary. Meanwhile, due to the short duration of the intervention (30-40 minutes per session), students displayed only moderate enthusiasm toward this learning method. Despite these findings, the remaining 14 studies demonstrated overwhelmingly positive outcomes. These studies confirmed that DGBL has a significant motivational and facilitative effect on students' acquisition of technical vocabulary, as well as on their learning motivation, attitudes, acceptance, satisfaction, and engagement. These results underscore the potential of DGBL as an effective tool for enhancing technical vocabulary learning across various dimensions. Nevertheless, it is important to note that only one out of the 17 studies (Kaldarova et al., 2023) involved K-12 participants, highlighting a marked absence of research focused on younger learners. Given the increasing integration of digital tools in school-level education, further studies targeting primary and secondary learners are urgently needed to validate the generalizability and scalability of DGBL in diverse educational contexts.

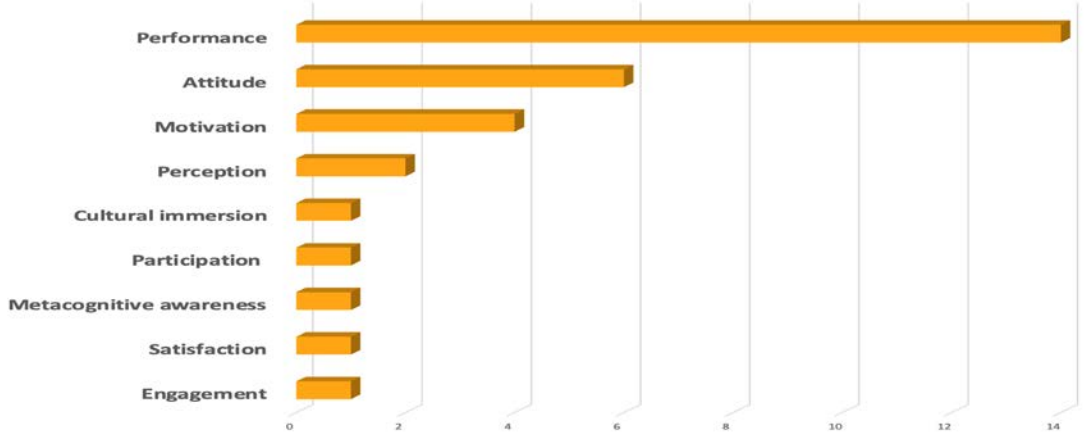


Figure 9. Research variables studied in reviewed publications

Discussion

This review synthesizes the findings from 17 empirical studies on applying DGBL for technical vocabulary acquisition. The analysis effectively addresses the first four research questions posed, offering a comprehensive overview of the field. The following discussion of these findings will highlight key research patterns and gaps within the existing body of research, providing valuable insights that can inform future investigations and educational practices.

Research trends and implications

The reviewed studies reveal a modest yet steady growth in DGBL research for technical vocabulary acquisition since 2020. However, this research remains predominantly concentrated in specific technical fields, such as engineering and medicine. While these domains are undeniably important and have yielded valuable insights, other disciplines, such as the humanities and commonly studied natural sciences (e.g., agriculture, architecture, and chemistry), have received insufficient attention. This imbalance highlights the narrow scope of current research and emphasizes the need to expand DGBL applications to a broader range of technical vocabulary domains to meet the diverse vocabulary acquisition needs of learners across various fields. Additionally, the majority of studies target population from higher education, with only the study of Kaldarova et al. (2023) being the single example focused on primary school students. This indicates a significant absence of K-12 learner populations in current research, which limits our understanding of how DGBL may benefit younger or secondary-level learners in acquiring subject-specific vocabulary. This finding aligns with the conclusions drawn by Vnucko and Klimova (2023) in their systematic review of DGBVL studies. This limited focus on population demographics constrains our understanding of the adaptability and effectiveness of DGBL across different age groups and educational levels.

Next, the analysis reveals that DGBL for technical vocabulary relies on off-the-shelf video games or educational platforms, such as Quizlet and Kahoot!, with limited use of custom-designed games. Among the 17 reviewed studies, only 4 employed games specifically tailored to learners' needs. Given the specialized nature of technical vocabulary, this reliance on generic platforms may compromise the effectiveness of DGBL in addressing learners' unique requirements. For instance, the research of Neville (2015) highlights this limitation, demonstrating that students in a non-customized 3D-DGBLL environment, which lacked strong cultural connections to the local context, experienced weaker cultural immersion compared to a control group using culturally relevant text-based materials. This finding underscores the importance of developing DGBL tools that align with learners' cultural and contextual realities. This is the same conclusion that Zhang et al. (2024) reached in their study, which also confirmed that purposefully developed games can be more effective in promoting academic development than commercial products since the solid theoretical foundation and precisely tailored learning objectives can serve students more accurately. In addition to form and customization, the reviewed studies also suggest variation in the game mechanics employed. While some studies utilized competitive formats (e.g., Kahoot!, quiz-based AR games), others adopted collaborative tasks (e.g., chatbot, paired challenges). These distinctions in mechanics appear to influence learning outcomes: competition is frequently linked to increased motivation and focus (Chen et al., 2023), while collaboration fosters communication skills and learner autonomy (Yang et al., 2025). However, most studies did not explicitly examine these relationships, and few reported comparative evidence across game mechanics.

Third, the linguistic scope of DGBL research predominantly focus on English as a second language, with limited attention given to multilingual learners who need to acquire technical vocabulary across multiple languages. This trend aligns with findings from general vocabulary acquisition studies (Hung et al., 2018; Xu et al., 2020), which similarly emphasizes a lack of diversity in linguistic contexts. This linguistic homogeneity also limits theoretical generalizability across diverse learner populations. According to Sweller's Cognitive Load Theory, additional language switching and unfamiliar technical terms may increase extraneous cognitive load (Bahari, 2023). Future DGBL research should investigate how multilingual game-based environments can be designed to reduce such load and support meaningful vocabulary transfer.

The distribution of variables examined in the analyzed studies highlights a strong emphasis on learning outcomes, with 14 out of 17 studies focusing on vocabulary acquisition. The results consistently demonstrate the effectiveness of DGBL in facilitating technical vocabulary learning. For instance, Soyoof et al. (2024) reported that students learning technical vocabulary through DGBL showed an average vocabulary knowledge improvement of 70.87%, compared to only 15.32% in the control group. Similarly, Lelardeux et al. (2017) found that DGBL could enhance vocabulary acquisition across an entire class. Some researchers (e.g., Abrams & Walsh, 2014; Chowdhury et al., 2024) attribute this effectiveness to the nature of digital games. While traditional textbook learning often exposes students only to the orthographic form of words, games offer a richer, multisensory experience by presenting vocabulary in both visual and auditory contexts (Simonnet et al., 2025). This immersive exposure facilitates a deeper understanding of word usage, likely due to the combination of meaningful contextualization and multimedia diversity, which significantly improve vocabulary retention during gameplay (Chen & Hsu, 2020). This finding is supported by Ramezanali and Faez (2019), who demonstrated that using dual annotations, combining L2 definitions with video aminations, is more effective for vocabulary learning and retention than relying on single annotations with L2 definitions. Likewise, Sundqvist (2019) confirmed the impact of interactive digital gaming environments in facilitating the mastery of new and particularly challenging vocabulary. The dynamic interactions within these games offer learners repeated encounters and contextual applications, which are essential for grasping intricate terms. Furthermore, specific psychological factors such as intrinsic and extrinsic motivation learning confidence, and cognitive load have received minimal attention in existing research.

Finally, the findings from the reviewed literature emphasize numerous advantages of DGBL for learners, aligning with the results of many studies on general vocabulary acquisition. Specifically, DGBL has been shown to aid learners in acquiring foreign language vocabulary through engaging gameplay (Kazu & Kuvvetli, 2023), enhance their motivation (Zhang et al., 2024) and engagement (Albayrak et al., 2022), reduce their cognitive load (Liu, 2024) and anxiety (Al-Aosail et al., 2024), establish their autonomous learning behavior (Fu et al., 2021), etc. However, a few studies indicate that the impact of DGBL on technical vocabulary acquisition may not always be significant. For instance, the study of Jia et al. (2023) revealed no notable differences between the AR-GBL group and the paper-based GBL group in terms of immediate vocabulary learning outcomes, although the AR-GBL group demonstrated superior in long-term retention. This finding is consistent with Lai and Chang (2021), who reported no significant differences between AR and flashcards in facilitating English vocabulary acquisition among first-grade students. Jia et al. (2023) attributed this to the potential additional cognitive load introduced by using digital devices and applications. Likewise, the research of Ebrahimzadeh (2017) echoed this perspective, suggesting that the high interactivity of games may impose an extra cognitive burden

on learners, which could contribute to the forgetting of some vocabulary. These mixed findings suggest that while DGBL holds promise as an effective tool for vocabulary learning, its design and implementation must carefully balance engagement and cognitive demands. Meanwhile, researcher have observed a lack of uniformity in the test forms used to evaluate technical vocabulary acquisition in the reviewed studies. This observation is consistent with the study of Vnucko and Klimova (2023), who noted the absence of standardized tools for assessing vocabulary in the digital game environment. This may draw from the complexity of technical vocabulary originating from multiple disciplines. Additionally, the findings underscore the limited attention given to the long-term retention of technical vocabulary. However, retaining and recalling vocabulary over extended periods is essential for effective and fluent communication (Masood, 2024). Among all reviewed studies, only Jia et al. (2023) provided a direct comparison between short-term and long-term retention outcomes, revealing the significant advantage of DGBL in supporting delayed recall. This gap calls for more longitudinal research that not only measures immediate post-test outcomes but also examines how learners retain specialized vocabulary weeks or months after initial learning. Many empirical studies have confirmed that multimodal multimedia input can significantly enhance long-term vocabulary retention (e.g., Teng, 2023; Teng & Zhang, 2023). This presents an important opportunity for future research to examine whether DGBL approaches yield comparable benefits for the enduring acquisition of technical vocabulary.

Suggestions for future studies

Given the relatively limited number of studies in this field, there are numerous possibilities for future research to delve deeper into various aspects of DGBL for technical vocabulary acquisition. First, from a multilingual and multidisciplinary perspective, the research could be extended to languages other than English. Such efforts would not only promote the research for linguistic diversity but also address the unique needs of learners in specialized linguistic environments. Simultaneously, the scope of research could be expanded to include additional disciplines such as chemistry, biology, and physics. These efforts would facilitate a better understanding of the adaptability and effectiveness of DGBL across diverse academic and professional contexts.

Then, although many existing studies focus on the immediate benefits of vocabulary acquisition, relatively little is known about the long-term retention of technical vocabulary or its practical application in academic or professional contexts. Future research could investigate, through longitudinal research, how learners retain technical vocabulary over time and how they utilize it in the reality, such as writing academic papers, delivering presentations, or engaging in professional communication.

In terms of game types, research on AR/VR-based games and developed games are very limited. Future educators could develop games which meet the needs of learners and the requirement of technical terms, incorporating professional and cultural elements. Moreover, future directions could explore the use of AI-driven games (Polyzi & Moussiades, 2023) to support personalized learning paths for technical vocabulary acquisition. Additionally, the potential of AR, VR, and AI could be explored to create adaptive, interactive, and immersive DGBL environments. Researchers could also investigate the interdisciplinary transferability of these tools, examining how games designed for one discipline could be adapted to others.

Finally, future research could also combine quantitative and qualitative research methods to understand the application of DGBL in technical vocabulary acquisition from multiple research

perspectives. Broader participant demographics, including young learners, adult professionals, and leaners from nontraditional educational settings, should also be considered to explore the adaptability of DGBL across different population. It is also worth exploring how teachers can provide instructional support for students in digital teaching environments and different teaching methods when using this technology.

Limitations

The study may have certain limitations in its literature selection process. First, several articles did not explicitly use terms related to technical vocabulary in their titles or keywords, such as the research of Dinçer and Dinçer (2021) who use "aviation English" as keywords. This created challenges in identifying relevant studies and may have led to the omission of some pertinent publications. Second, the evaluated publications were sourced from six databases: WoS, Scopus, ScienceDirect, Google Scholar, Springer, and Taylor & Francis. But unfortunately, there are very few journals dedicated to research on DGBL for technical vocabulary acquisition, and the inclusion criteria excluded master's and doctoral theses. Future research could address these limitations by broadening the search scope to include additional databases and publication types. Moreover, of those 17 reviewed studies, very few explicitly mentioned their theoretical foundations. Consequently, this study did not analyze the theoretical frameworks underlying the research. This aligns with the observation of Bodily et al. (2019) that articles in instructional design and technology journals rarely discuss learning theories or conceptual frameworks. Despite these limitations, they should not diminish the significance of this systematic review. It provides a comprehensive summary of the overall development of DGBL research in the field of technical vocabulary acquisition, offering valuable insights for future investigations and practical applications.

Conclusion

This study systematically reviews research on DGBL for technical vocabulary acquisition published between 2014 and 2024, yielding several key insights. The primary aim was to provide a comprehensive overview of current practices, learner populations, game types, and measured outcomes related to the implementation of DGBL in technical vocabulary instruction. First, most of these studies target English as the primary language and focus on population from higher education, with a significant concentration of research conducted in Asia. Second, the research platforms utilized predominantly consist of existing video games or online learning tools, with relatively few studies dedicated to games developed specifically for targeted learner population. Additionally, the research emphasis has primarily been on learning performance, attitudes, and motivation. However, studies investigating the long-term retention of technical vocabulary, intrinsic and extrinsic motivation, as well as affective, social, and metacognitive learning strategies, remain limited. These areas, critical to a holistic understanding of GGBL, have largely been overlooked. Fourth, the scope of technical fields explored is relatively narrow, with most studies concentrating on engineering, medicine, and business, leaving many other disciplines underrepresented.

Despite these limitations, the majority of the reviewed studies confirm the effectiveness of DGBL in facilitating technical vocabulary acquisition, though a few report less significant findings. Encouragingly, the number of publications in this field has been steadily increasing since 2020. Research has also evolved from employing basic computer-based games to incorporating

mobile platforms and diversified VR technologies, signaling a growing recognition of the potential of DGBL in foreign language education. Many researchers (e.g., Su & Zou, 2022; Zhang, 2022) similarly affirm that technological advancements have transformed language education, offering opportunities to enhance the efficiency of language learning and teaching. Accordingly, future research is recommended to explore the potential of DGBL among a wider range of learner groups, including vocational trainees and young learners in primary and secondary education. Such efforts would help assess the scalability and adaptability of DGBL across different educational levels, further advancing the field and supporting inclusive language learning practices. Exploring AI-driven, personalized game-based learning paths may also offer promising directions for enhancing learner engagement and long-term vocabulary retention.

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Reference

Abdullah Alhebshi, A., & Gamlo, N. (2022). The effects of Mobile Game-Based Learning on Saudi EFL foundation year students' vocabulary acquisition. *Arab World English Journal*, *13*(1), 408–425. https://doi.org/10.24093/awej/vol13no1.27

Abrams, S. S., & Walsh, S. (2014). Gamified vocabulary: Online resources and enriched language learning. *Journal of Adolescent & Adult Literacy*, *58*(1), 49–58. https://doi.org/10.1002/jaal.315

Al-Aosail, A. B. F., Lamouchi, A., Ibrahim, S. A., Gafar, M. G., & Hafez, W. E. (2024). Digital games for learning vocabulary: The effects on foreign language anxiety, buoyancy, online engagement, and vocabulary learning. *CALL-EJ*, *25*(4), 27–50.

Albayrak, M., Chen, J., & Williams, P. J. (2022). Exploring ESL students' perceived engagement in and experience of content vocabulary learning through virtual reality games.

In *Digital Games in Language Learning* (pp. 109–135). https://doi.org/10.4324/9781003240075-7

Alfehaid, A. (2019). Online English language learning activities and academic achievement: Experiences of first year students and their teachers. *Pertanika Journal of Social Sciences and Humanities*, *27*(3), 1557–1572.

Alharbi, K. (2023). Enhancing technical vocabulary acquisition: A multimedia strategic approach for English for specific purposes during COVID-19. *Interactive Learning Environments*, *0*(0), 1–19. https://doi.org/10.1080/10494820.2023.2205902

Ali, Z., & Ghazali, M. A. I. M. (2016). Learning technical vocabulary through a mobile app: English language teachers' perspectives. *International Journal of Language Education and Applied Linguistics*. https://doi.org/10.15282/ijleal.v4.487

Ali, Z., & Muhammad, N. N. (2019). Gender differences in perceived usefulness and attitudes towards VocBlast in learning specialized vocabulary. In M. Y. Mohamad Noor, B. E. Ahmad, M. R. Ismail, H. Hashim, & M. A. Abdullah Baharum (Eds.), *Proceedings of the Regional Conference on Science, Technology and Social Sciences (RCSTSS 2016)* (pp. 237–245). Springer. https://doi.org/10.1007/978-981-13-0203-9_22

Ali, Z., Sinnadurai, S. K., Hamzah, F., Azmuddin, R. A., & Sabuan, N. S. (2014). Ten interesting facts about OnVac: A tool to learn engineering and technology vocabulary. *International Journal of Language Education and Applied Linguistics*. https://doi.org/10.15282/ijleal.v1.417

Al-Rashidi, A. H. (2025). Does digital task-based instruction make a difference in EFL university students' motivation in Saudi Arabia? An Active theory perspective. *Learning and Motivation*, *90*, 102115. https://doi.org/10.1016/j.lmot.2025.102115

Aravind, B. R., & Rajasekaran, V. (2021). Exploring dysphasia learners' vocabulary acquisition through the cognitive theory of multimedia learning: An experimental study. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(12), 263. https://doi.org/10.3991/ijet.v16i12.22173

Ardasheva, Y., & Tretter, T. R. (2017). Developing science-specific, technical vocabulary of high school newcomer English learners. *International Journal of Bilingual Education and Bilingualism*, *20*(3), 252–271. https://doi.org/10.1080/13670050.2015.1042356

Babaie, H. (2022). On digital game-based reading strategy training: Implications for L2 reading ability development. *Computer-Assisted Language Learning Electronic Journal*, *23*(3), Article 3.

Bahari, A. (2023). Challenges and affordances of cognitive load management in technology-assisted language learning: A systematic review. *International Journal of Human–Computer Interaction*, *39*(1), 85–100. https://doi.org/10.1080/10447318.2021.2019957

Bakhmat, N., & Chaikovska, O. (2021). Web-based professional vocabulary learning with the high school students. In *International Conference on Economics, Law and Education Research (ELER 2021)* (pp. 318-324). Atlantis Press. https://doi.org/10.2991/aebmr.k.210320.054

Banu, A. R., Srabonty, S. N., Islam, M., Tisha, A. P., & Islam, U. S. (2025). Barricades to reading expertise among students of secondary high school of Bangladesh: Major challenges and insights. *Asian Journal of Social Sciences and Legal Studies*, *7*(2), 308–315.

Barcroft, J. (2018). *Vocabulary in Language Teaching*. Routledge.

Beck, I. L., McKeown, M. G., & Kucan, L. (2013). *Bringing Words to Life (Second Edition): Robust Vocabulary Instruction* (2nd Edition). The Guilford Press.

Bendebbache, A., & Azeroual, D. (2022). *The effectiveness of using the mobile game simcity in teaching technical vocabulary to urban planning students*. http://localhost:8080/xmlui/handle/123456789/13584

Binon, J., & Verlinde, S. (2003). How FSP shaped itself in the teaching of FLE: From teacher training at university to the design of a dictionary of business French [Comment le FOS s'est profilé dans la didactique du FLE : de la formation d'enseignants à l'université à la conception d'un dictionnaire du français des affaires]. *Les Cahiers de l'ASDIFLE*, *14*, 17–42.

Bodily, R., Leary, H., & West, R. E. (2019). Research trends in instructional design and technology journals. *British Journal of Educational Technology*, *50*(1), 64–79. https://doi.org/10.1111/bjet.12712

Boyinbode, O. (2018). Development of a gamification based English vocabulary mobile learning system. *International Journal of Computer Science and Mobile Computing*, *7*(8), 183–191.

Buil, I., Catalán, S., & Martínez, E. (2018). Exploring students' flow experiences in business simulation games. *Journal of Computer Assisted Learning*, *34*(2), 183–192. https://doi.org/10.1111/jcal.12237

Bulut, A., & Yıldız, M. (2024). The impact of computer-assisted and direct strategy teaching on reading comprehension. *Journal of Computer Assisted Learning*, *40*(6), 3369–3389. https://doi.org/10.1111/jcal.13068

Calvo-Ferrer, J. R. (2021). Effectiveness of type of feedback and frequency on digital game-based L2 vocabulary acquisition. *International Journal of Game-Based Learning (IJGBL)*, *11*(3), 38–55. https://doi.org/10.4018/IJGBL.2021070103

Calvo-Ferrer, J. R., & Belda-Medina, J. (2021). The effect of multiplayer video games on incidental and intentional L2 vocabulary learning: The case of among us. *Multimodal Technologies and Interaction*, *5*(12), Article 12. https://doi.org/10.3390/mti5120080

Carrier, S. J. (2013). Elementary preservice teachers' science vocabulary: Knowledge and application. *Journal of Science Teacher Education*, *24*(2), 405–425. https://doi.org/10.1007/s10972-012-9270-7

Castellano-Risco, I., Alejo-González, R., & Piquer-Píriz, A. M. (2020). The development of receptive vocabulary in CLIL vs EFL: Is the learning context the main variable? *System*, *91*, 102263. https://doi.org/10.1016/j.system.2020.102263

Castillo-Cuesta, L. (2020). Using digital games for enhancing EFL grammar and vocabulary in higher education. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(20), 116. https://doi.org/10.3991/ijet.v15i20.16159

Celik, F., & Baturay, M. H. (2024). The effect of metaverse on L2 vocabulary learning, retention, student engagement, presence, and community feeling. *BMC PSYCHOLOGY*, *12*(1), 58. https://doi.org/10.1186/s40359-024-01549-4

Chang, J. A., & Chang, C. S. (2023). Games applied to vocabulary learning: A bibliometric analysis on two decades of research. *Journal of Educational Media & Library Sciences*, *60*(1). https://doi.org/10.6120/JoEMLS.202303_60(1).0023.RS.AE

Chen, C.-H., Liu, J.-H., & Shou, W.-C. (2023). How competition in a game-based science learning environment influences students' learning achievement, flow experience, and learning behavioral patterns. *Journal of Educational Technology & Society*, *21*(2), 164-176.

Chen, H.-J. H., & Hsu, H.-L. (2020). The impact of a serious game on vocabulary and content learning. *Computer Assisted Language Learning*, *33*(7), 811–832. https://doi.org/10.1080/09588221.2019.1593197

Chen, M.-H., Tseng, W.-T., & Hsiao, T.-Y. (2018). The effectiveness of digital game-based vocabulary learning: A framework-based view of meta-analysis. *British Journal of Educational Technology*, *49*(1), 69–77. https://doi.org/10.1111/bjet.12526

Chowdhury, M., Dixon, L., Kuo, L.-J., Donaldson, J. P., Eslami, Z., Viruru, R., & Luo, W. (2024). Digital game-based language learning for vocabulary development. *Computers and Education Open*, *6*, 100160. https://doi.org/10.1016/j.caeo.2024.100160

Chung T. M., & Nation P. (2003). Technical vocabulary in specialised texts. *Reading in a Foreign Language*, *15*(2), 103–116.

Chung, T. M., & Nation, P. (2004). Identifying technical vocabulary. *System*, *32*(2), 251–263. https://doi.org/10.1016/j.system.2003.11.008

Coxhead, A., & Demecheleer, M. (2018). Investigating the technical vocabulary of Plumbing. *English for Specific Purposes*, *51*, 84–97. https://doi.org/10.1016/j.esp.2018.03.006

Del Moral, B. L. M., VanPutte, C. L., & McCracken, B. A. (2024). The use of role-play in the learning of medical terminology for online and face-to-face courses. *Advances in Physiology Education*, *48*(3), 578–587. https://doi.org/10.1152/advan.00273.2023

Dinçer, N., & Dinçer, R. (2021). The effect of a serious game on aviation vocabulary acquisition. *International Journal of Serious Games*, *8*(4), Article 4. https://doi.org/10.17083/ijsg.v8i4.464

Drayton, J., & Coxhead, A. (2023). The development, evaluation and application of an aviation radiotelephony specialised technical vocabulary list. *English for Specific Purposes*, *69*, 51–66. https://doi.org/10.1016/j.esp.2022.10.001

Ebrahimzadeh, M. (2017). Readers, players, and watchers: EFL students' vocabulary acquisition through digital video games. *English Language Teaching*, *10*, 1. https://doi.org/10.5539/elt.v10n2p1

Frumuselu A. D. (2018). The implications of cognitive load theory and exposure to subtitles in English foreign language (EFL). *Translation and Translanguaging in Multilingual Contexts*, *4*(1), 55–76. https://doi.org/10.1075/ttmc.00004.fru

Fu, Y., Zhang, L., Zhao, S., & Chen, Y. (2021). Perceptions of non-English major college students on learning English vocabulary with gamified apps. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(18), 268–276. https://doi.org/10.3991/ijet.v16i18.24125

Gaffas, Z. M. (2024). Learning medical terminology in an ESP medical course: Vocabulary notebooks versus word lists. *Australian Review of Applied Linguistics*. https://doi.org/10.1075/aral.24070.gaf

García-Pinar, A. (2024). Throtel, throttel, trottel or trotel. Engineering undergraduates' perception of the use of Kahoot! To review course content. *Teaching English as a Second or Foreign Language--TESL-EJ*, *28*. https://doi.org/10.55593/ej.28111int

Gómez-Ortiz, M.-J., Domínguez Romero, E., & Bobkina, J. (2023). Instagram as a learning tool to improve technical vocabulary for sports science students. *Journal of Hospitality, Leisure, Sport & Tourism Education*, *32*, 100416. https://doi.org/10.1016/j.jhlste.2022.100416

Hao, T., Wang, Z., & Ardasheva, Y. (2021). Technology-assisted vocabulary learning for EFL learners: A meta-analysis. *Journal of Research on Educational Effectiveness*, *14*(3), 645–667. https://doi.org/10.1080/19345747.2021.1917028

Hestiana, M., & Anita, A. (2022). The role of movie subtitles to improve students' vocabulary. *Journal of English Language Teaching and Learning*, *3*(1), 46–53. https://doi.org/10.33365/jeltl.v3i1.1715

Hsu, M.-H., & Chen, Y.-H. (2024). Personalized Medical Terminology Learning Game: Guess the Term. *Games for Health Journal*, *13*(2), 84–92. https://doi.org/10.1089/g4h.2023.0054

Hsueh-Chao, M. H., & Nation, P. (2000). Unknown vocabulary density and reading comprehension. *Reading in a Foreign Language*, *13*(1), 403–430.

Huei, L. S., Yunus, M. M., & Hashim, H. (2021). Strategy to improve English vocabulary achievement during COVID-19 epidemic. Does Quizizz help? *Journal of Education and E-Learning Research*, *8*(2), 135–142. https://doi.org/10.20448/journal.509.2021.82.135.142

Hung, H.-T., Yang, J. C., Hwang, G.-J., Chu, H.-C., & Wang, C.-C. (2018). A scoping review of research on digital game-based language learning. *Computers & Education*, *126*, 89–104. https://doi.org/10.1016/j.compedu.2018.07.001

Hwang, G.-J., Chen, P.-Y., Chu, S.-T., Chuang, W.-H., Juan, C.-Y., & Chen, H.-Y. (2023). Game-based language learning in technological contexts: An integrated systematic review and bibliometric analysis. *International Journal of Online Pedagogy and Course Design (IJOPCD)*, *13*(1), 1–25. https://doi.org/10.4018/IJOPCD.316184

Javis, S. (1998). Conceptual transfer in the interlanguage lexicon. *Bloomington, IN: Indiana University Linguistics Club*.

Jia, W., Pack, A., Guan, Y., Zhang, L., & Zou, B. (2023). The influence of game-based learning media on academic English vocabulary learning in the EFL context. *Computer Assisted Language Learning*, 1–25. https://doi.org/10.1080/09588221.2023.2276800

Kaldarova, B., Omarov, B., Zhaidakbayeva, L., Tursynbayev, A., Beissenova, G., Kurmanbayev, B., & Anarbayev, A. (2023). Applying game-based learning to a primary school class in computer science terminology learning. *Frontiers in Education*, *8*. https://doi.org/10.3389/feduc.2023.1100275

Kaldenberg, E. R., Watt, S. J., & Therrien, W. J. (2015). Reading instruction in science for students with learning disabilities: A meta-analysis. *Learning Disability Quarterly*, *38*(3), 160–173. https://doi.org/10.1177/0731948714550204

Kamaşak, R., Sahan, K., & Rose, H. (2021). Academic language-related challenges at an English-medium university. *Journal of English for Academic Purposes*, *49*, 100945. https://doi.org/10.1016/j.jeap.2020.100945

Karimi, M. N., & Nasouri, A. (2024). EFL learners' flow experience and incidental vocabulary learning during text-based game tasks: The moderating role of working memory capacity. *System*, *124*, 103398. https://doi.org/10.1016/j.system.2024.103398

Kazu, İ. Y., & Kuvvetli, M. (2023). A triangulation method on the effectiveness of digital game-based language learning for vocabulary acquisition. *Education and Information Technologies*, *28*(10), 13541–13567. https://doi.org/10.1007/s10639-023-11756-y

Kohnke, L., & Ting, A. (2021). ESL students' perceptions of mobile applications for discipline-specific vocabulary acquisition for academic purposes. *Knowledge Management and E-Learning*, *13*(1), 102–117. Scopus. https://doi.org/10.34105/j.kmel.2021.13.006

Lai, J.-Y., & Chang, L.-T. (2021). Impacts of augmented reality apps on first graders' motivation and performance in English vocabulary learning. *Sage Open*, *11*(4), 21582440211047549. https://doi.org/10.1177/21582440211047549

Le, C. N. N., & Miller, J. (2023). A core meaning-based analysis of English semi-technical vocabulary in the medical field. *English for Specific Purposes*, *70*, 252–266. https://doi.org/10.1016/j.esp.2023.01.006

Lei, L., & Liu, D. (2016). A new medical academic word list: A corpus-based study with enhanced methodology. *Journal of English for Academic Purposes*, *22*, 42–53. https://doi.org/10.1016/j.jeap.2016.01.008

Lelardeux, C. P., Galaup, M., Panzoli, D., Gilles, P., Minguella-Canela, J., Yassine-Diab, N., & Lagarrigue, P. (2017). Improving mechanical engineering vocabulary through the use of a game. *Procedia Manufacturing*, *13*, 1432–1439. https://doi.org/10.1016/j.promfg.2017.09.098

Lin, L. H. F., & Qian, D. D. (2019). The relationship between vocabulary knowledge and language proficiency. In *The Routledge Handbook of Vocabulary Studies*, 66-80. Routledge.

Liu, D. (2024). The effects of segmentation on cognitive load, vocabulary learning and retention, and reading comprehension in a multimedia learning environment. *BMC Psychology*, *12*(1). https://doi.org/10.1186/s40359-023-01489-5

Liu, D., & Lei, L. (2019). Technical Vocabulary. In *The Routledge handbook of vocabulary studies*, 111–124. Routledge.

Lu, F.-C., & Chang, B. (2016). Role-play game-enhanced English for a specific-purpose vocabulary-acquisition framework. *Educational Technology & Society*, *19*(2), 367–377.

Masood S. (2024). Cementing vocabulary in long-term memory: The influence of word association strategies. *International Journal of Literature and Languages*, *4*(12).

Miroshnychenko, I. (2024). Technical vocabulary in foreign language acquisition: Seeking effective methods for university students. *Collection of Scientific Papers «ΛΌГОΣ»*, Zurich, Switzerland. https://doi.org/10.36074/logos-24.05.2024.058

Moniza Ray, S. P., & Ajit, I. (2024). Digital game-based language learning: The impact of story-driven game Life is Strange 1 on language learners' listening skills. *Journal of Language Teaching and Research*, *15*(2), 448–457. https://doi.org/10.17507/jltr.1502.13

Mustaeva, G. S., Saidivalieva, B. S., & Ataeva, G. B. (2022). Features of professional vocabulary and its difference from terms. In *AIP Conference Proceedings* (Vol. 2432, No. 1, p. 060017). AIP Publishing LLC. https://doi.org/10.1063/5.0089598

Nation, I. S. P. (2001). *Learning Vocabulary in Another Language*. Cambridge University Press.

Neville, D. O. (2015). The story in the mind: The effect of 3D gameplay on the structuring of written L2 narratives. *RECALL*, *27*(1), 21–37. https://doi.org/10.1017/S0958344014000160

Othman, J. (2024). Academic vocabulary learning in EMI classrooms: Challenges and strategies. *Arab World English Journal*, *15*, 3–18. https://doi.org/10.24093/awej/vol15no2.1

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Pitarch, R. C. (2024). The engineer: Enhancing bachelor students' English technical engineering vocabulary proficiency with a serious video game. *Revista de Educación (Madrid)*, *405*, 293–310. https://doi.org/10.4438/1988-592X-RE-2024-405-636

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist*, *50*(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533

Plass, J. L., Mayer, R. E., & Homer, B. D. (Eds.). (2020). *Handbook of Game-Based Learning*. The MIT Press.

Polyzi, P., & Moussiades, L. (2023). An artificial vocabulary learning assistant. *Education and Information Technologies*, *28*(12), 16431–16455. Scopus. https://doi.org/10.1007/s10639-023-11810-9

Pratiwi, T. L., Togatorop, S. A., & Marsevani, M. (2024). Enhancing students' speaking skills with Wordwall game-based learning: Classroom action research. *Journal of English Teaching, Applied Linguistics and Literatures (JETALL)*, *7*(2), Article 2. https://doi.org/10.20527/jetall.v7i2.19682

Ramezanali, N., & Faez, F. (2019). Vocabulary learning and retention through multimedia glossing. *Language Learning & Technology*, *23*(2), 105–124.

Rasti-Behbahani, A. (2021). Why digital games can be advantageous in vocabulary learning. *Theory and Practice in Language Studies*, *11*(2). https://doi.org/10.17507/tpls.1102.01

Rivers, W. M. (1983). *Communicating Naturally in a Second Language: Theory and Practice in Language Teaching* (6th ed.). Cambridge University Press.

Roohani, A., & Heidari Vincheh, M. (2023). Effect of game-based, social media, and classroom-based instruction on the learning of phrasal verbs. *Computer Assisted Language Learning*, *36*(3), 375–399. https://doi.org/10.1080/09588221.2021.1929325

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A Self-Determination Theory approach. *Motivation and Emotion*, *30*(4), 344–360. https://doi.org/10.1007/s11031-006-9051-8

Schmitt, N., & Schmitt, D. (2020). *Vocabulary in Language Teaching*. Cambridge University Press.

Shi, D., Révész, A., & Pellicer-Sánchez, A. (2024). The effects of task repetition on the processing and acquisition of technical vocabulary through video-lecture-based tasks: A mixed-methods study. *Language Learning*, *n/a*(n/a). https://doi.org/10.1111/lang.12679

Simonnet, E., Loiseau, M., & Lavoué, É. (2025). A systematic literature review of technology-assisted vocabulary learning. *Journal of Computer Assisted Learning*, *41*(1), e13096. https://doi.org/10.1111/jcal.13096

Song, S. (2018). Second language acquisition theories. In S. Song, *Second Language Acquisition as a Mode-Switching Process*, 9–36. Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-52436-2_2

Soyoof, A., Reynolds, B. L., Shadiev, R., & Vazquez-Calvo, B. (2024). A mixed-methods study of the incidental acquisition of foreign language vocabulary and healthcare knowledge through serious game play. *Computer Assisted Language Learning*, *37*(1–2), 27–60. https://doi.org/10.1080/09588221.2021.2021242

Stewart, J., Stoeckel, T., McLean, S., Nation, P., & Pinchbeck, G. G. (2021). What the research shows about written receptive vocabulary testing: A reply to webb. *Studies in Second Language Acquisition*, *43*(2), 462–471. https://doi.org/10.1017/S0272263121000437

Su, F., & Zou, D. (2022). Technology-enhanced collaborative language learning: Theoretical foundations, technologies, and implications. *Computer Assisted Language Learning*, *35*(8), 1754–1788. https://doi.org/10.1080/09588221.2020.1831545

Sundqvist, P. (2019). Commercial-off-the-shelf games in the digital wild and L2 learner vocabulary. *Language Learning & Technology*, *23*(1), 87–113. https://doi.org/10.10125/44674

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction*, *4*(4), 295–312. https://doi.org/10.1016/0959-4752(94)90003-5

Tan, W., Supian, N., & Cheah, K. S. (2022). Game-based learning in improving English vocabulary and detecting metacognitive awareness among English for specific purposes undergraduates. *2nd International Conference on Social Science, Humanities, Education and Society Development* (ICONS 2021), Tegal, Indonesia. https://doi.org/10.2991/assehr.k.220101.021

Teng, M. F. (2023). The effectiveness of multimedia input on vocabulary learning and retention. *Innovation in Language Learning and Teaching*, *17*(3), 738–754.

Teng, M. F., Mizumoto, A., & Takeuchi, O. (2024). Understanding growth mindset, self-regulated vocabulary learning, and vocabulary knowledge. *System*, *122*, 103255. https://doi.org/10.1016/j.system.2024.103255

Teng, M. F., & Zhang, D. (2023). The associations between working memory and the effects of multimedia input on L2 vocabulary learning. *International Review of Applied Linguistics in Language Teaching*, *61*(3), 1021–1049. https://doi.org/10.1515/iral-2021-0130

Urun, M. F., Aksoy, H., & Comez, R. (2017). Supporting foreign language vocabulary learning through Kinect-based gaming. *International Journal of Game-Based Learning (IJGBL)*, *7*(1), 20–35. https://doi.org/10.4018/IJGBL.2017010102

Vnucko, G., & Klimova, B. (2023). Exploring the potential of digital game-based vocabulary learning: A systematic review. *Systems*, *11*(2), Article 2. https://doi.org/10.3390/systems11020057

Woodward-Kron, R. (2008). More than just jargon – The nature and role of specialist language in learning disciplinary knowledge. *Journal of English for Academic Purposes*, *7*(4), 234–249. https://doi.org/10.1016/j.jeap.2008.10.004

Wright, T. S., & Peltier, M. R. (2016). Supports for vocabulary instruction in early language and literacy methods textbooks. *Reading & Writing Quarterly*, *32*(6), 527–549. https://doi.org/10.1080/10573569.2015.1031925

Wu, T.-T. (2018). Improving the effectiveness of English vocabulary review by integrating ARCS with mobile game-based learning. *Journal of Computer Assisted Learning*, *34*(3), 315–323. https://doi.org/10.1111/jcal.12244

Wu, Y., Hong, J.-C., & Huang, P. S.-B. (2020). Using a game-based mobile application to learn medical academic vocabulary: Learning effects and learners' perceptions. *Taiwan International ESP Journal*, *11*(1). https://doi.org/10.6706/TIESPJ.202008_11(1).0001

Xodabande, I., Atai, M. R., & Hashemi, M. R. (2024). Exploring the effectiveness of mobile assisted learning with digital flashcards in enhancing long-term retention of technical vocabulary among university students. *Journal of Computers in Education*. https://doi.org/10.1007/s40692-024-00347-6

Xu, Z., Chen, Z., Eutsler, L., Geng, Z., & Kogut, A. (2020). A scoping review of digital game-based technology on English language learning. *Educational Technology Research and Development*, *68*(3), 877–904. https://doi.org/10.1007/s11423-019-09702-2

Yang, S., Lodge, J. M., & Brooks, C. (2025). Capturing multi-layered regulated learning in collaboration. *Metacognition and Learning*, *20*(1), 2. https://doi.org/10.1007/s11409-024-09409-7

Yi-ju, Jong-Chao Hong, & Paul Sin-Bao Huang. (2020). Using a game-based mobile application to learn medical academic vocabulary: Learning effects and learners' perceptions. *Taiwan International ESP Journal*, *11*(1). https://doi.org/10.6706/TIESPJ.202008_11(1).0001

Yüksel, H. G., Mercanoğlu, H. G., & Yılmaz, M. B. (2020). Digital flashcards vs. Wordlists for learning technical vocabulary. *Computer Assisted Language Learning*, *35*(8), 2001–2017. https://doi.org/10.1080/09588221.2020.1854312

Zhang, R., Zou, D., & Cheng, G. (2024). Self-regulated digital game-based vocabulary learning: Motivation, application of self-regulated learning strategies, EFL vocabulary knowledge development, and their interplay. *Computer Assisted Language Learning*, 1–43. https://doi.org/10.1080/09588221.2024.2344555

Zhang, W. (2022). The role of technology-based education and teacher professional development in English as a foreign language classes. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.910315

Zou, B., Huang, L., Ma, W., & Qiu, Y. (2021). Evaluation of the effectiveness of EFL online teaching during the COVID-19 pandemic. *SAGE Open*, *11*(4), 21582440211054491. https://doi.org/10.1177/21582440211054491

Zou, D., Huang, Y., & Xie, H. (2021). Digital game-based vocabulary learning: Where are we and where are we going? *Computer Assisted Language Learning*, *34*(5–6), 751–777. https://doi.org/10.1080/09588221.2019.1640745

Appendices

Appendix A

Reviewed publications of DGBL for technical vocabulary acquisition

No.	Sources	Target language/Context	Sample	Professional field of voc
1	Ali et al. (2014)	(English) Online vocabulary game	32 students in a Malaysia public university	Engineering and technolo
2	Neville (2015)	(German) 3D digital game	42 students in a university of Southeast United States	German recycling and w management systems
3	Lu & Chang (2016)	(English) Digital role-play game	80 students in northern Taiwan vocational high school	Different workplace env (restaurant owner for ex
4	Urun et al. (2017)	(English) Kinect-based game	52 students in a state university in Turkey	Military vocabulary
5	Lelardeux et al. (2017)	(English) Digital anagram-like games	9 students in a French university	Engineering vocabulary operations and machine
6	Ali & Muhammad (2019)	(English) Mobile app game	129 students in Malaysia university	Engineering vocabulary
7	Wu et al. (2020)	(English) Mobile app game (custom-designed)	30 students from a College of Medicine in Taiwan	Medical vocabulary

No.	Sources	Target language/Context	Sample	Professional field of voc
8	Dinçer & Dinçer (2021)	(English) Digital serious video game	30 students in a state university in Turkey	Aviation vocabulary
9	Bakhmat & Chaikovska (2021)	(English) Online game	96 students in a state university in Podolia	Engineering vocabulary
10	Kohnke & Ting (2021)	(English) Mobile app game (custom-designed)	16 students in a Hong Kong university.	Technical vocabulary in and clothing, design, bus engineering, tourism ma hotel management
11	Tan et al. (2022)	(English) Digital video game	65 students in a private university in Malaysia	Commercial vocabulary
12	Kaldarova et al. (2023)	(English) Mobile app game (custom-designed)	50 primary students in Kazakhstan	Computer science vocab
13	Jia et al. (2023)	(English) AR-based digital game, Quizlet, physical flash card and puzzle (custom-designed AR game)	90 university students in China	Digestive vocabulary
14	Soyoof et al. (2024)	(English) Digital serious video game	160 university students in Iran	Nursing vocabulary
15	Pitarch (2024)	(English) Digital serious video game	64 university students in Valencia	Engineering vocabulary
16	Hsu & Chen (2024)	(English) Online chatbot with digital flash card game	48 nursing students in Taiwan	Medical vocabulary
17	García-Pinar (2024)	(English) Online game	36 university students in Spain	Engineering vocabulary