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Technology-mediated vocabulary learning in EFL classrooms in Japan: A qualitative synthesis of research

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This study aimed to gain an understanding of technology-mediated vocabulary learning in English as Foreign Language (EFL) classrooms in Japan via a qualitative synthesis of existing research. Following a methodological framework for the qualitative synthesis of research (Chong & Plonsky, 2021), using keywords, and screening the results based on inclusion criteria, this research identified 17 relevant articles for analysis. Extracted data were synthesised using thematic analysis. The findings highlighted the use of Data-driven learning (DDL) and simulation games as being salient within the selected articles. While helping to promote vocabulary learning and to motivate students, the articles also indicated that technology-mediated vocabulary learning often required teachers' assistance before and during technology use. More generally, this research noted a dearth of qualitative research focused on technology-mediated vocabulary learning in a Japanese EFL context, particularly in settings outside of higher education. Limitations of the research and implications for future teaching and researching are discussed.

Keywords: Vocabulary teaching and learning, technology, EFL, qualitative synthesis of research

1. Introduction

Learning vocabulary can be a key to efficiently improving each essential component (listening, reading, speaking, writing) in language teaching and learning. In Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) announced a new Course of Study in 2018 (MEXT, 2018), which was

implemented in high schools in 2022. Also, they announced an innovative plan called the “GIGA school plan”(MEXT, 2019). Key components of these changes are as follows: an increase in the amount of vocabulary that students should learn during the period of elementary school to high school; emphasis on technology use in classrooms; offering proactive, interactive, and authentic learning (MEXT, 2018, 2019).

Regarding vocabulary, the number of words that students in Japan learn has increased by about 1,000-2,000 words compared to the previous version of the Course of Study (Figure 1). For teachers in high schools where students are aiming to succeed on university entrance exams, it is necessary to plan lessons so students can learn, or at least be exposed to, 5,000 words.

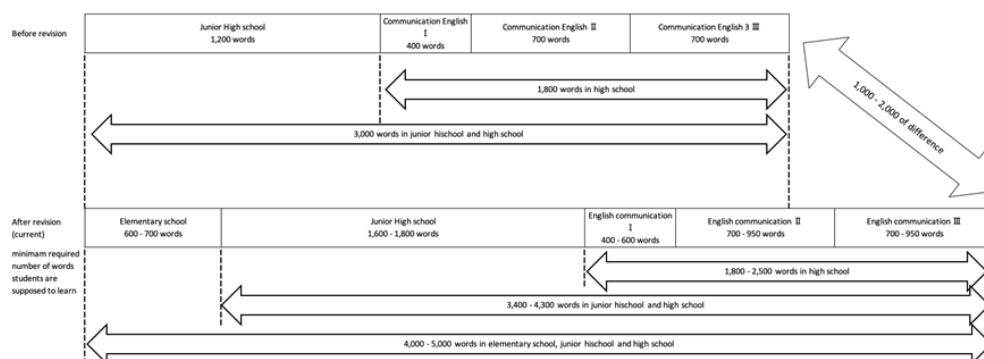


Figure 1. Comparison of number of words (based on Akase and Uenishi [2015] and MEXT [2018])

Akase and Uenishi (2015) noted mixed results when examining the vocabulary size development of Japanese EFL senior high school learners, with some students even showing evidence of vocabulary size shrinkage. This research, which was conducted before the most recent revisions to vocabulary targets, suggests that both students and teachers may struggle with the more ambitious targets that have been introduced.

Teachers in Japan generally use government-authorized textbooks in classrooms, but most of them do not make use of vocabulary learning principles or provide learners with enough exposure to learn vocabulary for long-term retention (Waring, 2011). Matsuoka and Hirsh (2010) found that textbooks offer limited opportunities for learners to improve their vocabulary knowledge. Using a textbook alone would not be enough to provide rich learning opportunities (Nation, 2022; Waring, 2011).

However, teachers in Japan are expected to incorporate basic vocabulary learning principles and technology into their teaching while offering proactive, interactive, and authentic learning. Despite a plethora of intriguing research on vocabulary teaching and learning, including technology-assisted vocabulary learning, many English language teachers in Japan appear to have limited knowledge of such domains and their application to the classroom. Some do not even have time to read those kinds of articles or cannot access them, or

even if they can, others complain that those findings would not fit the context where they teach (Chong, 2020; Sato & Loewen, 2019).

It is important to note that while the application of technology into classrooms is an urgent demand in Japanese high school, most empirical research on technology-mediated vocabulary learning has been concentrated in tertiary contexts. While our intention in this study was to gather empirical studies from both high schools and tertiary settings, no research in high schools was ultimately included in this review (see 4. Results and Discussion, and 5. Conclusion). Therefore, this research aims to gain insights from synthesised findings from research and to provide a foundation for a future implementation, informing integration of technology in vocabulary teaching in classrooms at all levels of education.

To gain perspectives of technology-mediated vocabulary learning in EFL classrooms in Japan, this study employed a qualitative synthesis of research (Chong et al., 2023), focusing especially on the characteristics, affordances, and limitations. The term “affordances” in this study means opportunities or possibilities that technology-mediated vocabulary learning influence. The research questions were set as follows:

1. What are the characteristics of technology-mediated vocabulary learning in EFL classrooms in Japan?
2. What are the affordances and limitations of technology-mediated vocabulary learning in EFL classrooms in Japan?

2. Literature review

2.1 Defining vocabulary acquisition – intentional learning and incidental learning

Vocabulary learning can be classified into intentional and incidental learning. Intentional learning is studying words in an activity focusing on deliberately trying to learn vocabulary (Nakata, 2019; Webb & Nation, 2017). On the other hand, incidental learning is often defined as learning words as a by-product of an activity where learners try to understand the content (Zaki & Ellis, 1999). Incidental learning provides opportunities to learn how words can be used and a deeper understanding of word usage and collocation (Webb et al., 2020). Meaning-focused tasks such as extensive reading contribute significantly to vocabulary learning (Webb & Nation, 2017), enhancing comprehension and reading skills (Nation, 2022; Waring, 2011).

Intentional vocabulary learning has been found to be efficient and also effective (Elgort, 2011). In Mondria’s research (Mondria, 2003), memorising words was the most effective among three methods of inferring, verifying, and memorising, to increase vocabulary breadth and depth. By using word cards, learners efficiently acquire vocabulary breadth (Nakata, 2019). Judd (1978) stated learners should know the linguistic context where the word is encountered because they retain words better when learning them in a sentence context (Laufer & Shmueli, 1997). Webb (2007) compared vocabulary learning with

word cards and one from context, concluding that using word cards was more effective or not different from the other approach. Considering the limited possibility of learning from context (Webb & Nation, 2017) in an EFL environment, intentional learning would enable learners to encounter many words efficiently. This efficient learning may be enhanced by combining intentional learning with spaced learning (Nakata, 2017; Nation, 2022). The term ‘spaced learning’ here can refer to a learning method spreading out the process of learning and practising words across multiple sessions over a while, with the aim of maximising learning outcomes (Zhang et al., 2022).

Both intentional and incidental learning have positive and negative points. In the research by Laufer and Rozovski-Roitblat (2015), the most effective approach was reading materials after word-focused tasks. Although various kinds of activities involve intentional and incidental learning, it would be realistic for learners to combine both and for teachers to consider a lesson while keeping that in mind.

2.2 Technology-mediated vocabulary learning in CALL and MALL

According to Ma (2017), technologies in computer-assisted language learning (CALL) and mobile-assisted language learning (MALL) would mediate vocabulary learning and play a pivotal role in teachers’ classroom teaching and students’ learning both in and out of classrooms. As for vocabulary learning in CALL, Nation (2022) stated it may provide fast and easy access to various multimedia resources, and motivate learners. Grgurović et al. (2013) also claimed that computer-assisted second or foreign language learning was as effective as learning without technology. It would provide retrieval practices and opportunities to review learnt words (Nakata, 2011), enhancing learners’ vocabulary knowledge. Some applications (e.g., Anki (<https://apps.ankiweb.net/>) and Quizlet (<https://quizlet.com/>)) enable users to keep a learning record and learn vocabulary based on it. An individual schedule can be set according to the needs such as frequent questions with a low percentage of correct answers (Nakata, 2019).

Also, corpora and data-driven learning (DDL) may contribute to improving language awareness and noticing (Boulton, 2017) and promoting in-depth knowledge of target vocabulary such as collocations and how to use the target words (Lee et al., 2019; Lee & Lin, 2019). DDL also enables learners to encounter vocabulary in real sentences which offer rich information on words (Nation, 2022). However, only intermediate or higher L2 proficient learners may benefit from these learning styles. Due to the complicatedness of corpora and DDL, many learners, especially those with lower proficiency, would face difficulty as they could not deal with them (Boulton, 2017; Lee et al., 2019; Lee & Lin, 2019).

As for vocabulary learning in MALL, Lin and Lin (2019) showed that mobile L2 vocabulary learning was effective, especially in L2 word retention, and that mobile applications such as short message service (SMS) enabled learners to gain comprehensive input and interact with people using recently learnt vocabulary. However, mobile technologies may not be so beneficial because

some learners consider mobile devices as social tools rather than tools for study (Stockwell, 2010). While MALL can help learners retain L2 words, it would be important for teachers to consider students' perceptions and how to apply the technology to learning activities.

2.3 Meta-analyses on technology-mediated vocabulary learning

In the meta-analysis conducted by Hao et al. (2021) and similarly, Yu and Trainin (2022), technology-assisted L2 vocabulary learning would be more effective than conventional vocabulary instruction without technology. Hao et al. (2021) added that the use of technologies positively impacted long-term memory retention for newly learnt words. Vocabulary learning would be most beneficial, especially when learners use their mobile phones and their use is not limited to their classroom. However, it contradicts Stockwell (2010, 2016) stating learners did not necessarily like to use mobile phones as a studying tool. Though mobile phones might be statistically effective, the meta-analysis did not gather learners' opinions about the use of mobile devices. Therefore, it would be questionable whether mobile phones are beneficial, let alone outside classrooms if learners do not consider them a learning tool.

Also, Yu and Trainin (2022) claimed that technology would benefit incidental learning better than intentional learning because it could provide learners with authentic spoken input, communication opportunities, and individualised studying environments. This has contradicted some research on vocabulary with online quiz applications (e.g., Quizlet and Kahoot! (<https://kahoot.com/>)). Indeed, technology would expose learners to various learning environments with authentic resources, but recent flashcard software has been compatible with intentional learning (Nakata, 2011) while facilitating retrieval, receptive recall and productive recall (Kaitsu & Nakata, 2025). In addition, Mondria (2003) cast doubt on the effectiveness of incidental learning in vocabulary learning.

In these respects, the findings from these meta-analyses may not necessarily reflect reality in different individual contexts. Ali-Hoorie et al. (2022) found that vocabulary learning researchers preferred meta-analyses of experimental effects to systematic reviews, underscoring the importance of considering researching qualitative aspects as well. According to their scoping review of L2 vocabulary-related secondary research, 25 reviews adopted meta-analysis and 7 reviews utilised systematic reviews out of 31 reviews. One of the reviews seemed to adopt a systematic review and meta-analysis. The researchers also claimed that secondary research on technology-enhanced vocabulary acquisition has been one of the trends for the past 30 years. Within this broader trend, it is apparent that a greater focus on synthesising qualitative findings would be beneficial. Whether technology actually enhances vocabulary teaching and learning in any particular context is likely to depend on the features of that context, including how and what kind of technology is used, and the characteristics of the learners themselves. By aggregating characteristic themes, the findings of this qualitative synthesis of research will crystallise an overview of

the topic (Chong, 2020) and inform English teachers and researchers in Japan of some tips for teaching and future research.

3 Methodology

3.1 Research method

To better understand the topic, this present study employed a qualitative synthesis of research (QSR) as the methodology. This is a research synthesis that adopts a qualitative approach to synthesising data extracted from both quantitative and qualitative paradigms (Chong et al., 2023). As with qualitative research synthesis (QRS), the approach follows a systematic procedure (Chong & Plonsky, 2023; Liu & Chong, 2023), but is different from QRS, which only synthesises qualitative evidence (Chong et al., 2023), as it may include quantitative studies as well. The reason for adopting QSR is to capture the rich and diverse students' thoughts and experiences of social phenomena (Chong et al., 2023) that quantitative meta-analysis might overlook. However, given the time constraint for this research, the scope for literature search is limited to only three databases which were felt to give broad coverage of relevant literature. The aim of this synthesis was to uncover rich data within a focused context rather than to synthesise literature from across multiple different contexts. In the present study, by extracting both quantitative and qualitative components and synthesising them, this research would contribute to the findings within the selected scope while offering a reliable description based on a systematic approach (Chong & Plonsky, 2021).

This study referred to a methodological framework for conducting qualitative research synthesis in TESOL (Chong & Plonsky, 2021) (see Table 1) because this framework can guide its process, helping take each step systematically and transparently (Chong & Plonsky, 2021; Liu & Chong, 2023). This methodological framework is based originally on a qualitative research synthesis on technology-mediated task-based language teaching (TBLT) (Chong & Reinders, 2020) and has been used in various research syntheses including a qualitative synthesis of research conducted by Liu and Chong (2023) to investigate the situation of bilingual education in China and the perceptions of teachers and learners.

The research protocol for this synthesis was prepared and accepted at the International Database of Educational Systematic Reviews (IDESR) (Kato & Jordan, 2023).

Table 1. Phases of a methodological framework for qualitative research synthesis in TESOL
(Chong & Plonsky, 2021, p. 1027)

1 Design research question
2 Identify keywords for conducting literature search
3 Conduct literature search
4 Evaluate literature using inclusion criteria
5 Extract qualitative data
6 Synthesise qualitative data
7 Report synthesised qualitative data

3.2 Keywords for conducting literature search

When identifying keywords, it is important to use interchangeable terms (Chong & Plonsky, 2021). The focus of this research is on “technology-mediated vocabulary learning” in the Japanese context. Therefore, with the second author’s advice, not just “technology-mediated” but “technology”, “computer-mediated”, “computer-assisted”, “technology-enhanced” and “mobile-assisted” were also used as keywords. The term “technology” can capture relevant technology-related studies. Some other technology-related terms such as “AI”, “Large Language Model (LLM)”, and “Chat-GPT” are not included, as they were not yet prevalent at the time of the literature collection. In addition to “learning”, “teaching”, “instruction”, and “acquisition” were chosen. Based on these terms, the following keywords were used in searching for the relevant literature in English:

(“technology*” OR “technology-mediated*” OR “computer-mediated*” OR “computer-assisted*” OR “technology-enhanced*” OR “mobile-assisted*”) AND “vocabulary” AND (“teaching*” OR “learning*” OR “instruction*” OR “acquisition*”) AND “Japan”

On top of the keywords, Japanese keywords were also developed as this study focused on the Japanese context. In Japanese, the term “technology” can often be replaced by “computer”, “mobile”, “ICT”, and “digital”. The term “単語” is not used in the Japanese keywords. While it is often used in daily conversation, “語彙” is the more standardised academic terms applied in Japanese vocabulary learning research and its use maintains consistency with the English keyword “vocabulary.” With the second author’s agreement (the second author is also highly proficient in Japanese), the following Japanese keywords were used in searching for the literature:

(テクノロジー OR コンピュータ OR モバイル OR ICT OR デジタル) AND 語彙 AND (指導 OR 学習 OR 習得)

3.3 Literature search

Using the keywords mentioned above, a literature search on the primary research was carried out in May 2023 on the following databases: Scopus, ERIC, and J-STAGE. For literature written in English, Scopus and ERIC were used, and J-STAGE was used for searching for articles written in Japanese. To maintain the rigour of each primary research, this study focused on peer-reviewed journal articles. However, on Scopus, since a significant number of studies appeared and due to the limited amount of time for this project, journals were limited as follows: Computer Assisted Language Learning (CALL), Recall, System, Language Teaching Research, JALT CALL Journal, and TESOL Quarterly. These journals were chosen as they were influential peer-reviewed journals within the field of applied linguistics and CALL, and have a strong track record in publishing vocabulary, technology-related language education, and CALL research. In addition, from J-STAGE, bulletin papers from academic associations were also included because there were few articles on the topic in Japanese.

In a literature search, titles and abstracts of the identified studies were first skimmed through, and those that did not have keywords or meet search conditions were removed. While Scopus and ERIC automatically excluded some articles that did not satisfy search conditions, some results shown were not Japanese-specific. In addition to titles and abstracts, potential studies were found by skimming whether research was conducted in Japan. On the other hand, a Japanese database, J-STAGE, does not have advanced search features like the other databases. Therefore, potential studies from the database were identified only through skimming titles. Through the identification process from Scopus, ERIC, and J-STAGE, 63 potential articles were included (See Figure 2). Information about those papers was recorded in an Excel spreadsheet, and the following details were noted: titles, authors, years, journals, locations, contexts, whether they are conducted in the classroom, whether they have a qualitative component, and DOI or URLs. The articles were also screened through titles, abstracts, and methodology sections or participants sections, and when studies were considered to include such information, studies were downloaded and run through. After this screening process, 26 studies were excluded, resulting in 37 articles (see Figure 2).

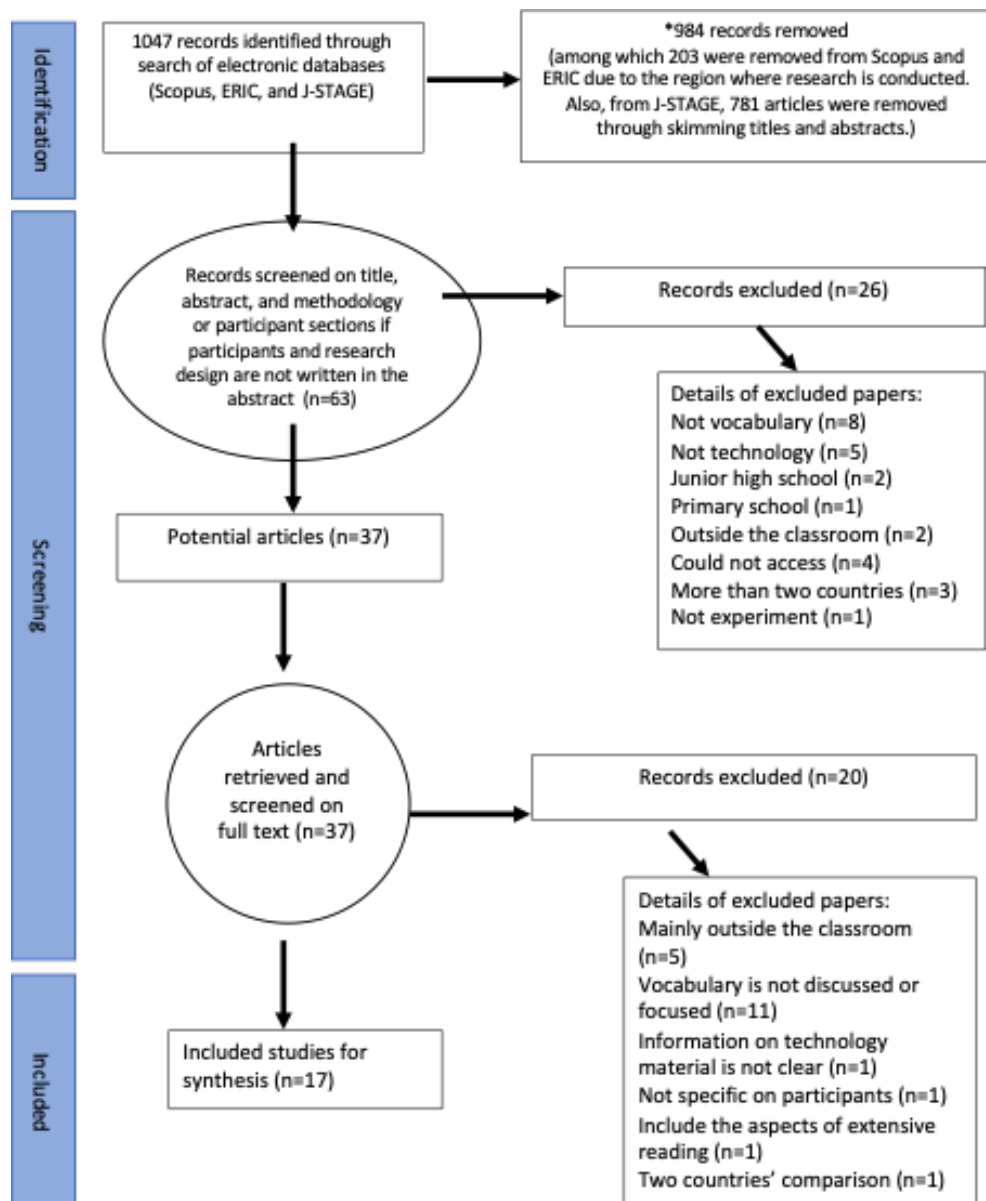


Figure 2. Flow chart of the selection process (based on Page et al., 2021)

3.4 Literature evaluation with inclusion criteria

After the first screening process, a further screening was conducted by adopting the following inclusion criteria:

1. The articles were published between 2013 and 2023 April, or until the database allowed us to access them (the year range was applied during the first identification process when searching literature).
2. The studies were conducted in EFL classrooms in Japanese universities or high schools.
3. The articles were published in English or Japanese.

4. Primary research in journal articles (Scopus and ERIC) and in journal articles and bulletin papers (J-STAGE).
5. The articles refer to at least one type of technology and adopt a conceptual or theoretical framework for vocabulary learning or teaching.
6. To assess the quality of each study, the qualitative analysis of the articles follows the guidelines adopted by Chen's (Chen, 2016, p. 376) systematic review using the Qualitative Research Guidelines of the Journals of Language Learning and Technology and TESOL Quarterly (Mahboob et al., 2016). Criteria summarised include (a) meticulous descriptions of participants and contexts; (b) a theoretical or conceptual framework; (c) data collection and data analysis; (d) limitations and implications; and (e) findings and discussion. In terms of (a) meticulous descriptions of participants and contexts, some raw data (e.g., student interviews and teacher interviews) should be transcribed. However, this study also includes papers only with some interpreted data even if raw data were not written if the interpreted data are sufficient to contribute to the research.

The year range was between 2013 and 2023, which provides up-to-date information on technology-mediated vocabulary learning. This year frame would reflect the reality that technology has advanced rapidly for the past ten years. However, ERIC did not return results published in 2023 at the time the search was conducted. The year range of the articles from ERIC was therefore between 2013 and 2022.

In terms of language, primary studies written in English and Japanese were included. As for the context, studies conducted in EFL classrooms in Japanese high schools and universities were included. Indeed, quality studies are written in other languages or conducted in other teaching contexts such as teaching and learning other languages using technology (e.g., teaching Spanish vocabulary using technology in Japan). However, in order to focus on teaching and learning English vocabulary using technology, this research focused only on EFL classrooms.

This present study also focused on the articles that refer to at least one type of technology and included some aspects of vocabulary teaching and learning as a central part. The articles that did not have a section discussing vocabulary teaching or learning were excluded. Even if some studies investigated influences on learning caused by technology and found some effectiveness on vocabulary, those studies were excluded if they did not explicitly discuss vocabulary acquisition.

After the 37 articles were identified, all of them were downloaded and screened on full text. 20 of them were excluded for the following reasons respectively: mainly outside the classroom (five studies), no explicit section to discuss vocabulary (11 studies), not clear information on technology (one study), insufficient information on participants (one study), not Japan focused (one study), and extensive reading focused (one study) (see Figure 2). The study on extensive reading was excluded because its focus was not on vocabulary teaching and learning, but more on enhancing autonomy through extensive

reading (Shimomura & Hattori, 2021). Finally, 17 studies were chosen for this qualitative synthesis of research (see Appendix 1 online).

3.5 Data extraction and synthesis

From the 17 included studies, information was extracted using an extraction form (see Appendices 2 and 3 online). This form corresponds to the research questions. It was also reviewed by a collaborator who is an expert in the field of TESOL and education, with experience of supervising students' secondary research. After receiving feedback, data extraction was begun. At this stage, both raw and interpreted qualitative data were extracted.

To gain insight into technology-mediated vocabulary learning in EFL classrooms in the Japanese context, thematic analysis based on Braun and Clarke (2006) was adopted to identify, analyse, and report the characteristics, advantages and disadvantages, and students' perceptions of the topic. Thematic analysis can be a flexible and accessible approach to novice researchers, and findings from this are generally available to researchers and the educated public such as teachers (Braun & Clarke, 2006). This inductive approach is in line with the intention to make the characteristics and other aspects of this research available to many teachers as well as researchers.

The data synthesis was conducted through six phases adopted by Braun and Clarke (2006, pp. 87–93) (see Table 2). In synthesising data, referring to Liu and Chong (2023), data were compared with different points such as research questions and participants, and themes for each point were developed in an inductive way.

In synthesising research, NVivo (Release 1.7.2), a qualitative research software was used to create codes and themes. With it, 339 initial codes were made in total. Codes were inductively created based on background information, as well as emergent themes based on the research questions of the included studies, RQ1, and RQ2. It is worth noting that the first author was in a supervised context for his master's dissertation. Although the second author (the supervisor) oversaw and discussed the synthesising process, the code creations were mainly done by the first author. To avoid bringing subjective views into coding, the second author reviewed the analysis process, provided feedback (particularly on how codes would be merged, and the names of different themes), and discussed the risks and difficulties that the first author would face (see Appendix 4 online for records of discussion of coding and theme making with the second author).

For example, in terms of *Effects* of emergent themes from research questions, the first author initially coded 'Does student English proficiency level influence the relative effectiveness of digital and paper flashcards in terms of L2 vocabulary learning gains?' (Ashcroft et al., 2018, p. 18) as *effectiveness of digital and paper flashcards* and 'What effects, if any, does a mobile-based AAM instructional strategy exert on the vocabulary learning achievement of Japanese EFL university students?' (Lewis III & Datzman, 2020, p. 12) as *effects of a mobile-based authentic audio-visual material*. Following the second author's

advice of using general and simple terms for themes, the first author combined them and relevant data into the theme named *Effects*. As for the presentation of themes, it is also important to note that the frequencies reported in this study do not indicate significance by themselves. However, the authors did feel it was important to show the prevalence of specific themes within the literature reviewed.

This research aimed to be explicit about its quality and validity (Gough, 2007). To improve transparency and accuracy of the research, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Page et al., 2021) was adopted (Chong & Plonsky, 2021). In addition, the Weight of Evidence (WoE) Framework (Gough, 2007) was applied to the appraisal of the review. The framework has three different criteria and some dimensions in each criterion (See Table 3). This present review would be considered as meeting all the Weight of Evidence (WoE) criteria from A to C: WoE A by its systematic and transparent reporting of research process; WoE B by choosing a qualitative synthesis of research as a method aligned with the research questions; WoE C by its focus specifically on classroom-based and technology-mediated studies that are also relevant to the research questions.

Before submission of this research to a journal, the title was registered on the Title Registration of Research Synthesis in Applied Linguistics (<https://docs.google.com/forms/d/e/1FAIpQLSc08Z07mRrH5VNhP3NHHt0DXZbimUdt-Q1iJF-7HyPHhyVSAw/viewform>). This form keeps records of ongoing research synthesis to prevent other synthesists from duplicating research on progress and potentially promote future collaborations with researchers who have similar interests.

Table 2. Phases of thematic analysis (Braun & Clarke, 2006, p. 87)

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Table 3. Framework of the Weight of Evidence and dimensions (based on Gough, 2007, p. 224)

The Weight of Evidence	Dimensions
Weight of Evidence A: Generic on quality of execution of study	Transparency: clarity of purpose Accuracy: accurate Accessibility: understandable Specificity: method-specific quality
Weight of Evidence B: Review specific on appropriateness of method	Purposivity: fit for purpose method
Weight of Evidence C: Review specific on focus/ approach of study to review question	Utility: provide relevant answers Propriety: legal and ethical research

4. Results and Discussion

4.1 Background information of the 17 studies

In the 17 studies, 34 research questions were found, and they were classified mainly into three themes: *Effects*, *Perceptions*, and *Outside the classroom* (see Table 4). Effect-related questions accounted for 25 out of 34 questions. 17 questions were about the effectiveness of technology-mediated vocabulary learning, and of the 17 studies, 16 studies set this kind of question and conducted their research (Obermeier & Elgort, 2021). Four out of 34 research questions were those about cognitive aspects such as retention and recall (e.g. Dilenschneider, 2017), and the other four questions aimed to report or clarify the outcome of technology-mediated vocabulary learning (Geluso & Yamaguchi, 2014). Followed by the theme of *Effect*, the second largest theme was *Perceptions*, which accounted for seven research questions. Six of them were students’ perceptions of technology-mediated vocabulary learning (e.g., Tanaka et al., 2015), and the remaining question tried to reveal potential concerns (e.g., Hadley & Charles, 2017). The last theme of research questions was *Outside the classroom*, accounting for two out of 34 (Dizon & Tang, 2017).

Regarding research methods, 11 studies carried out quantitative research using questionnaires and various kinds of tests (Obermeier & Elgort, 2021). Six studies adopted mixed methods (e.g., Mueller & Jacobsen, 2015). In the included 17 studies, none of them exclusively used qualitative analysis.

As for learners in the studies, all the research was conducted in a university or college. Six studies clarified students’ English levels. Four studies reported that students’ English proficiency was intermediate level (e.g., Satake, 2022), and the other two studies reported their proficiency was around intermediate to advanced level (e.g., Ashcroft et al., 2018). There was no research conducted in high school even though it was in the inclusion criteria.

Table 4. Emergent themes from research questions

Theme names	Number of studies (out of 17 studies)	Frequency of occurrence (out total of 34 instances)
Effects	16	25
Perceptions	6	7
Outside the classroom	2	2

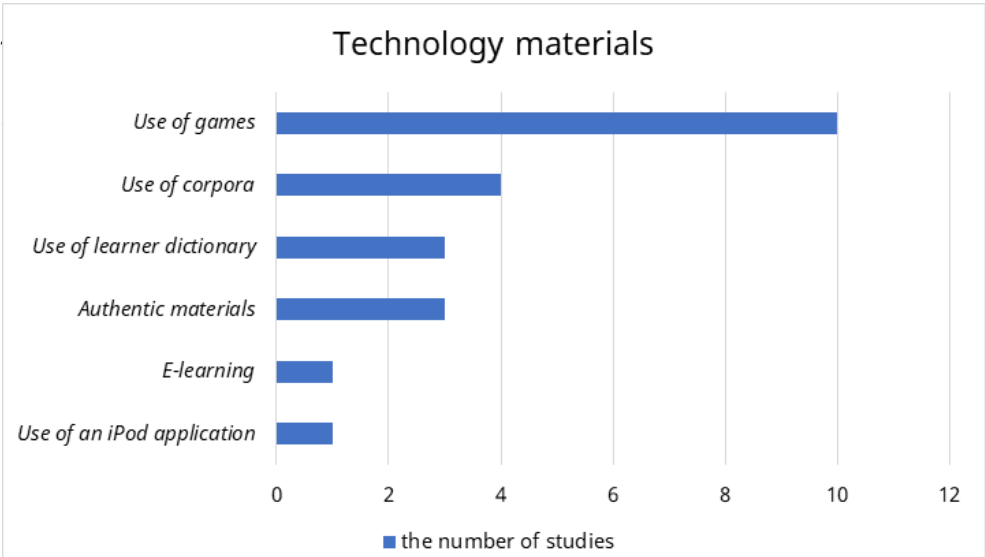


Figure 3. Materials of technology-mediated vocabulary learning

Table 5. Subthemes from Use of games (percentage of frequency of occurrence was rounded off when calculated)

Themes names - Sub-themes	Number of studies (out of 17 studies)	Frequency of occurrence (total of 53 instances)
Use of games	10	26 (49%)
- Flashcard games	- 9	- 21 (40%)
- Simulation games	- 2	- 5 (9%)

The use of games can be considered to promote both intentional and incidental learning. To be more specific, flashcard quizzes relate to the aspect of intentional learning, and simulation games promote incidental learning.

Though flashcard games are separated from teaching contexts, they enable learners to check many words efficiently within a limited amount of time, and can help with vocabulary acquisition (Nakata, 2019). As investigated in Kaitsu and Nakata (2025), flashcard games seem to be beneficial for L2 vocabulary learning. *Quizlet* and *Kahoot!* have functions that allow students to facilitate retrieval and receptive and productive recall while enjoying themselves through gamified activities in classrooms. They also enable learners to create

a set of words with target words and their meanings and share it with other students. In addition to simple quizzes, these tools allow learners to have competitions in groups or in a class, which would motivate them and make them want to use those applications more. Additionally, questionnaire software such as Google Forms and Survey Monkey were also used along with *Quizlet* or *Kahoot!* in three studies (Lewis III & Datzman, 2020; Nakanishi et al., 2021; Obermeier & Elgort, 2021). These appeared less attractive compared to *Quizlet* and *Kahoot!* as they do not have a game element nor provide questions with visual materials such as pictures at the same time. However, the questionnaires can help teachers to better manage students' learning conditions (Nakata, 2019). When students answer quizzes in the questionnaire, having them provide their names and student IDs allows the teacher to grasp what each student has learned, which would help the teacher to consider the teaching method, leading to the improvement of the class. The teacher can apply the information to the classroom so that students can have more repetition or spaced learning (Nakata, 2017; Nation, 2022) by using flashcard games. Thus, as Elgort (2011) and Webb (2007) stated about the effectiveness of intentional learning, the combination of quiz applications and questionnaires may be effective and efficient. This combination has the potential to promote students' vocabulary acquisition, while also providing teachers with useful progress information regarding their students.

Another characteristic noted, the use of simulation games, would provide students not only with individual words but also with expressions/formulaic language within contexts, leading to incidental learning. Two included studies (Franciosi, 2017; Franciosi et al., 2016) adopted group work for a simulation game, and both games are close to real-life settings. In these studies, students had opportunities to discuss and decide on some issues as the story progressed, providing sufficient information on how words can be used (Webb et al., 2020). The use of simulation games may be effective in this era of Japanese English education, considering that MEXT (2019) has recently been aiming to realise proactive, interactive, and authentic learning while encouraging the use of technology. Through students working in a group, the simulation games generate interactions with peers, facilitating their understanding of the stories (Gass et al., 2011). By tackling issues close to real-life settings, students may gain depth of vocabulary knowledge such as English usage and collocations (Zhang & Lu, 2015).

In terms of technology-mediated vocabulary learning, the combination of flashcards or quizzes and simulation games has the potential to work well together in developing students' breadth and depth of vocabulary knowledge. However, applying simulation games in many Japanese schools may be challenging. Teachers are often required to teach with authorised textbooks, which may limit the class time available for such games. In addition, it seems questionable whether the simulation games can promote students' output that aligns with the curriculum, and students may choose not to speak English during discussions and interaction with peers while working on the simulation games. On the other hand, applying flashcard applications seems a realistic approach

for the teacher to use technology along with textbooks. This has the potential to maximise students' vocabulary learning with spaced learning (Nakata, 2019; Zhang et al., 2022).

Followed by *Use of games*, the second most significant characteristic was *Use of corpora* (see Figure 3). Two studies used the Corpus of Contemporary American English (COCA) (e.g., Mueller & Jacobsen, 2015), one study the British National Corpus (BNC) (Satake, 2022), and one study Bookworms Graded Readers as corpus material (Hadley & Charles, 2017). Of the four studies, three studies implemented DDL using the corpora (e.g., Geluso & Yamaguchi, 2014), and the other study utilised one of the corpora as a comparison with dictionaries (Mueller & Jacobsen, 2015).

This research found that corpora and DDL had advantages and disadvantages. Rich information in a corpus contributes to remembering collocational expressions and understanding the depth of vocabulary knowledge (Satake, 2022). Also, some learners feel that corpora and DDL are useful in writing and speaking tasks (Geluso & Yamaguchi, 2014). Information on corpora enables learners to choose appropriate words that are adapted to situations, leading to the improvement of accuracy (Mueller & Jacobsen, 2015). These agree with Lee et al. (2019), which notes that corpus use promotes a deep understanding of word usage and collocations. Corpora can serve as both intentional and incidental vocabulary learning. Activities where teachers ask students to intentionally utilise corpora would be an efficient way of expanding their knowledge of usage and collocations on a focused word. Some students in Geluso and Yamaguchi (2014) state difficulties in understanding the meanings of sentences in a corpus and nuanced differences because texts students encounter during DDL are often separated from contexts. However, with teachers' support, DDL can provide students with massive exposure to authentic texts, potentially contributing to efficient vocabulary learning (Boulton, 2017), facilitating incidental learning.

On the other hand, two studies (Lee et al., 2019; Lee & Lin, 2019) also point out that low-proficiency learners of L2 may not benefit from the use of corpora and DDL. This is confirmed by the disadvantages of DDL use that are evident from this synthesis. Learners found it hard to use corpora (Geluso & Yamaguchi, 2014; Hadley & Charles, 2017; Mueller & Jacobsen, 2015; Satake, 2022), and despite rich information on corpora (Mueller & Jacobsen, 2015), they appeared to fail to capture the meaning of some words because of a lack of context beyond just one single sentence (Geluso & Yamaguchi, 2014; Mueller & Jacobsen, 2015).

4.3 RQ2 – What are the affordances and limitations of technology-mediated vocabulary learning in EFL classrooms in Japan?

In answer to the second research question, Table 6 provides significant themes that appeared from this qualitative synthesis of research. The data were as follows: Promoting vocabulary acquisition (n = 15); Fostering students' attitudes toward vocabulary learning (n = 13); Obstacles to learning with technology (n

= 8); Students' negative opinions (n = 9) (see Table 6). These affordances and limitations, which emerged from Japanese classroom-based studies, may provide food for thought for teachers considering technology-mediated vocabulary learning. The constraints shown here could be moderated by additional teacher support.

Table 6. Emergent themes from the thematic analysis (the percentage of the frequency of occurrence was rounded off when calculated)

Themes names - Sub-themes	Number of studies (out of 17 studies)	Frequency of occurrence (total of 174 instances)
Promoting vocabulary acquisition	15	61 (35%)
- Contribution to comprehension	- 4	- 4 (2%)
- Efficient	- 3	- 5 (3%)
- Enhancing vocabulary learning	- 15	- 48 (28%)
- Informative	- 2	- 2 (1%)
- Output	- 1	- 2 (1%)
Fostering students' attitudes toward vocabulary learning	13	49 (28%)
- Favourable	- 10	- 33 (19%)
- Fun	- 2	- 7 (4%)
- Motivation	- 4	- 9 (5%)
Obstacles to learning with technology	8	38 (22%)
- Complicatedness	- 6	- 29 (17%)
- The need for assistance	- 6	- 9 (5%)
Students' negative opinions	9	26 (15%)
- Little motivation	- 5	- 9 (5%)
- Not effective	- 8	- 16 (9%)
- Not natural	- 1	- 1 (1%)

4.3.1 Affordance 1: Promoting vocabulary acquisition. One advantage noted of technology-mediated vocabulary learning in EFL classrooms in Japan is *Promoting vocabulary acquisition*, which accounted for 35% of occurrences, spread across 15 studies. In this theme, the most significant sub-theme was *Enhancing vocabulary learning*, which was the largest share among all the emergent themes on technology-mediated vocabulary learning in EFL classrooms in Japan. All of the 15 studies mentioned the positive influence on vocabulary acquisition through vocabulary activities using technology in classrooms. For example, Ashcroft et al. (2018) stated digital flashcard L2 vocabulary learning positively impacted proficiency in learners' newly learnt words. The accessibility of rich example sentences from online materials, such as in a web-based multimodal dictionary, enabled learners to look up the target words and expressions (Sato, 2016). Some other research noted that technology, such as vocabulary learning applications and online dictionaries, contributed to word retention (Dilenschneider, 2017) and quick recall of word meanings (Sato et al., 2013), and that learners' creating vocabulary questions online helped them remember words (Nakanishi et al., 2021). Vocabulary acquisition was also supported by online quiz functions (Dizon, 2016). Such different usages of technologies seemed to facilitate intentional learning. Five other studies reported

that technology use inside classrooms improved the depth of learners' vocabulary knowledge, especially about the use of words (Geluso & Yamaguchi, 2014; Lewis III & Datzman, 2020; Mueller & Jacobsen, 2015; Obermeier & Elgort, 2021; Satake, 2022). Studies that adopted corpora and DDL demonstrated increased learners' knowledge of collocations and how to use the target words (Geluso & Yamaguchi, 2014; Mueller & Jacobsen, 2015). It was also illustrated that technology facilitated the understanding of authentic English such as English expressions that were written or that learners heard (Geluso & Yamaguchi, 2014). Technologies such as corpora, as well as authentic materials, appeared to contribute significantly to incidental learning.

The finding that technology promotes vocabulary learning (Ashcroft et al., 2018) agrees with Hao et al. (2021) and Yu and Trainin (2022), but the result of this present study shows a slightly different outcome from theirs. Though they both show that technology contributes to learners' vocabulary acquisition, Hao et al. (2021) mentioned it was in memory retention that technology-mediated vocabulary learning was most effective, especially when students are allowed to use the technology device or services outside the classrooms. Yu and Trainin (2022) claimed that authentic spoken input, communication opportunities, and individual studying environments using technology are more conducive to incidental learning than intentional learning. In comparison, this present study focused only on technology inside classrooms and found that technology-mediated vocabulary learning may be beneficial for memory retention, incidental learning, and intentional learning, improving both the breadth and depth of vocabulary knowledge. It is important to remember that such effects may vary depending on what kind of technology is used or how it is adopted in classrooms. As can be seen in section 4.2, meaning-focused input and form-focused activities such as flashcards and quizzes using technology connect with intentional learning, contributing mainly to developing the breadth of vocabulary knowledge. By incorporating flashcards and quizzes with spaced learning, intentional vocabulary learning can be enhanced. On the other hand, simulation games and DDL incorporated with writing and speaking tasks may positively influence the depth of vocabulary knowledge. Authentic materials used in the included studies, which would lead to incidental learning (Webb, 2007; Webb & Nation, 2017), are also combined with activities such as flashcards and quizzes. Such a combination of materials may facilitate an appropriate balance of intentional and incidental learning.

4.3.2 Affordance 2: Fostering students' attitudes toward vocabulary learning. The second affordance from the emergent themes was *Fostering students' attitudes toward vocabulary learning*, which accounted for 28% of occurrences across 13 studies. Ten studies noted favourable opinions about technology-mediated vocabulary learning. For instance, technology was useful in checking the learning progress (Tanaka et al., 2015), learning natural expressions (Satake, 2022), and repeatedly practising the same words they once encountered (Tanaka et al., 2015). Some studies noted the convenience technology provided. Two studies in which corpora were used mentioned their convenience and

usefulness (Mueller & Jacobsen, 2015; Satake, 2022). Technology made it easier for learners to access the meaning of words they did not know (Dilenschneider, 2017), and its convenience and accessibility led to favourable attitudes by learners saying that they liked using technology and wanted to use it more (Mueller & Jacobsen, 2015).

In addition to some preference for technology-mediated vocabulary learning, four studies showed positive influences on learners' motivation. For example, the technology use improved their motivation (Nakanishi et al., 2021), increased the time they got exposed to English (Tanaka et al., 2015), and led to autonomous learning (Nakanishi et al., 2021). Also, some studies mentioned that technology enabled learners to study vocabulary while having fun, to learn it as if they were playing a game, and to understand it in a quiz style (Dizon & Tang, 2017; Nakanishi et al., 2021).

That technology-mediated vocabulary learning motivates students and makes them want to study more (Nakanishi et al., 2021) corresponds to Nation (2022) stating that technology-assisted vocabulary learning motivates and engages learners in studying. The findings of this study suggest that technology enables students to learn vocabulary while having fun, which would lead to their attitude toward vocabulary learning using technology. Quizzes using Quizlet or Kahoot! have this aspect as some students did not find it arduous to study vocabulary with technology (Nakanishi et al., 2021). Students in the included study also found technology functions such as recoding their learning progress, and repeated and spaced practice, effective. It is conceivable that such functions would generate students' favourable impression of technology-mediated vocabulary learning.

4.3.3 Limitation 1: Obstacles to learning with technology. One of the limitations evident from the data was *Obstacles to learning with technology* (n = 8). This was also divided into two sub-themes: *complicatedness* (n = 6) and the *need for assistance* (n = 6) (See Table 6). Regarding complicatedness, four studies that adopted corpora and DDL reported the difficulty learners experienced in using them (e.g., Hadley & Charles, 2017). As with Boulton (2017), two studies (Lee et al., 2019; Lee & Lin, 2019) explain that many learners had difficulties dealing with corpora and DDL, the same can be true of the outcomes from this present study. Due to the complicatedness of usage and large amounts of information, students in the included studies may have felt overwhelmed and demotivated, especially learners with lower levels of L2 proficiency (Geluso & Yamaguchi, 2014; Mueller & Jacobsen, 2015; Satake, 2022).

As for the *need for assistance*, some studies noted the need for assistance or instructions to learners from teachers (n = 6). In addition to the importance of support for students, Mueller and Jacobsen (2015) claimed that creating teacher manuals would also be necessary. It would enable teachers to deal with technological issues and problems that students might face in technology-mediated learning.

Offering some assistance to learners can contribute to the improvement of such obstacles. How the teacher conducts lessons using corpora and DDL

may determine their efficacy, and the key to such lessons can be how he/she prepares for them and how he/she provides students with assistance. The difficulties and complicatedness can be alleviated to some extent by such assistance. This would change students' feelings toward DDL, possibly improving the limitations.

4.3.4 Limitation 2: Students' negative opinions. The other limitation that appeared was *Students' negative opinions*. In this limitation, nine studies referred to the negative aspects of technology-mediated vocabulary learning aside from its difficulties (Dilenschneider, 2017), and technology-mediated learning was sometimes reported as being ineffective ($n = 8$). In some studies, for example, learners concluded that it was just rote learning (Hadley & Charles, 2017), just copying and pasting (Tanaka et al., 2015), and simply monotonous work (Geluso & Yamaguchi, 2014). Two studies mentioned that technology-mediated learning did not bring a huge difference in learning compared to when students were not using technology (Dilenschneider, 2017; Sato, 2016). Some students in the included studies pointed out that technology-mediated vocabulary learning did not enhance their motivation (Hadley & Charles, 2017). In terms of retention, while technology was useful in students' retention or comprehension of words (Nakanishi et al., 2021), two included studies reported that the use of technology did not lead to their enhancement (Ashcroft et al., 2018; Dilenschneider, 2017). This contradicts Hao et al. (2021) and one of the affordances of this study saying that technology contributes to vocabulary retention and memorization (Dilenschneider, 2017). It may depend on individual students or activities using technology whether technology-mediated vocabulary learning enhances their vocabulary learning, especially the breadth of their vocabulary knowledge.

In contrast to students' positive attitudes toward vocabulary learning, technology-mediated learning did not stimulate their motivation ($n = 5$) (Hadley & Charles, 2017). In the studies that adopted corpora and DDL, learners were not comfortable with using them and did not have sufficient vocabulary to understand sentences on them (Mueller & Jacobsen, 2015).

On the other hand, this study contradicts Stockwell (2010, 2016) suggesting that students cannot consider mobile devices as studying tools. No such data were found in the included studies (noting that these were limited in number), although this study does not focus only on mobile devices.

4.4 Implications for practice

4.4.1 Relationship between meaning-focused output and technology-mediated vocabulary learning in EFL classrooms in Japan. Technology-mediated vocabulary learning may not lead to activities that promote students' speaking skills. Although more elements such as output or interaction with other students and teachers should be considered (Yu & Trainin, 2022), it is challenging to design activities that enhance students' productive skills when teachers consider vocabulary teaching materials based on. The primary studies in this

research adopted technology to encourage meaning-focused input, language-focused input, and fluency development, influencing positively intentional and incidental learning through these strands. However, no technology-mediated vocabulary learning related to meaning-focused output was reported in the included studies.

In terms of classroom vocabulary teaching, Nation (2022) claimed that the teacher should plan teaching with an appropriate balance of four strands: meaning-focused input, language-focused input, meaning-focused output, and fluency development. Vocabulary learning in the classroom should ideally be supported across these strands, with strategies and support provided by teachers. Technology-mediated vocabulary learning in classrooms requires more time on the teacher's instructions about how to use technology, and teachers may need to support students constantly during activities mediated by technology. Also, given that technology-mediated vocabulary learning may be difficult to combine with meaning-focused output that enhances students' productive skills, a realistic approach to developing their ability to produce vocabulary knowledge may be to adopt technology-mediated vocabulary learning activities as a complement to output activities, rather than attempting to combine these two elements.

4.4.2 Need for assistance. In implementing technology-mediated vocabulary learning in EFL classrooms, it is necessary for the teacher to explain how to use technology explicitly, observe students' activities, and offer some guidance. As can be seen in the affordances and limitations sections above, the advantages and disadvantages conflict with each other. This contradiction could also apply to other vocabulary learning using technology. Two limitations, obstacles to learning with technology and students' negative opinions, can be ameliorated by step-by-step support from the teacher. These limitations may influence each other. The fact that many students in the included studies found technology-mediated vocabulary learning difficult may lead to their negative attitude. The complicatedness of technology-mediated vocabulary learning may have caused the barriers, negatively affecting students' feelings. However, those feelings can be mitigated through explicit instructions (Tanaka et al., 2015) and ongoing support during their activities (Dizon, 2016). Therefore, the teacher needs to be familiar with how to use the technology and provide step-by-step support. Vocabulary learning strategies and support provided by teachers, focused on an appropriate balance across four strands over time (Nation, 2022), may help maximise positive impact on students' vocabulary learning using technology.

5. Conclusion

This qualitative synthesis of research underscores the roles of digital games, corpora, and DDL in Japanese EFL classrooms in tertiary contexts. Games, including flashcards and simulations, can effectively enhance vocabulary breath, though the integration of the digital games is often constrained by text-book centred curricula. Conversely, corpora and DDL facilitate a deeper

understanding of vocabulary depth, such as word usage and collocations. Students will make the most of them if teachers provide scaffolded, step-by-step guidance. It would especially be necessary for lower-proficiency learners.

Although technology-mediated vocabulary learning can potentially enhance students' vocabulary knowledge, motivation, and positive attitude towards the use of technology in vocabulary learning, this study demonstrates two barriers: complexity and students' scepticism regarding long-term retention, which could also affect their motivation. To alleviate these, teachers could offer explicit instruction about technology and share some stories of students who successfully employed technology to enhance vocabulary knowledge. Moreover, technology alone may not foster meaning-focused output. Therefore, to facilitate balanced vocabulary teaching over time, teachers play a crucial role in navigating pedagogical difficulties with technology in different learning contexts.

This research synthesis on technology-mediated vocabulary learning in EFL classrooms in Japan has some limitations. The author limited the journals and databases searched for practical reasons. However, this focused synthesis does not reflect a comprehensive view of the field and does not present findings that are generalisable to any educational context. In particular, this research may have underrepresented emerging or grass-roots practices or classroom research found in other international or regional journals. Also, this research has some potential biases. While care was taken to ensure that all decisions made during the research process were based on objective and transparent criteria, it is possible that the author's enthusiasm for technology and vocabulary teaching and learning may have influenced the interpretations of some data.

This study highlights a lack of research on technology-mediated vocabulary learning in settings outside of higher education, including high schools, in Japan (see Appendix 1 online), likely due to teachers' busy schedules and inability to conduct research beyond everyday classes. It is often said that research results may not align with teaching contexts, but in a sense, this is not surprising if there is no research being done in the first place, if it cannot afford to be done, and if there is little research close to the contexts of particular groups of practitioners. To address this, teacher-researchers would be well-placed to closely mirror various contexts and conduct research that aligns with the needs of these contexts. The Board of Education or MEXT should consider creating an environment where teaching practitioners can engage in both research and teaching, allowing them to make the most of the impact of research and provide enhanced teaching.

Vocabulary learning research is not limited to high schools and tertiary contexts. This study excluded other contexts such as primary school, junior high school, and out of school contexts. It would be beneficial for future syntheses to capture a more comprehensive perspective from broader contexts.

Future research should also examine teachers' perspectives on technology-mediated vocabulary learning in EFL classrooms, as no teachers' perceptions existed in the 17 included studies reviewed here (see Appendix 3 online). This research first attempted to gather teachers' perceptions to compare those with learners' (see Appendix 2 online). However, the data gathered were mainly

on students' opinions and researchers' interpretations, which may not reflect the unique experiences of teachers in teaching English. Research inside classrooms would be more practical by reflecting both students' and teachers' perceptions. If more qualitative aspects are synthesized for secondary research from broader contexts, they will further reflect the detailed reality of learning environments. This may have a synergetic and positive effect on classroom teaching and learning.

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Data availability statement

The data supporting the findings of this study are available within the article and its online appendices.

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