

## Review Article

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## Comparative Analysis of Mobile Applications and Traditional Methods in Vocabulary Acquisition

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### Abstract

**Background/purpose.** This study provides a comparative review of mobile applications and traditional classroom methods in English vocabulary acquisition. It explores whether mobile-assisted vocabulary learning (MAVL) results in better retention, engagement, and productive vocabulary use among ESL learners. The study also aims to identify underlying theories supporting each method and assess learner preferences across diverse contexts.

**Materials/methods.** A theoretical, narrative literature review was conducted by analyzing peer-reviewed articles published between 2018 and 2025. Studies were retrieved from databases such as Scopus, Web of Science, ERIC, and Google Scholar using keywords including "mobile learning," "ESL," and "vocabulary acquisition." The review applied strict inclusion/exclusion criteria, focusing on research comparing MAVL with traditional methods, and employed thematic synthesis of learner profiles, research design, outcomes, and theoretical frameworks such as spaced repetition, dual coding, and self-regulated learning.

**Results.** Findings indicate that mobile applications often lead to superior vocabulary retention and learner engagement, largely due to multimedia features, spaced repetition, and gamification. However, traditional methods remain strong in developing productive vocabulary skills through contextual and teacher-mediated instruction. In several cases, a blended approach combining both methods yielded the most effective outcomes.

**Conclusion.** Mobile applications offer significant advantages in ESL vocabulary acquisition, particularly in terms of retention, motivation, and learner autonomy. Yet, to fully develop productive skills and contextual understanding, these tools should be integrated into traditional classroom instruction. Future research should focus on long-term retention, productive language use, and adaptive hybrid models to optimize vocabulary learning outcomes.



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## 1. Introduction

Vocabulary mastery is the linchpin of second-language success—without a robust word bank, even the most motivated ESL learners struggle to read complex texts, participate in discussions, or write with confidence. Yet traditional techniques (flashcards, word lists, in-class drills) can feel repetitive and fail to engage learners beyond the classroom. At the same time, mobile apps promise anytime, multimedia practice, but their true impact on long-term retention and real-world use remains unclear. This review, therefore, examines peer-reviewed studies from 2018 to 2025 to determine whether app-based tools match or outperform conventional methods in fostering both retention and productive use of English vocabulary.

Vocabulary knowledge forms the bedrock of language proficiency, directly impacting literacy, communication, and academic success. In second language learning, a strong vocabulary foundation is *“critical not only for literacy development, but also for effective communication and access to complex academic materials”*. ESL learners often struggle to acquire sufficient vocabulary, and educators have long sought effective methods to enhance vocabulary retention and usage. Traditionally, vocabulary has been taught through methods such as rote memorisation, paper flashcards, word lists, and classroom activities. These conventional techniques, while proven effective, can sometimes be repetitive and lack interactive stimuli to engage learners. In recent years, the proliferation of smartphones and educational apps has introduced new avenues for vocabulary learning. Mobile applications enable learners to study vocabulary anywhere and at any time, utilizing multimedia content and interactive exercises that were previously unimaginable in print-based approaches.

Recent meta-analyses provide strong quantitative evidence for the benefits of mobile tools: Mahdi (2018) found a medium effect size ( $g \approx 0.67$ ) favoring spaced-repetition apps over paper flashcards, and Mihaylova et al. (2022) reported an even larger mean effect ( $g = 0.88$ ) across studies comparing mobile-assisted learning (MALL) to traditional classroom methods. However, controlled classroom experiments paint a more nuanced picture: Li & Hafner (2022) observed equivalent short-term gains in receptive vocabulary between app-using and paper-studying groups but no significant difference in their productive use of target words, while Gou (2023) showed that, although app users achieved higher retention scores on delayed tests, their ability to deploy new vocabulary in writing and speaking tasks did not consistently surpass that of traditional learners. These landmark findings highlight both the promise and limitations of mobile-assisted approaches, setting the stage for a systematic review that examines when and for whom digital tools outperform—or simply match—conventional methods.

The rise of mobile-assisted language learning (MALL) reflects a broader digital shift in education. Mobile vocabulary applications (e.g., digital flashcard apps, vocabulary games) offer features such as audio pronunciations, images, quizzes, and gamified rewards, which can enhance engagement and memory. Unlike static word lists or flashcards, these apps often incorporate adaptive learning algorithms—most notably *spaced repetition* schedules—to optimise review intervals for long-term retention. From a theoretical standpoint, such tools align with principles of memory psychology, providing repeated retrieval practice and dual coding (combining verbal and visual representations) of vocabulary items. Furthermore, mobile learning environments can foster greater learner autonomy, as students can self-pace their studies and access materials on demand, an aspect linked to self-regulated learning theory.

Thus, a comparative review of recent literature is both necessary and valuable. Focusing on peer-reviewed studies published between 2018 and 2025—a period of accelerated innovation in educational technology—allows us to identify clear patterns in how mobile and traditional methods affect vocabulary learning. This review synthesizes evidence from various ESL/EFL contexts to address

the central question: To what extent do mobile application–based techniques match or exceed conventional methods in promoting vocabulary acquisition? Our analysis examines key learning outcomes (e.g., retention rates, depth of word knowledge), learner attitudes and motivation, and the theoretical underpinnings that explain observed effects. In doing so, it will illuminate each approach’s advantages and limitations and uncover remaining gaps in the research. The insights gained are intended to advance theoretical models (such as spaced repetition and self-regulated learning) and to offer practical guidance for educators integrating technology into their vocabulary instruction. The sections that follow review the selected studies, explore emerging themes and points of divergence, and conclude with recommendations for future research and classroom practice.

### Research Objectives & Questions

Building on the gaps identified above, this review seeks to answer the following questions:

1. To what extent do mobile applications outperform or match traditional vocabulary methods in both retention and productive use?
2. How do learner profiles (e.g., age, proficiency level) and motivational factors mediate these outcomes?
3. Which theoretical frameworks (e.g., spaced repetition, dual coding, self-regulated learning) best explain the observed effects?

## 2. Literature Review

### 2.1. Contexts and Learner Profiles in Recent Studies

Contemporary studies comparing mobile and traditional vocabulary learning have been conducted across a range of ESL/EFL contexts, encompassing different educational levels and learner backgrounds. Most research has involved academic settings, particularly university students learning English as a foreign language. For example, Gou (2023) studied Chinese college students at B1–B2 proficiency levels, while Anwer et al. (2023) surveyed undergraduates in Pakistan who regularly used mobile apps for learning English vocabulary. These participants typically represent young adult learners who are digitally literate and have intermediate English skills. Other studies have focused on more specific learner groups; Xodabande, Atai, and Hashemi (2024) targeted Iranian university students majoring in chemistry and needing to learn technical English terms, whereas Yang and Song (2024) examined primary-school EFL learners using a self-regulated vocabulary app (indicating growing interest in younger learners and K-12 contexts). In most cases, participants share the characteristic of being in environments where English is not the dominant language (i.e. ESL/EFL rather than immersion), underscoring the importance of efficient vocabulary learning tools to supplement limited exposure to English outside the classroom.

The learning contexts in these studies vary from formal classrooms to informal, out-of-class study. Some experiments integrated mobile apps into class instruction or assigned them as homework, creating a blended context (e.g. weekly class sessions plus app-based practice). Others encouraged entirely self-directed use of vocabulary apps outside school. For instance, an out-of-class learning experiment by Xodabande et al. (2022) had one group use a mobile flashcard app independently while a control group used print materials; the mobile group’s advantage on post-tests provided evidence that “*self-directed and out-of-the-classroom*” vocabulary learning via apps can be effective. Such designs reflect real-world usage where learners often employ apps on their own time. However, even in studies set in classrooms, the learner’s profile in terms of autonomy and motivation plays a role – those comfortable with technology and self-regulation may gain more from the mobile approach, whereas others might prefer teacher-guided traditional techniques. Notably, the meta-analysis by Mahdi (2018) found that adult learners benefited more from mobile vocabulary learning

than younger learners, suggesting that maturity and study habits can mediate success with autonomous digital tools. This aligns with the observation that university students readily adopt mobile learning strategies, while very young learners might require more scaffolding to use apps effectively.

In summary, research to date has sampled a spectrum of ESL learner populations, predominantly in higher education with intermediate proficiency, but increasingly extending to children and various language needs (general English, academic vocabulary, technical jargon). The consistency of positive findings across different contexts (from Pakistan to China to Iran) indicates a broad relevance of mobile-assisted vocabulary learning, though learner characteristics such as age, proficiency, and comfort with self-study have been noted as important factors to consider.

## **2.2. Learning Outcomes and Assessment Metrics**

To compare mobile applications with traditional vocabulary learning methods, studies have measured a variety of learning outcomes. The most common metric is vocabulary gain as evidenced by test scores – usually comparing pre-test and post-test results between an experimental (mobile) group and a control (traditional) group. For example, Gou (2023) administered a standardised English test to both groups at the end of the study and found the mobile-assisted group scored significantly higher (mean score ~74.7) than the control group (~65.9). The improvement translated not only into test scores but also into higher proficiency levels; by the end of the training, 86% of the app-using students had advanced to C1 or C2 levels, whereas the control group's proficiency distribution remained largely unchanged. Such outcome measures demonstrate the potential academic impact of mobile learning, in this case pushing learners into advanced proficiency tiers.

Vocabulary retention over time is another critical outcome. Several studies include a delayed post-test weeks or months after the intervention to gauge long-term retention. Xodabande et al. (2024) used the Vocabulary Knowledge Scale test at three intervals (pre, post, and delayed) to compare retention of technical terms between mobile flashcard users and paper flashcard users. While both groups experienced some decline in scores after a delay (a typical forgetting curve), the mobile group maintained *significantly higher* scores than the traditional group on the delayed test. This indicates better long-term retention for the app-based learning, likely attributable to the spaced repetition scheduling in the app. In another study focusing on academic vocabulary, Mohammadi et al. (2024) found that using digital flashcards led to *significant gains in both receptive and productive vocabulary knowledge*. Participants were tested on their ability to recognize word meanings (receptive) and to use or recall words in context (productive); the mobile-assisted group showed substantial improvement on both fronts, suggesting that well-designed apps can foster comprehensive word knowledge (not just passive recognition). However, it is worth noting that many studies, especially older ones, have primarily assessed receptive knowledge (e.g. multiple-choice meaning questions), which is easier to test and often shows quicker improvement. The development of productive vocabulary (being able to actively produce the word in speech or writing) generally requires more time and practice, and thus remains a challenge to capture within short study durations.

Beyond test scores, researchers have evaluated qualitative outcomes such as learner motivation, engagement, and attitudes. These factors are crucial because a method that improves motivation may indirectly boost learning by increasing time-on-task. Anwer et al. (2023) used questionnaires to gather students' perceptions of using mobile apps for vocabulary. The findings were overwhelmingly positive: students reported that learning vocabulary via apps was "*easier... when vocabulary is accessible in numerous ways such as pictures, definition, sound,*" and that the visuals and audio left "*a long-lasting impact on their memory.*" Moreover, the *majority of participants considered learning vocabulary through mobile apps an enjoyable experience*. Similarly, in Gou's (2023) experiment, many

students in the app group found the format engaging and conducive to collaboration, as the mobile platform allowed them to discuss and practice vocabulary together online. These self-reported outcomes highlight that mobile applications can enhance motivation and learner satisfaction, likely because of their interactive and gamified elements absent in rote learning from books. Some studies also track usage data (e.g. how often learners practiced, or whether they completed optional exercises). For instance, Xodabande et al. (2022a) observed that app users frequently monitored their own progress (through in-app statistics and feedback), which *motivated them to continue engaging* with vocabulary practice more consistently than the control group. Such evidence suggests that mobile apps, by providing immediate feedback and a sense of achievement (points, levels, progress bars), can cultivate self-regulatory behaviors in learners – they take more initiative in practicing, thereby achieving greater exposure to the target vocabulary.

In traditional learning settings, outcomes are usually measured by in-class tests or quizzes and perhaps teacher observations of usage of new words in writing or speech. These remain important, as a number of studies compare not only test scores but also qualitative performance. For example, some instructors noted that students in traditional settings might use new words in essays or class discussions, whereas app users excel in quizzes. However, systematic data on productive use in authentic tasks is less common in the comparative literature. To address this, a few researchers have begun incorporating writing tasks or oral interviews as part of the post-test assessment, examining whether app-trained students can actually *use* the words. While findings are still emerging, initial results (e.g. from Mohammadi et al., 2024) show that app learners are at least on par with, if not better than, traditional learners in incorporating new vocabulary into sentences.

In summary, the body of research employs a robust set of outcome measures: immediate vocabulary gains, long-term retention, receptive versus productive knowledge, and affective variables like motivation. The convergence of evidence suggests that mobile applications are quite effective in promoting short-term vocabulary gains and particularly strong in ensuring those gains are retained over time. They also tend to increase learner engagement. The next section explores the theoretical reasons behind these outcomes and how mobile and traditional methods differ in practice.

### **2.3. Theoretical Frameworks Underpinning Vocabulary Learning**

Differences between mobile application-based and traditional vocabulary learning can be understood through several theoretical lenses. One key framework is self-regulated learning (SRL), which refers to learners' ability to plan, execute, and monitor their own learning activities. Mobile vocabulary apps, by their very nature, encourage a degree of self-regulation: learners decide when to study, which words to review, and often get real-time feedback on their performance. Studies such as Yang and Song (2024) explicitly integrated SRL principles by designing an app with goal-setting and self-monitoring features for primary students. As a result, students using the SRL-enhanced app demonstrated improved self-regulatory capacity alongside vocabulary gains. Even when not explicitly designed for SRL, many apps implicitly promote it – for instance, by showing a streak count of consecutive days studied, or by letting learners choose practice modes. This aligns with findings that mobile-assisted vocabulary learning *“promotes learner autonomy”*, as learners take charge of vocabulary study outside teacher-led classrooms. In contrast, traditional methods rely more on external regulation (teacher-led schedules, assigned homework), which can be effective in structured settings but may not cultivate independent study habits to the same extent.

Another crucial theoretical concept is spaced repetition, derived from memory research (Ebbinghaus' forgetting curve), which posits that information is better retained when review sessions are spaced out over time. Many vocabulary apps (e.g. Anki, Memrise, Duolingo's word practice) implement spaced repetition algorithms that schedule reviews of each word at optimal intervals – a

task impractical to do manually with paper flashcards. Digital flashcards “support spaced repetition, a well-researched method for improving long-term retention”. Nakata (2019) and others have shown that such systematic spacing can dramatically improve vocabulary retention compared to massed practice. Traditional classroom methods may include periodic quizzes or recycling of vocabulary in new contexts (for example, revisiting words in later lessons), but rarely with the personalised, data-driven precision of an app’s algorithm. This theoretical advantage of apps was borne out in empirical results like Xodabande et al. (2024), where the mobile group’s long-term retention surpassed the control group’s. The use of spaced repetition in apps thus provides a theoretical explanation for why mobile learners often forget less over time: the app ensures they encounter the word just before they would likely forget it, strengthening memory each time.

Dual-coding theory (Paivio, 1971) offers another perspective: learning is more effective when verbal information is paired with visual imagery. Mobile apps nearly always present new words with additional media – pictures, videos, or at least audio pronunciation. For example, a vocabulary app might show a picture of an “apple” alongside the word and play the pronunciation. Traditional vocabulary learning, especially through textbooks or word lists, might lack such multimodal input. The study by Anwer et al. (2023) highlighted that *visuals leave a long lasting impact on memory* and that having definitions, images, and sounds all accessible made learning easier for students. This points to multimedia learning theory: combining text with audio-visual aids can improve recall by engaging multiple cognitive channels. In a traditional setting, a skilled teacher might bring in realia or images, but the breadth and consistency of multimedia in an app (which can do this for hundreds of words systematically) is a distinct advantage of the digital medium.

Furthermore, the concept of gamification is increasingly applied in mobile learning. Gamification involves using game-like elements (points, badges, leaderboards, challenges) to motivate learners. Vocabulary apps often gamify the learning experience – awarding points for correct answers, unlocking levels, or allowing learners to compete with peers. According to Teymouri (2024), these features “*promote engagement and long-term vocabulary retention through features like spaced repetition and gamification*”, whereas “*traditional methods such as paper flashcards... lack the interactive and personalized benefits*” of digital tools. Motivation theories (e.g. self-determination theory) would suggest that the immediate rewards and sense of progress from gamification satisfy learners’ need for a sense of achievement, thus motivating them to invest more effort. Empirically, this is supported by reports of higher voluntary practice time in app users and comments like students finding the app “*enjoyable*”. Traditional methods can certainly be enjoyable (some learners like the tactile feel of paper flashcards or the social aspect of classroom games), but maintaining motivation over time can be harder without the continuous feedback loop that apps provide.

Finally, it’s important to consider contextual and social learning theories. Mobile apps historically have been used for individual learning, but newer apps incorporate social features – for instance, sharing scores, or collaborative vocabulary lists. The study by Gou (2023) involved students using apps “*in conjunction with... online collaboration*”, indicating that pairing mobile learning with peer interaction can be beneficial. In contrast, traditional vocabulary learning often happens in a social classroom context by default (group activities, teacher-student interaction). Thus, each mode has different affordances: mobile apps excel in personalised, self-paced learning (consistent with constructivist views of learner-centered education), whereas traditional methods offer structured guidance and immediate human feedback (rooted in sociocultural theory where interaction mediates learning). Some theoretical frameworks argue for a blended approach to get the best of both worlds – this is discussed later as a direction for future research.

In summary, theoretical perspectives from cognitive psychology (spaced repetition, dual coding), educational psychology (self-regulation, motivation via gamification), and second language acquisition (engagement, interaction) all shed light on why mobile applications can be powerful tools

for vocabulary acquisition. They also help explain differences observed: for example, better long-term recall in app users (due to spaced review), or higher engagement (due to interactive, multimedia content). Traditional methods remain grounded in proven pedagogical approaches (explicit teaching, use in context, etc.), but they may not leverage these principles to the same extent or efficiency. These theoretical insights set the stage for examining what empirical research has found when directly comparing the outcomes of mobile vs. traditional vocabulary learning.

### 3. Methodology

This study utilizes a theoretical literature-based methodology to systematically review and synthesize existing research comparing mobile application-based and traditional vocabulary learning methods in ESL contexts. The methodological approach consisted of the following stages:

#### Literature Selection Criteria:

Peer-reviewed research articles published between 2018 and 2025 were included. Studies were required to focus explicitly on ESL/EFL vocabulary acquisition, comparing mobile-assisted vocabulary learning (MAVL) methods, such as digital flashcards, vocabulary gaming apps, and spaced repetition applications, with traditional vocabulary acquisition methods (e.g., printed flashcards, word lists, rote memorization, and classroom-based instruction).

#### Search and Screening Process:

Databases searched included Scopus, Web of Science, ERIC, Google Scholar, and relevant academic journals focusing on educational technology and language learning. Searches employed targeted keywords: "mobile learning," "vocabulary acquisition," "ESL," "spaced repetition," "self-regulated learning," "digital flashcards," "mobile applications," and "traditional vocabulary learning." Initially, titles and abstracts were screened to confirm relevance, followed by full-text reviews to ascertain adherence to the inclusion criteria.

#### Data Extraction and Analysis:

Selected studies were systematically analyzed, extracting information related to learner contexts (educational setting, proficiency level, geographic location), research designs (experimental, quasi-experimental, case studies, mixed-method approaches), outcome measures (retention rates, productive vs. receptive vocabulary skills, motivation and engagement levels), and theoretical frameworks employed (e.g., spaced repetition, dual coding theory, self-regulated learning, gamification).

The data from the selected literature were qualitatively synthesized through thematic analysis, identifying patterns, contradictions, strengths, and limitations of mobile and traditional learning methods. Comparative efficacy was examined by assessing consistent outcomes across studies, highlighting areas of strong agreement and those exhibiting divergent results. Methodological rigor and potential biases within studies were also noted.

This comprehensive literature review aimed not only at identifying the relative strengths and limitations of each approach but also at uncovering research gaps and suggesting directions for future investigation and pedagogical practice.

### 4. Comparative Efficacy of Mobile Applications vs. Traditional Methods

A central question in the literature is whether learning vocabulary via mobile applications yields better outcomes than traditional methods. Across numerous studies in the 2018–2025 period, there is a consistent trend: mobile-assisted vocabulary learning tends to be at least as effective as traditional techniques, and in many cases more effective in certain respects. Meta-analytic evidence provides a broad overview. Mahdi's (2018) meta-analysis of 16 studies (N = 986 learners) found a

medium overall effect size ( $g \approx 0.67$ ) favoring mobile device use for vocabulary learning, for both receptive and productive knowledge types. A more recent meta-analysis by Mihaylova et al. (2022) focused specifically on mobile language learning apps versus traditional classroom methods, reporting an even larger mean effect size ( $g = 0.88$ ) in favor of mobile applications. Such effect sizes (moderate to strong) indicate that on average, learners using mobile apps outperform those using traditional approaches on vocabulary tests by a notable margin. However, the 2022 meta-analysis also cautioned that many studies had a high risk of bias (e.g., non-random group assignment or additional exposure time for the experimental group), so results should be interpreted with care.

Looking at individual studies, the positive impact of mobile learning is often evident. In experimental comparisons, the mobile app group frequently outperforms the control group on post-tests. For example, Basoglu and Akdemir (2010) – an earlier study still relevant as a precursor – found that students learning English words via a phone app scored significantly higher on a multiple-choice test than those who used paper flashcards. Focusing on recent work, Wu (2015) (as cited in later analyses) created a vocabulary app for Chinese college students and found the app-using group scored about 8.5% higher on the post-test than a control group that studied the same words via their own self-devised methods. In our target timeframe, Xodabande et al. (2024) showed that after one semester, the app group not only had higher immediate scores but also maintained an advantage at a three-month delayed test, confirming superior retention. Another 2024 study by Mohammadi et al. demonstrated substantial gains in academic word knowledge through mobile-based practice, with statistical analysis showing significant improvements in both the recognition and recall of target vocabulary for the app group. Lin and Lin (2019) similarly noted that learners using mobile tools exhibited higher vocabulary gains than those relying on traditional study. When multiple studies report similar findings, patterns emerge: mobile learning seems particularly effective for increasing retention (as repetitive algorithms keep words fresh in memory) and breadth of learning (students often learn more total words than they would in class alone). It also appears to boost short-term performance in many cases, perhaps due to increased time spent practicing. Indeed, one interpretation is that apps encourage more frequent practice sessions, which naturally lead to better outcomes – a confounding factor that nonetheless highlights a practical benefit of mobile learning.

On the other hand, traditional methods are certainly not ineffective – and the literature does not claim that apps trump traditional teaching in all aspects. In fact, virtually all studies find that both groups (app and control) improve their vocabulary knowledge; the question is which improves more. For instance, a study on Chinese EFL learners (Li & Hafner, 2022) observed significant vocabulary gains in both an app-based learning group and a traditional word list group, but *no significant difference* between their final test scores. This suggests that dedicated study, whether via app or conventional means, can yield similar results when properly implemented. In some cases, traditional methods might excel in areas not captured by standard tests – for example, learning through reading or classroom context might promote deeper understanding of word usage (collocations, connotations) or better integration into writing skills. If an app primarily drills definitions, a student might know the meaning but not nuances of usage. A few studies have raised this point, noting that traditional instruction often provides richer context for new vocabulary (through sentences, teacher explanation, or communicative activities), whereas apps can be somewhat decontextualized. However, modern apps are addressing this by including example sentences and even short reading passages.

Another aspect of comparative efficacy is learner engagement and persistence. Many studies anecdotally report that students in the mobile condition were more eager to continue learning beyond the required time. For example, in one experiment, students using a gamified vocabulary app voluntarily completed far more practice exercises than the syllabus required, whereas the traditional group did only the minimum written assignments. This extra practice likely contributed to the app

group's better performance, blurring the line between *method effect* and *effort effect*. Yet from a pedagogical perspective, if an app motivates students to practice more, that is a legitimate benefit of the method. Surveys consistently show a preference for the mobile approach: "*students reported that using mobile phones was a more effective method and more preferable to... printed materials*" in learning vocabulary. Such positive attitudes correlate with better outcomes; learners who enjoy the platform will spend more time on it and thus learn more. In Gou's (2023) study, qualitative feedback indicated that students appreciated the instant feedback and interactive exercises in the apps, whereas those in the traditional setting sometimes found vocabulary study tedious. This affective dimension is part of efficacy – an approach that sustains motivation leads to sustained learning gains.

It is also instructive to consider specific subskills. For receptive vocabulary knowledge, mobile apps have shown clear efficacy. Recognising word meanings (as tested by multiple-choice, matching, or recognition tests) is directly trained by most apps, and thus app users often excel in these formats. For productive vocabulary, the gap is narrower. Traditional methods like writing sentences or speaking exercises directly train production, potentially giving an edge to the control group in some studies. However, when apps incorporate productive elements (e.g. prompting the learner to type the word from memory or say it aloud), they too can improve productive knowledge. Some evidence (e.g. Mohammadi et al., 2024) indicates no significant difference between app and traditional groups in productive post-test tasks, meaning the app group did not lag behind, contrary to what one might assume. This could be because even recognition practice strengthens memory enough that learners can produce the word when required (especially if the post-test is soon after learning). Nonetheless, researchers have pointed out that many current ESL mobile apps focus more on receptive tasks and less on prompting active production. This is a design choice that could be improved to further boost productive vocabulary outcomes for mobile learners.

In sum, the comparative evidence tilts in favor of mobile applications for vocabulary acquisition in many scenarios: they often lead to higher test scores, better retention, and greater learner enthusiasm. Traditional methods are still effective and remain indispensable for teaching nuanced usage and providing human interaction. Rather than an "either-or" winner, the literature suggests each approach has strengths. Mobile apps excel in efficiency, engagement, and personalization; traditional methods excel in contextualization, structured guidance, and productive practice. The next section discusses the nuances and gaps that have emerged, highlighting that while mobile learning is promising, it is not a panacea and should be integrated thoughtfully.

## 5. Contradictions and Mixed Findings

While the general trend favors mobile-assisted vocabulary learning, not all findings are unequivocal. A number of studies present mixed results or highlight conditions where mobile and traditional methods perform equally well. Understanding these contradictions is important to avoid overgeneralising the benefits of technology.

One source of mixed results is differences in study design. In some experiments, the mobile group's advantage disappears when the time-on-task is controlled. If both groups spend exactly the same amount of time and have access to the same content (one digitally, one on paper), the outcomes can converge. For example, a controlled study in ReCALL (2022) found that after a fixed practice period, both the app group and the paper group showed significant vocabulary gains with *no statistically significant difference* between them. This suggests that the medium itself is not magical – what matters is that learners are engaging with the vocabulary. In cases where mobile learners outperform, it might be because they end up doing more practice (driven by the app's reminders or enjoyability). Indeed, a critique noted by Lin and Lin (2019) is that in past research, "*learning with mobile-assisted tools was taken as an additional intervention, and the extra learning*

*time*” benefited the learners, so naturally results seemed positive. In other words, if the mobile group studies 30% longer than the control, it’s unsurprising they learn more. High-quality experimental design tries to avoid this, but not all studies succeed, leading to some inflation of the perceived mobile advantage. The meta-analysis by Mihaylova et al. (2022) explicitly flagged this risk of bias, meaning we should be cautious in interpreting extremely large gains.

Another area of inconsistency is long-term retention. While a few studies (like Xodabande & Atai, 2024) have demonstrated that mobile learning supports long-term vocabulary retention better than traditional methods, not all research has included delayed post-tests. Some that did include them found that initial advantages diminished over time if learners did not continue using the app. If a mobile group stops practicing after the study, their forgetting might mirror that of any other group. Hence, there is a call in the literature for more systematic investigation into retention: *“existing research gaps [include] the need for further investigation into productive vocabulary use and long-term retention”*. Inconsistent findings on retention might simply be due to limited data; with more longitudinal studies, a clearer picture should emerge.

The development of productive vocabulary is another area with mixed findings. Traditional instruction often encourages usage (e.g. “use this word in a sentence” exercises), which intuitively should help production. Mobile apps, if they only use recognition quizzes, might leave learners able to understand words but hesitant to produce them. Some recent evidence, however, shows that apps can yield productive gains comparable to traditional methods. The contradiction here may lie in the specific app design or the evaluation method. For instance, if productive knowledge is measured by a fill-in-the-blank test (which still provides some context or cues), app learners do fine. But if measured by a free recall of words or a speaking task, maybe traditional learners who practiced output do better. Unfortunately, few studies have directly compared productive use in authentic contexts, so we have an incomplete understanding. What is clear is that current mobile apps tend to prioritise recognition over production, and this is a limitation. As one review put it, *“many mobile tools tend to focus on recognition-based tasks,”* indicating a need to incorporate more active recall and usage opportunities into app design. The mixed findings in productive vocabulary gains underscore a potential gap: mobile learning might need to be supplemented with productive practice (either within the app or in class) to reach parity with traditional methods on this front.

Learner individual differences also contribute to varied results. As noted earlier, age and level can influence effectiveness. Mahdi (2018) found adult learners benefited more than younger ones from mobile learning, possibly because adults are better at self-regulation or because the content/design of apps suits older learners’ study habits. Conversely, very young learners might respond better to face-to-face interactive teaching. Another factor is learner preference: not everyone enjoys learning on a phone. A minority of students in some surveys preferred traditional methods, citing reasons like eye strain, distraction, or simply the comfort of paper and pen. If a learner is reluctant to use the app, their outcomes will reflect that. Additionally, digital literacy and access can be an issue; not all learners have equal ease with installing or navigating apps, which could hinder the mobile group’s performance in some contexts (though this has become less of an issue over time as students are increasingly tech-savvy). Taken together, these differences mean that a method might shine in one context and falter in another. For instance, an app proven effective in an Asian university context might not automatically yield the same results in, say, a refugee adult ESL class in Europe, if the learners’ profiles and needs differ significantly. Thus, some contradictions in the literature may simply arise from different settings and participant characteristics.

Finally, a notable theme in discussions is that the distinction between mobile and traditional is not binary. Several scholars argue that it’s not about replacing one with the other, but integrating both. Traditional methods can be augmented by technology, and vice versa. There have been cases where a “hybrid” group (using both app and classroom activities) outperforms either alone, though

such studies are few. The recognition of this has led to calls for exploring blended approaches. Teymouri (2024) suggests that “*future developments... may include hybrid approaches that combine the strengths of both traditional and digital methods*”. Some mixed results might actually indicate that each approach compensates for the other’s weaknesses. For example, if a teacher uses an app for homework (mobile learning) and then in class has students use those words in conversation (traditional practice), the combined effect could surpass either method used in isolation. When studies do not account for such synergy, it might seem like one method alone has limitations – which is true, but such limitations could be resolved by thoughtful integration.

In summary, while mobile applications have shown great promise, the literature contains important nuances and exceptions. Key points of divergence include the importance of controlling study time, the need to verify long-term retention advantages, ensuring productive vocabulary development, and considering learner characteristics. These mixed findings do not so much invalidate the benefits of mobile learning as they provide a more balanced view: mobile apps are a powerful tool, but their impact is maximised when used appropriately and in conjunction with sound pedagogical practices. Recognising these gaps and contradictions is crucial for researchers and educators aiming to refine vocabulary learning strategies. The next section will delve into these gaps in more detail and suggest directions for future inquiry and practice.

## 6. Discussion

This review reveals that mobile applications have become a significant adjunct (and sometimes alternative) to traditional vocabulary learning methods in ESL contexts, generally yielding strong outcomes in recent studies. Learners often gain vocabulary knowledge effectively through apps, benefiting from features like spaced repetition schedules, multimedia presentations, and interactive quizzes. The motivational appeal of mobile learning is also evident, with many learners finding it engaging and convenient. Traditional methods, while occasionally outshone in test performance, remain valuable for contextual and productive practice of vocabulary. The comparison is not simplistic; rather, it highlights a complex interplay of factors influencing vocabulary acquisition. In reflecting on the literature, several research gaps and future directions emerge, as well as implications for classroom practice.

### Identified Gaps in Research:

Based on the synthesis of studies from 2018–2025, the following gaps merit attention:

- **Long-Term Retention:** More studies are needed that extend beyond immediate post-tests to examine whether vocabulary gains from mobile apps persist over months or years. While initial evidence suggests a retention advantage for spaced-repetition-based apps, longitudinal research (with multiple delayed post-tests) would strengthen conclusions. For instance, tracking learners’ vocabulary knowledge 6 or 12 months after an intervention would reveal the durability of learning by each method.
- **Productive Vocabulary Use:** There is a notable lack of research on how well app-trained learners can *use* new vocabulary in speaking or writing. Many experiments focus on recognition/recall in test settings. Future studies should incorporate productive measures (e.g. oral interviews, essay writing) to see if mobile learning fully supports active vocabulary usage. Likewise, researchers might design apps that include productive exercises (such as prompted sentence creation or speech recognition tasks) and test their efficacy against traditional output-focused activities.
- **Learner Differences and Adaptivity:** The field would benefit from studies exploring how learner characteristics (age, proficiency, learning style, technological familiarity) impact the effectiveness of mobile vs. traditional methods. Initial findings indicate adults may gain more from apps than younger learners, but the reasons are unclear. Are adults simply more disciplined with self-

study, or do they leverage app features better? Additionally, adaptive learning that personalises difficulty or content to the learner is a strength of apps – research could investigate how different learners respond to such personalisation. Ultimately, a more differentiated understanding could inform teachers which subsets of learners might need extra support when using mobile tools.

- **Blended and Hybrid Approaches:** Rather than treating mobile and traditional methods as competitors, future research should explore integrated approaches. For example, studies could compare: (a) a traditional-only condition, (b) an app-only condition, and (c) a blended condition where classroom instruction is paired with app-based homework. There is a theoretical expectation that the blended condition might outperform either alone by combining contextual learning with frequent practice. Empirical evidence for this is still sparse. Investigating how to optimally mix methods – e.g. using apps for initial learning and class time for application, or vice versa – would have high pedagogical value. This also extends to teacher involvement: how does guidance or reflection sessions on app usage influence outcomes? Integrating the strengths of each approach is a promising frontier.

Beyond these research directions, a few theoretical implications are worth noting. The success of mobile applications in teaching vocabulary lends support to theories of distributed practice and multimodal learning. It reaffirms that frequent retrieval practice (as enabled by apps) is key to vocabulary retention, echoing decades of cognitive psychology research in a real-world learning context. The findings also highlight the role of motivation in learning efficacy – a point often stressed by second language acquisition theorists: an enjoyable method can facilitate more input and practice, which in turn yields better acquisition (an affective filter perspective). However, the necessity to engage in productive use of language reminds us of Output Hypothesis (Swain, 1985) – learners need opportunities to produce language to fully acquire it. Thus, any approach that neglects output may fall short in developing communicative competence, a nuance reflected in calls for more research on productive vocabulary.

### **Pedagogical Implications for ESL Teaching:**

For practitioners, the insights from this comparative analysis can inform more effective vocabulary instruction. Key implications include:

- **Integrate Mobile Tools as Supplements:** ESL instructors should consider incorporating vocabulary apps into their teaching repertoire, not as a replacement for teaching but as a supplement. Assigning students to use a curated app (or a set of digital flashcards on platforms like Quizlet) for homework or extra practice can offload the rote memorisation component to an engaging medium. The evidence suggests students can *acquire and retain more words* with such supplementary mobile practice. Teachers can then use class time for higher-order usage of those words (discussions, writing, etc.), achieving a flipped-learning effect for vocabulary.

- **Leverage Spaced Repetition:** In traditional settings, it is challenging to implement truly individualized spaced review, but teachers can still apply the principle by revisiting vocabulary at intervals and encouraging students to use apps that do this for them. Many free or inexpensive apps exist that follow spaced repetition schedules. Guiding learners to consistently use these tools will likely improve their long-term retention of vocabulary, as indicated by research.

- **Provide Context and Encourage Production:** While apps are excellent for recall practice, teachers should be aware of their tendency to focus on form-meaning mapping in isolation. It's crucial to provide rich context for new vocabulary (through sentences, stories, or realia) during instruction, so that words are learned with their nuances intact. Afterwards, encourage learners to *produce* the new words – be it in spoken answers, dialogues, or writing exercises – to solidify productive knowledge. If the app itself does not offer productive tasks, the teacher's role in this

becomes even more important. This blended strategy addresses the weakness that “*current ESL mobile apps focus more on receptive language skills*”.

- **Monitor and Support Learner Engagement:** Not all students will automatically thrive with independent mobile learning. Teachers should monitor student engagement with the assigned app (many applications provide progress tracking which teachers can review). If a student is not engaging, interventions could include troubleshooting technical issues, clarifying how to use the app, or boosting motivation by perhaps incorporating a friendly competition or rewarding app usage. In essence, teacher facilitation can enhance the efficacy of mobile learning – a point noted by Xodabande et al. (2022a) who emphasized integrating MAVL into a broader instructional framework with teacher support.

- **Consider Learner Preferences and Training:** It’s wise to survey or informally ask students about their comfort with mobile learning. For those unfamiliar or unenthusiastic, some initial training sessions can help – for example, demonstrating the app in class, explaining its benefits, and even discussing strategies for self-regulated learning (setting reminders, making it a habit, etc.). Fostering a positive attitude towards the tool can make a difference, as attitude correlates with usage and outcomes. Also, provide alternatives for students who might not have reliable access to devices or internet; equity considerations mean that no student should be disadvantaged by the chosen method.

In conclusion, mobile applications represent a powerful addition to the vocabulary teaching toolkit, aligning well with contemporary learners’ lifestyles and applying sound pedagogical principles like spaced repetition and multimedia learning. Traditional methods, with their emphasis on context and productive use, remain indispensable. Rather than viewing them in opposition, the goal for educators and researchers is to find the optimal blend that maximizes vocabulary acquisition and retention. The period of 2018–2025 has shown significant advances in understanding how these methods compare, generally affirming that mobile-assisted learning can significantly enhance vocabulary outcomes in ESL contexts. As technology continues to evolve, future work should ensure that our pedagogical approaches evolve in tandem, guided by empirical evidence and a learner-centred focus. Ultimately, the aim is to empower ESL learners to acquire the vocabulary they need for proficiency, whether through a flashcard in hand or a smartphone in hand, and to do so in the most engaging and effective way possible.

## 7. Conclusion

Vocabulary acquisition in a second language is both crucial and challenging, requiring effective strategies to commit large numbers of new words to memory and to recall them when needed. This review has provided a comparative analysis of two broad approaches to this task – mobile application-based learning and traditional vocabulary learning methods – drawing on recent research from 2018 to 2025. The evidence suggests that mobile applications, when well-designed and used appropriately, can substantially aid vocabulary learning. They harness principles of spaced repetition, multimedia input, and learner autonomy to produce notable gains in both the breadth of vocabulary learned and the durability of retention. Many studies document higher test scores and better long-term recall for learners using apps as compared to those relying on word lists, flashcards, or solely classroom instruction. Learners also tend to respond favorably to mobile learning, finding it engaging and convenient, which in turn can increase their exposure and practice time.

At the same time, traditional methods of vocabulary teaching have not been rendered obsolete. The review highlights that teacher-led introduction of vocabulary, contextual learning (through reading, discussion, etc.), and opportunities for producing language are invaluable for developing deep, usable word knowledge. In some cases, traditional techniques achieved similar outcomes to mobile apps, particularly when the latter were not leveraged to their full potential or when equal

time was devoted to study. Moreover, the human element in traditional teaching – the ability of a teacher to clarify meaning, illustrate nuance, and stimulate interaction – remains a unique strength that technology alone cannot replicate. Therefore, rather than choosing one approach over the other, the consensus emerging is to combine them. Blended learning models, where mobile apps supplement classroom instruction, appear to be a fruitful direction, capitalizing on the strengths of each modality.

The review also underscored several theoretical implications. It validated the effectiveness of spaced repetition and retrieval practice in real-world learning via apps, contributing to applied linguistics theory on vocabulary retention. It brought attention to the role of self-regulated learning in vocabulary acquisition – learners who engage with mobile tools often take more ownership of their learning process, a positive outcome aligned with learner-centred pedagogies. Conversely, it exposed the need to integrate communicative and productive aspects into vocabulary learning, as emphasized by communicative language teaching theories, to ensure that words learned are not only recognised but also usable in communication.

For educators, a clear message is that embracing educational technology for vocabulary teaching can yield significant benefits. However, it should be done thoughtfully: selecting evidence-based apps, providing guidance on their use, and complementing them with rich language activities in class. Teachers should also stay attuned to student feedback – while most enjoy the digital mode, some may face hurdles, and instructional flexibility is key. From a policy or curriculum perspective, investing in digital resources for vocabulary learning (and training teachers to integrate them) can be a wise decision, as it aligns with the learning habits of today's students and has demonstrated positive outcomes.

In summary, the comparative analysis presented in this article finds that mobile applications are a highly effective tool for ESL vocabulary acquisition, often outperforming traditional methods in terms of retention and learner engagement, while traditional methods provide essential depth and productive practice. The optimal path forward is leveraging the advantages of both. Pedagogically, this means designing learning experiences where, for example, an ESL learner might learn and review new words through an app at home (gaining initial familiarity and memorisation), and then practice using those words in meaningful contexts during class, with feedback from peers and the teacher. Such an approach would likely yield the best of both worlds, as hinted by current research trends.

As research continues beyond 2025, it will hopefully address the gaps identified – long-term impacts, productive skill transfer, individual differences, and blended strategies – thus providing an even stronger evidence base. The ongoing evolution of technology (such as AI-driven personalized learning or improved speech recognition for pronunciation practice) may further blur the line between “mobile” and “traditional” learning, creating new hybrid tools. What will remain constant is the fundamental goal: empowering learners to acquire vocabulary effectively. The findings and discussions in this review contribute to that goal by illuminating what has been learned about mobile vs. traditional methods, and by guiding educators and researchers in making informed decisions to enhance vocabulary learning in the ESL context.

## Declarations

**Author Contributions.** Hasan Alisoy conceptualized the study, designed the methodology, and wrote the manuscript. Zarifa Sadigzade contributed to literature analysis, data synthesis, and final editing.

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