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Mobile Microlearning in English as A Foreign Language: Designing Daily Task Cycles for Retention

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Abstract

Mobile microlearning has become an increasingly relevant pedagogical approach in the English as a Foreign Language (EFL) context, particularly where learners exhibit fragmented study patterns and rely heavily on mobile devices for academic support. Although microlearning is widely adopted, its mechanisms for supporting long-term retention remain insufficiently theorized. Research tends to emphasize engagement and convenience rather than cognitively grounded task design. This study aims to examine the effects of three mobile microlearning task cycles, called spacing, retrieval practice, and mixed-strategy interleaving, on long-term retention among Indonesian EFL learners at Universitas Negeri Manado (UNIMA). A quasi-experimental pretest-posttest design was conducted with 98 Indonesian EFL learners at Universitas Negeri Manado. Participants were assigned to three treatment groups representing spacing, retrieval practice, and mixed-strategy interleaving task cycles and received daily microlearning activities via WhatsApp for eight weeks. Data were collected through pretests, posttests, delayed retention tests, learning analytics, and semi-structured interviews. Quantitative data were analyzed using inferential statistics, while qualitative interview data were subjected to thematic analysis. The results indicate that mixed-strategy interleaving cycles produced significantly higher long-term retention compared to single-strategy cycles, along with more stable weekly participation. Additionally, the qualitative findings indicate that daily micro tasks reduce cognitive load, foster autonomous learning habits, and increase learners' willingness to engage in incremental study. These findings suggest that the effectiveness of mobile microlearning depends not merely on brevity but on integrating cognitive learning principles into task design, with important implications for EFL pedagogy, digital task design, and mobile learning integration.

Keywords: EFL Retention; Micro-learning; Mobile Learning; Retrieval Practice; Spacing.

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1. INTRODUCTION

The proliferation of mobile technologies has reshaped how English as a Foreign Language (EFL) learners access, process, and engage with linguistic input beyond formal instructional settings. Smartphones have become ubiquitous learning companions, providing learners with continuous opportunities for language contact through messaging applications, mobile-based quizzes, flashcard platforms, and social media interactions (Burston, 2015; Kukulska-Hulme & Viberg, 2018). This shift toward ubiquitous mobile engagement aligns with the emergence of microlearning, typically defined as short, focused learning activities lasting from one to five minutes and designed for rapid consumption and frequent repetition (Buchem & Hamelmann, 2010; Hug, 2015). Such activities are increasingly integrated into EFL instruction because they minimize cognitive load, fit naturally into learners' daily routines, and capitalize on brief moments of availability—conditions common among university students with heavy academic workloads.

In EFL contexts like Indonesia, where limited natural exposure to English remains a consistent barrier to language development (Tanashur et al., 2024), microlearning has been promoted as a feasible strategy to extend learning beyond the classroom (Fidan, 2023; Taylor & Hung, 2022). The promise of "little-but-often" exposure resonates well with the realities faced by Indonesian learners, who may struggle to sustain long study sessions. Despite these advantages, the pedagogical potential of microlearning remains unevenly theorized. Existing studies often highlight positive student perceptions—such as enjoyment, motivation, or convenience (Mahdi, 2018; Sung et al., 2016)—but rarely address how microlearning leads to durable learning outcomes. As several scholars note, many microlearning implementations prioritize technological novelty over instructional rigor, leading to fragmented learning experiences (Crompton & Burke, 2018; Ifenthaler & Yau, 2020).

A central gap in the literature concerns long-term retention, which is essential for vocabulary growth, formulaic language acquisition, and general language proficiency (Nation & Hunston, 2013; Schmitt & Schmitt, 2020). While microlearning can increase short-term engagement and exposure, its capacity to produce lasting memory traces depends on the cognitive processes the tasks activate. Unfortunately, many microlearning studies adopt descriptive, platform-driven designs (e.g., using WhatsApp simply because it is accessible) without grounding microtasks in cognitive principles empirically known to support retention (Kang, 2016). As a result, the relationship between microlearning and deep learning remains insufficiently clarified.

Cognitive psychology provides at least three robust mechanisms critical for long-term memory formation: spacing, retrieval practice, and interleaving. Spacing supports distributed learning over time, enabling gradual consolidation in long-term memory (Cepeda et al., 2006). Retrieval practice strengthens memory by requiring learners to actively recall information rather than simply re-expose themselves to it (Karpicke & Blunt, 2011; Roediger & Butler, 2011). Interleaving enhances discriminative learning by mixing related topics or skills, reducing overconfidence and promoting deeper cognitive engagement (Birnbaum et al., 2013). These mechanisms, individually and collectively, have been shown to significantly improve the retention of linguistic items, yet they have rarely been systematically implemented in mobile-based microlearning designs for EFL learners (Ziegler, 2016).

Recent empirical studies have reported promising outcomes of mobile microlearning in EFL contexts, although their focus has largely remained on engagement and immediate learning gains. For example, Mahdi (2018) investigated mobile-assisted vocabulary learning among EFL learners using a quasi-experimental design and found significant improvements in vocabulary acquisition and learner motivation. Similarly, Sung et al. (2016) conducted a meta-analysis of mobile learning interventions and reported moderate positive effects on academic achievement across educational settings. Li (2023) and Wahyudi et al. (2025) employed a mobile microlearning intervention with university students and found that short, frequent learning activities enhanced learner participation and perceived flexibility, although retention outcomes were not examined. Zhang and Pérez-Paredes (2021) utilized smartphone-based vocabulary microtasks in an EFL setting and reported increased vocabulary performance and learning engagement, yet the study measured only immediate post-intervention outcomes. Klimova (2019)

reviewed mobile-assisted language learning studies and concluded that mobile technologies can facilitate language learning effectiveness; however, evidence regarding long-term retention remained inconclusive. Furthermore, Viberg and Grönlund (2017) found that mobile learning environments positively influenced learner autonomy and self-regulation, but they emphasized the need for stronger theoretical grounding in instructional design. Collectively, these studies demonstrate the educational potential of mobile microlearning but also reveal a predominant emphasis on motivation, usability, engagement, and short-term achievement.

Despite these advances, several limitations remain evident. First, previous studies rarely compare different cognitively informed microlearning task structures within a single experimental framework. Second, long-term retention is seldom employed as the primary outcome variable despite its central importance in language acquisition. Third, cognitive mechanisms such as spacing, retrieval practice, and interleaving are often discussed separately in the cognitive psychology literature but are rarely operationalized and systematically compared in mobile microlearning environments for EFL learners. Consequently, evidence remains limited regarding which microlearning task design is most effective for supporting durable language learning outcomes.

The present study addresses this theoretical and empirical gap by integrating these cognitive principles into three distinct microlearning task cycles and evaluating their effects on long-term retention of vocabulary and formulaic expressions among undergraduate EFL learners at Universitas Negeri Manado (UNIMA). Unlike prior studies that emphasize immediacy or affective gains, this research foregrounds retention, engagement sustainability, and learners' perceptions of cognitive difficulty and autonomy. By employing a quasi-experimental design supported by learning analytics and qualitative inquiry, this study offers a more comprehensive understanding of how microlearning can be structured to maximize durable learning outcomes.

Current research on mobile microlearning suggests that mobile platforms can enhance learner engagement, motivation, accessibility, and short-term language learning outcomes. However, the literature has yet to establish how different cognitively grounded microlearning task cycles influence long-term retention in EFL contexts. This study therefore addresses a significant research gap by integrating three evidence-based cognitive learning principles—spacing, retrieval practice, and interleaving—into mobile microlearning task designs and examining their comparative effects on retention, the sustainability of engagement, and learner perceptions. The novelty of this study lies in three aspects. First, it moves beyond platform-centered evaluations by focusing on cognitive task architecture as the primary explanatory mechanism for learning effectiveness. Second, it systematically compares spacing, retrieval practice, and mixed-strategy interleaving within a single quasi-experimental study. Third, it combines learning outcome measures, learning analytics, and qualitative learner perspectives to provide a more comprehensive understanding of mobile microlearning's effectiveness. Accordingly, this study contributes to the development of a theoretically grounded framework for mobile microlearning design in EFL education and offers practical guidance for educators seeking to promote durable learning through technology-mediated instruction.

2. RESEARCH METHOD

The present study employed a mixed-methods quasi-experimental design to examine the effectiveness of three mobile-based microlearning task cycles on long-term retention of vocabulary and formulaic expressions among EFL learners. Mixed-methods research combines quantitative and qualitative approaches to provide a more comprehensive understanding of educational phenomena by integrating numerical outcomes with participants' experiences and perceptions (Creswell & Clark, 2007). The quantitative component utilized a quasi-experimental design because participants were drawn from intact classes at Universitas Negeri Manado (UNIMA), making random assignment impractical while allowing systematic comparison among treatment conditions (Fraenkel, 2011). The qualitative component involved semi-structured interviews to explore learners' perceptions of the microlearning experience and to complement the quantitative findings. Three microlearning conditions were compared: a spaced-cycle emphasizing distributed review, a retrieval-cycle emphasizing active recall, and a mixed-strategy cycle integrating spacing, retrieval, and interleaving.

The participants consisted of ninety-eight undergraduate EFL learners enrolled in intermediate-level English

courses. These learners were selected through cluster random sampling across three intact classes and assigned to treatment conditions based on their existing enrollment. All participants had access to smartphones and stable internet connections, making them suitable for mobile-based task delivery. Their institutional placement scores confirmed that they possessed comparable English proficiency at the outset of the study, reducing the likelihood that pre-existing differences would influence the outcomes. Before the intervention began, learners were briefed on the purpose of the study, the nature of the tasks they would receive, and their rights regarding voluntary participation and confidentiality.

Data collection involved multiple instruments designed to capture both measurable learning outcomes and learner perceptions. A 40-item vocabulary and formulaic expression test served as the principal measurement tool and was administered as a pre-test, an immediate post-test, and a delayed test four weeks after the intervention. The pre-test established baseline proficiency, the post-test assessed immediate learning gains, and the delayed test measured long-term retention. The test consisted of multiple-choice items, cloze procedures, matching tasks, and short production prompts to capture different levels of lexical knowledge. Parallel forms were used for each administration to maintain equivalent difficulty while avoiding repetition effects. Reliability estimates from pilot testing demonstrated strong internal consistency, indicating that the tests were appropriate for tracking changes in retention.

The delivery of the microlearning tasks constituted a central feature of the methodological design. Microtasks were crafted to require no more than 1 to 3 minutes of focused engagement and were delivered daily at 7:00 PM via WhatsApp, a platform familiar to and easily accessible to all participants. Each task reflected the cognitive principle associated with the group's assigned condition: the spaced cycle provided repeated exposure at controlled intervals, the retrieval cycle required learners to recall target items without prompts, and the mixed-strategy cycle alternated between spaced review, recall-based tasks, and interleaving activities that mixed lexical and grammatical elements. By designing microtasks in accordance with cognitive learning principles, the study ensured that each treatment condition embodied theoretically grounded mechanisms expected to influence long-term retention.

Data analysis combined quantitative and qualitative procedures to generate a comprehensive understanding of learning outcomes. Quantitative scores from the three testing sessions were processed through repeated-measures ANOVA to determine whether significant changes occurred within and across groups over time. When significant differences were detected, Tukey HSD post-hoc comparisons were employed to identify which groups differed from one another. In addition, engagement data such as daily completion rates and task submission times were examined descriptively to understand how consistently participants interacted with the microlearning tasks. Qualitative data from semi-structured interviews with twenty volunteers provided deeper insight into learners' experiences, including their perceptions of cognitive load, motivation, and self-regulation. These qualitative findings supported and contextualized the quantitative results, enabling a richer interpretation of how microlearning delivery functioned in practice.

3. FINDINGS AND DISCUSSION

3.1. Findings

The results of this study are presented in three main parts: (1) vocabulary and formulaic expression test outcomes, (2) engagement patterns derived from microtask completion analytics, and (3) qualitative insights from learner interviews. Together, these results provide a comprehensive picture of how different microlearning task-cycle designs influence both long-term retention and learner behavior. The quantitative findings are supported with descriptive and inferential statistics, while qualitative findings help illuminate the cognitive and motivational processes underlying those patterns.

The first set of findings concerns the learners' performance on the pre-test, post-test, and delayed test. As shown in Table 1, all three groups demonstrated improvement from the pre-test to the post-test, indicating that microlearning—regardless of cycle design—contributes positively to short-term learning gains. However, the

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magnitude of improvement differed substantially across groups. The Mixed-Strategy Microtask Cycle (MMC) group achieved the highest mean scores in both the post-test and delayed test, suggesting stronger retention and less decay over time. The Retrieval Microtask Cycle (RMC) group demonstrated moderate gains, while the Spaced Microtask Cycle (SMC) group showed the smallest improvement, particularly in the delayed test. This indicates that spacing alone, while beneficial, may not be sufficient to produce optimal long-term retention unless combined with more cognitively effortful strategies.

Table 1. Test results

Group	Pre-test	Post-test	Delayed test
SMC	56.2	72.4	69.8
RMC	55.7	76.1	71.9
MMC	56.9	82.5	80.7

The data in Table 1 highlights several important patterns. First, the MMC group's delayed test score (80.7) is only slightly lower than its post-test score (82.5), indicating extremely limited forgetting. This suggests that integrating spacing, retrieval, and interleaving may produce synergistic cognitive benefits. Second, the RMC group's stronger post-test performance relative to the SMC group (76.1 vs. 72.4) supports the well-established advantage of retrieval practice for strengthening memory traces. However, the RMC group still experienced a more pronounced decline between the post-test and the delayed test than the MMC group. This indicates that retrieval alone, although powerful, may not offer the same level of reinforcement as when combined with spacing and interleaving. Finally, the SMC group's scores show that spacing produces consistent gains but is insufficient on its own to minimize forgetting after the intervention ends.

Inferential statistics corroborated these patterns. A repeated-measures ANOVA revealed statistically significant differences among the groups over time, with post-hoc tests confirming that MMC performed significantly better than both RMC and SMC. These results indicate that cycle design—not merely the presence of microlearning—is a critical determinant of long-term retention. From a cognitive perspective, these findings align with previous research demonstrating that retrieval strengthens memory by actively reconstructing information, spacing supports consolidation, and interleaving enhances discrimination and transfer. The MMC condition benefits from all three mechanisms, making it the most cognitively robust.

Beyond test scores, the study also examined learners' engagement patterns through weekly microtask completion analytics. These patterns are visualized in Figure 1, which shows how consistently learners in each group completed the daily tasks across the eight-week intervention. While all groups showed a natural decline in participation over time—a common finding in technology-mediated learning—the MMC group exhibited the most stable engagement curve. Their completion rates remained above 85% for most of the intervention, dropping only slightly toward the final weeks. In contrast, the SMC group showed the steepest decline, suggesting that repeated exposure to similar task types may reduce novelty and reduce learners' willingness to participate.

Table 2. Test results

Week	SMC	RMC	MMC
1	94	96	95
2	89	91	94
3	84	87	92
4	78	82	89
5	72	81	90
6	68	75	88
7	65	73	87
8	61	69	86

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A closer look at Table 2 reveals not only quantitative differences but also important behavioral tendencies. The MMC group's higher stability suggests that variation in task types may prevent monotony, maintain learner interest, and support stronger habits of daily engagement. This aligns with self-regulated learning theories, which state that variation in task difficulty and structure can prevent cognitive fatigue and sustain motivation. Meanwhile, the RMC group's moderate decline may reflect the demanding nature of daily retrieval tasks, which—while beneficial for learning—require more cognitive effort and may be harder to sustain without alternating task types. The SMC group's rapid decline suggests that repetition-based microtasks may be perceived as predictable or less engaging, reducing adherence over time.

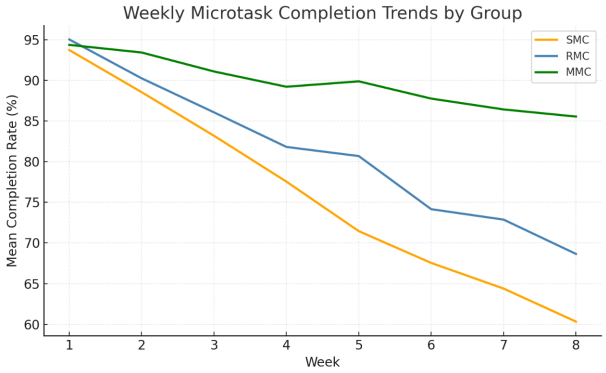

Figure 1. Weekly microtask completion by group

Figure 1 visually compares the consistency with which learners completed their daily microtasks throughout the eight-week intervention. The results indicate that the MMC (Mixed-Strategy Condition) maintained the highest level of engagement, with completion rates remaining between 85% and 95%, suggesting that the integration of spacing, retrieval, and interleaving strategies helped sustain learner interest over time. In contrast, the RMC (Retrieval-Based Condition) exhibited a moderate decline in engagement, likely due to the greater cognitive demands associated with retrieval practice despite its recognized effectiveness for learning. The SMC (Spacing-Only Condition) demonstrated the most pronounced decrease in participation, implying that repeated exposure without sufficient task variation may lead to learner monotony. Overall, the findings presented in Figure 1 strongly support the argument that the design of the task cycle plays a more critical role in maintaining learner engagement than the microlearning format itself.

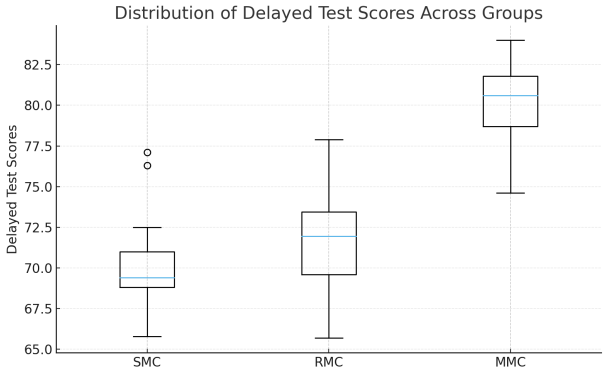

Figure 2. Distribution of Delayed test scores across groups

Figure 2 illustrates the extent to which learners retained vocabulary and formulaic expressions four weeks after the completion of the intervention. The MMC (Mixed-Strategy Condition) achieved the highest median retention score, accompanied by the narrowest score distribution and the fewest outliers, indicating not only superior

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performance but also greater consistency among learners. The RMC (Retrieval-Based Condition) demonstrated moderate retention outcomes with a slightly wider dispersion of scores, suggesting that while retrieval practice is effective for long-term learning, its impact may be enhanced when combined with spacing and interleaving strategies. In contrast, the SMC (Spacing-Only Condition) recorded the lowest retention scores and the greatest variability, implying that spacing alone may be insufficient to support durable knowledge retention. These findings align with cognitive learning research, which consistently identifies the combined application of retrieval practice, spaced repetition, and interleaving as one of the most effective approaches for strengthening long-term memory.

Qualitative interview data further illuminate these quantitative patterns. Learners in the MMC group often described the microtasks as "challenging but enjoyable," emphasizing that the alternation among different types of tasks helped maintain their interest and sense of progress. Many also appreciated that interleaving created opportunities to revisit previous material within new contexts, reinforcing learning without feeling repetitive. Learners in the RMC group acknowledged the difficulty of retrieval tasks and reported remembering more when asked to produce language, but some admitted to feeling "mentally tired" on days when they had other academic responsibilities. The SMC group generally found the tasks easy and manageable, but several learners noted that over time the tasks felt "too similar," which may explain the drop in engagement.

Taken together, the findings indicate that cognitive task-cycle design significantly influences not only retention outcomes but also engagement and learner motivation. The MMC condition stands out because of its combination of spacing, retrieval, and interleaving, which not only improves retention but also creates a more dynamic and sustainable learning experience. From a pedagogical perspective, this suggests that microlearning interventions should move beyond simple repetition-based tasks and embrace cognitive diversity to maximize both learning and participation. These findings provide strong support for integrating cognitive science principles into technology-mediated language learning environments, particularly in EFL contexts where sustained exposure and engagement are critical for success.

3.2. Discussion

The present study set out to investigate how different microlearning task-cycle designs—spacing, retrieval practice, and mixed-strategy interleaving—affect long-term retention of vocabulary and formulaic expressions among Indonesian EFL learners. The findings clearly indicate that task-cycle design plays a decisive role in determining the extent to which microlearning supports durable learning gains. This section interprets the quantitative and qualitative findings in light of relevant theories, discusses the relative strengths of each microlearning approach, and considers implications for EFL pedagogy and technology integration.

The first major finding of this study was that all three microlearning groups improved from pre-test to post-test, demonstrating that microlearning, regardless of specific design, can effectively enhance short-term vocabulary learning. This is consistent with existing literature showing that mobile-based microtasks increase exposure frequency and stimulate engagement, which naturally leads to initial learning gains (Mahdi, 2018; Sung et al., 2016). However, the degree of retention—as shown in the delayed test—depended strongly on the cognitive structure of the microtasks. The Mixed-Strategy Microtask Cycle (MMC) produced the highest retention scores and the smallest decline between post-test and delayed test, suggesting that combining spacing, retrieval practice, and interleaving creates an additive or even synergistic effect. This aligns with theories from cognitive psychology indicating that memory is strengthened most effectively when information is revisited at intervals, retrieved effortfully, and practiced in varied contexts (Birnbaum et al., 2013; Kang, 2016; Roediger & Butler, 2011).

The performance of the Retrieval Microtask Cycle (RMC) group further reinforces the importance of active recall. Although their retention did not match that of the MMC group, their scores were significantly higher than those of the Spaced Microtask Cycle (SMC) group. This pattern mirrors findings from Karpicke and Blunt (2011), who argue that retrieval practice produces deeper encoding and more durable memory traces than restudying or passive review. Learners' interview comments also reveal that retrieval activities, despite being more cognitively demanding, were perceived as "useful" and "memorable," a perception echoed in earlier CALL studies where

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productive tasks yielded stronger retention than receptive ones (Ziegler, 2016). The RMC group's moderate decline from post-test to delayed test may indicate that retrieval practice is highly effective, but its benefits are maximized when combined with other principles such as spacing and interleaving, as seen in the MMC group.

In comparison, the SMC group showed steady but notably smaller learning gains and a more pronounced decline on the delayed test. Although spacing is a well-established mechanism for strengthening memory through distributed practice (Cepeda et al., 2006), spacing alone may not trigger the level of cognitive effort required for deeper processing. The findings suggest that spaced exposure without frequent retrieval or varied contexts may lead to shallow encoding. This is consistent with research warning that passive or repetitive microlearning tasks can become predictable and fail to challenge learners cognitively (Crompton & Burke, 2018; Ifenthaler & Yau, 2020). Several learners in this group even expressed that the tasks felt "easy" or "monotonous," which likely contributed to declining engagement and less durable learning.

Engagement analytics add an important behavioral dimension to these cognitive interpretations. The MMC group maintained the most stable completion rates across eight weeks, while the RMC and especially the SMC groups showed sharper declines. This trend underscores the idea that task variation, not just task brevity, is essential for sustaining long-term participation in mobile-based learning. Interleaving, which introduces variety and unpredictability, is known to reduce boredom and maintain learner curiosity (Birnbaum et al., 2013). Learners in the MMC group described the tasks as "interesting" and "not repetitive," illustrating how cognitive diversity can simultaneously support memory processes and motivational factors. The SMC group's declining participation suggests that repeated exposure to the same type of task may reduce attention and diminish the motivational appeal of microlearning, echoing findings from Kukulska-Hulme and Viberg (2018) on the importance of novelty and cognitive stimulation in mobile learning environments.

Qualitative insights also illuminate the relationship between cognitive effort and emotional engagement. Learners in the RMC and MMC groups frequently noted that retrieval-based tasks felt difficult but satisfying, an affective reaction similar to the concept of "desirable difficulties" proposed by Bjork and Bjork (2011). These tasks create a productive level of challenge that enhances retention while also promoting a sense of accomplishment. Conversely, learners in the SMC group often felt that tasks required minimal effort, which may have contributed to weaker learning and lower engagement. This supports the idea that the cognitive challenge intrinsic to retrieval practice or interleaved tasks may foster not only deeper learning but also stronger intrinsic motivation.

Overall, the findings suggest that microlearning cannot be assumed to be effective simply because it is brief or delivered via mobile devices. Instead, its success depends heavily on how microtasks are designed. Microlearning that adheres to principles of cognitive psychology is more likely to yield long-term retention, stronger engagement, and more positive learner perceptions. The mixed-strategy cycle, in particular, demonstrates that spacing, retrieval, and interleaving can complement each other, enhancing both the durability of memory and the sustainability of engagement. This provides a strong argument for designing microlearning interventions with theoretical rigor rather than convenience or technological novelty.

From a pedagogical perspective, these findings highlight several implications for EFL practitioners. First, microlearning activities should involve varied task types that require learners to retrieve information, apply it in new contexts, and periodically revisit it. Second, teachers should leverage mobile platforms not merely as delivery tools but as strategic environments for implementing cognitive principles. Third, because engagement tends to decline over time, especially in repetitive task cycles, incorporating interleaving may be crucial for maintaining learner motivation, particularly in low-exposure contexts such as Indonesia. Finally, microlearning should be viewed as a supplement—not a substitute—for structured classroom instruction, providing frequent reinforcement that supports longer-term language development.

Taken together, the findings of this study largely support previous research demonstrating the benefits of mobile learning, spacing, retrieval practice, and interleaving for language learning and memory retention (Cepeda et al., 2006; Karpicke & Blunt, 2011; Mahdi, 2018; Sung et al., 2016). However, the present study extends the existing literature in several important ways. While earlier studies primarily focused on learner motivation,

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usability, engagement, or short-term learning gains, the current research specifically examined long-term retention as the primary outcome and directly compared three cognitively informed microlearning task-cycle designs within the same instructional context. The findings reveal that the effectiveness of mobile microlearning depends not merely on frequent exposure or technological accessibility, but on the integration of complementary cognitive mechanisms within task design. In particular, the superior performance of the mixed-strategy cycle suggests that combining spacing, retrieval practice, and interleaving yields stronger and more sustainable learning outcomes than implementing any single strategy in isolation. Therefore, this study not only corroborates previous findings but also provides new empirical evidence for a more theoretically grounded approach to designing mobile microlearning interventions in EFL education.

4. CONCLUSION

This study found that the Mixed-Strategy Microtask Cycle (MMC), which combined spacing, retrieval practice, and interleaving, produced the strongest long-term retention of vocabulary and formulaic expressions among EFL learners. The Retrieval Microtask Cycle (RMC) also showed better retention than spacing alone, whereas the Spaced Microtask Cycle (SMC) yielded the weakest long-term gains. The findings further revealed that the effectiveness of microlearning depends not merely on its mobile or brief format, but on the cognitive demands embedded within the task design. Learners in the MMC group also demonstrated higher engagement and more sustained participation throughout the intervention.

Future research is recommended to explore other forms of microlearning tasks, integrate adaptive AI-based feedback systems, and investigate the effectiveness of microlearning for broader language skills such as grammar, pragmatics, and discourse competence. Studies involving larger samples, multiple institutions, and longer follow-up periods are also needed to strengthen the generalizability of these findings.

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