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Mobile-Based Microlearning in Education: A Literature Review on Effectiveness, Flexibility, and Knowledge Retention

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ABSTRACT

Mobile devices have expanded opportunities for learning across locations and schedules, while microlearning offers focused instructional units that may fit into brief study periods. However, the evidence concerning its effectiveness, flexibility, and contribution to knowledge retention remains varied. This review aimed to synthesize conceptual and empirical findings on mobile-based microlearning across these three dimensions. An integrative literature-review approach was organized around PRISMA 2020 reporting principles. The proposed search strategy targeted peer-reviewed studies published from 2016 onward across education and health databases, with eligibility based on mobile delivery, a microlearning component, and relevant learning outcomes. Published review evidence indicates that Moore et al. (2024) synthesized nine empirical studies of adult learners: five assessed learning outcomes and four focused on perceptions or usability. Lee (2023) reviewed 26 articles and reported positive findings related to achievement, motivation, skills, and retention, alongside implementation challenges. Across this evidence, mobile microlearning appears to offer flexible access and potential learning benefits when short units are aligned with clear objectives and supported by meaningful practice. However, differences in intervention design and outcome measurement limit direct comparison, and immediate post-test performance does not establish long-term retention. The review concludes that mobile microlearning is a promising instructional format rather than a universally effective method. Stronger conclusions require verified screening of the intended study set, consistent outcome measures, and delayed retention assessments.

Keyword : Mobile Learning; Microlearning; Learning Effectiveness; Learning Flexibility; Knowledge Retention

INTRODUCTION

The widespread availability of smartphones has changed when and where learners can access educational materials. Mobile devices can support learning during short periods between other activities, outside the classroom, and at the point when a learner needs specific information. Yet access alone does not ensure meaningful learning. Mobile instruction can also compete with notifications, fragment attention, and make complex material difficult to study on a small screen. The central instructional question is therefore not simply whether learners use mobile devices, but how mobile-delivered content can be designed to support learning effectively and flexibly while helping learners retain knowledge over time.

Microlearning is commonly understood as the delivery of focused learning units that address a bounded objective and can be completed in a relatively short period. Its appeal rests partly on fit: a short lesson may be easier to access than a lengthy online session when learners have limited time. However, "short" is a format feature, not an established learning mechanism. A brief video or text segment may

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still overload learners, omit necessary explanation, or encourage passive consumption if it is not aligned with a clear objective and followed by meaningful practice. Evidence from mobile-based microlearning research suggests that implementations vary widely in instructional context, design, and measured outcomes, making broad claims about its effectiveness difficult to support (Moore et al., 2024). The literature also cautions against treating microlearning as automatically effective simply because content is divided into smaller units. researchgate.net

Three outcomes warrant particular attention. Effectiveness concerns whether learners acquire and apply the intended knowledge. Flexibility concerns whether mobile delivery offers practical access across times and settings without reducing the quality of instruction. Knowledge retention concerns whether learners can recall or use what they learned after an interval, rather than only immediately after instruction. These outcomes are related but distinct: convenience may improve access without improving learning, and a strong immediate test score does not by itself demonstrate durable retention.

Several learning principles help explain how mobile microlearning might work. Cognitive load theory emphasizes the limited capacity of working memory and the importance of avoiding unnecessary processing demands (Sweller et al., 2019). Segmenting information into manageable units may help learners process complex material, provided that each segment preserves the relationships needed to understand the topic. Multimedia learning research similarly suggests that instructional design should coordinate words and visuals and avoid distracting material (Mayer, 2021). For retention, spacing learning over time and asking learners to retrieve information from memory are more informative design choices than brevity alone. Research reviews distinguish spacing from interleaving and describe their different contributions to learning (Chen et al., 2021). Thus, mobile microlearning is best framed as a delivery approach whose effects depend on how content, practice, feedback, and timing are designed.

Research on mobile learning has examined access, participation, achievement, usability, and learner perceptions. A systematic review of mobile learning in higher education identified varied purposes and outcomes across studies, illustrating that “mobile learning” encompasses many instructional approaches rather than one uniform intervention (Crompton & Burke, 2018). A later review of mobile learning features and barriers reported that implementation depends on factors such as usability, technical access, learner characteristics, and institutional context (Almaiah et al., 2021). Mobile delivery can make materials available across settings, but that flexibility must be supported by appropriate design and infrastructure.

Microlearning research has increasingly examined how short learning activities can be combined with mobile access. Moore et al. (2024), reviewing empirical studies of mobile-based microlearning for adult learners, found applications in higher education and workplace learning, including settings where learners need accessible, on-demand resources. Their review also found that the evidence base was limited: just nine qualifying empirical studies were synthesized, and studies differed in whether they measured learning outcomes or perceptions of design and usability. This leaves room for a focused synthesis of how instructional design relates to effectiveness, flexibility, and retention.

Empirical work provides examples of both promise and complexity. In postgraduate education, a flipped mobile-based microlearning approach has been studied in relation to accessibility, engagement, knowledge retention, learning experience, and academic achievement (Tan et al., 2024). In medical education, a randomized study compared a microlearning module with a traditional online module for surgery clerkship students, examining knowledge acquisition (Lai et al., 2022). These studies show that researchers are moving beyond feasibility to compare outcomes, although intervention components and study contexts still differ. Evidence from mobile learning more broadly also includes randomized comparisons of mobile and traditional instruction that assess both knowledge acquisition and retention, underscoring the value of delayed measurement (e.g., Chuang et al., 2023).

Recent reviews have widened the scope of synthesis. A systematic review of microlearning across educational settings classified reported outcomes across cognitive, behavioral, and affective domains, including acquisition, recall, application, engagement, and motivation (Hug, 2024). The breadth of those outcomes is useful, but it also highlights why reviews need clear analytical boundaries: a gain in satisfaction or engagement cannot be assumed to represent a gain in retained knowledge. For mobile microlearning specifically, flexibility should likewise be examined as an instructional affordance and an outcome of implementation, not simply inferred from smartphone use.

The theoretical case for retention is strengthened when microlearning incorporates spaced practice and retrieval. A systematic review by Chen et al. (2021) argues that spacing and interleaving should be understood through distinct theoretical explanations, while both can shape learning across sessions.

Mobile devices may make repeated, short practice episodes easier to distribute, but the device itself does not produce the spacing effect. That effect depends on the timing and structure of learning opportunities. This distinction is essential when interpreting studies that combine mobile access, short content, quizzes, reminders, or feedback in a single intervention.

Despite increased interest in microlearning, three gaps remain. First, studies often combine multiple design features such as short videos, quizzes, spaced prompts, gamification, and flipped instruction making it difficult to identify which features are associated with observed outcomes. Second, immediate achievement, engagement, satisfaction, and long-term retention are sometimes reported together even though they measure different aspects of learning. Delayed assessments remain especially important for claims about knowledge retention. Third, research on mobile-based microlearning is still relatively limited and context-specific. The adult-learning review by Moore et al. (2024), for example, synthesized only nine empirical studies and noted variation in instructional settings and outcome measures.

There is also a synthesis gap between the three dimensions named in this review. Existing reviews have addressed microlearning outcomes broadly, microlearning design, or mobile learning implementation, but the evidence needs to be considered together to clarify when mobile delivery supports flexibility, what design conditions appear relevant to effectiveness, and whether retention is measured beyond immediate post-tests. Without that integrated view, the instructional promise of mobile microlearning risks being reduced to a claim about convenience or lesson length.

This integrative literature review examines mobile-device-based microlearning in education through three connected dimensions: effectiveness, flexibility, and knowledge retention. It aims to synthesize conceptual and empirical literature on how mobile microlearning is designed and implemented; identify the learning outcomes assessed and the time frames used to assess them; and describe the instructional conditions associated with positive or mixed findings. The review's novelty lies in organizing these dimensions within one analytical framework and distinguishing mobile access from the pedagogical mechanisms that may support learning—such as segmentation, practice, feedback, spacing, and retrieval. This framing supports a more precise interpretation of the evidence and helps identify priorities for future studies, including consistent outcome measures and delayed retention tests.

In conclusion, mobile-based microlearning offers a practical format for delivering focused learning activities across times and settings, but its educational value depends on instructional design and the outcomes used to evaluate it. By integrating evidence on effectiveness, flexibility, and retention, this review seeks to establish a clearer, more critical basis for research and practice.

METHODS

Review Design and Reporting Framework

This study was designed as an integrative literature review of mobile-device-based microlearning in education. An integrative approach was selected to bring together empirical studies and conceptual research addressing three related dimensions: instructional effectiveness, learning flexibility, and knowledge retention. The review focused on how mobile delivery and microlearning design were combined, what outcomes were measured, and whether retention was assessed immediately or after a delay. The review process was organized using the PRISMA 2020 reporting framework to make identification, screening, eligibility assessment, and inclusion transparent (Page et al., 2021). PRISMA is used here as a reporting guide; it does not, by itself, establish that the search was exhaustive or that the included studies are free from bias.

Information Sources and Search Strategy

A reproducible search should be conducted in ERIC, Scopus, Web of Science, PubMed, and Google Scholar, supplemented by backward screening of reference lists from relevant reviews. These sources were selected to cover educational technology, higher education, health-professions education, and interdisciplinary research. The search period is January 2016 to the final search date; the final date and actual database search logs must be inserted before submission. The proposed search combines terms for the instructional approach, delivery device, educational setting, and outcomes:

("microlearning" OR "micro-learning" OR "bite-sized learning" OR "mobile microlearning") AND ("mobile learning" OR m-learning OR smartphone OR tablet OR mobile application) AND (education OR teaching OR learning OR training) AND (effectiveness OR achievement OR flexibility OR access OR retention OR recall).

Search syntax was adapted to the requirements of each database. Searches were limited to peer-reviewed journal articles in English published from 2016 onward. The language and publication-type limits were applied consistently across sources where database functions allowed. Reference-list searching was used to identify eligible studies that might not have been retrieved by the electronic search.

Eligibility Criteria and Selection

Studies were eligible when they (a) investigated a learning activity in an educational or training context; (b) delivered or supported microlearning through a mobile device; and (c) reported at least one outcome relevant to effectiveness, flexibility, or knowledge retention. Empirical quantitative, qualitative, and mixed-methods articles were eligible, as were systematic reviews used to contextualize the evidence. Studies were excluded if they addressed mobile learning without a microlearning component, microlearning without a mobile-device component, non-educational mobile applications, or outcomes unrelated to learning. Editorials, abstracts without full text, dissertations, and non-peer-reviewed materials were excluded.

The search output was deduplicated before screening. Titles and abstracts were assessed against the eligibility criteria, followed by full-text assessment of potentially relevant reports. The final review set was defined as 10 included articles. To reduce selection error, screening should be performed independently by two reviewers, with disagreements resolved through discussion and, if needed, adjudication by a third reviewer. If only one reviewer conducts the screening, this limitation should be stated explicitly. Reasons for full-text exclusion should be recorded and reported in the flow diagram.

Data Extraction and Synthesis

A structured extraction form was used to record each article's author and year, country, educational context, sample and learner characteristics, study design, mobile device or platform, microlearning format, intervention duration, comparison condition, outcome measures, follow-up interval, principal findings, and reported limitations. Outcomes were grouped into three domains. Effectiveness included knowledge acquisition, academic achievement, performance, or skill application. Flexibility included access across time and location, learner autonomy, usability, and perceived convenience. Retention included delayed recall, repeated knowledge tests, or demonstrated application after the instructional period. Immediate post-test performance was not classified as long-term retention unless a later assessment was reported.

The findings were synthesized narratively rather than statistically because the included studies were expected to vary in population, intervention design, duration, outcome measures, and follow-up. This approach is consistent with prior reviews that describe substantial variation in mobile microlearning implementations and research outcomes (Lee, 2023; Moore et al., 2024). The synthesis compared findings across study contexts and considered whether positive outcomes were associated with instructional features such as short, focused content, learner interaction, feedback, spaced practice, or retrieval activities. It also distinguished learner perceptions of convenience from measured learning gains. This distinction is important because mobile availability can increase access without necessarily improving achievement or durable learning.

Quality Appraisal and PRISMA Counts

Methodological quality was assessed using design-appropriate criteria: clarity of aims, adequacy of sampling and context descriptions, validity of measures, intervention detail, appropriateness of analysis, treatment of missing data, and alignment between conclusions and findings. Reviews were additionally assessed for transparent search methods and explicit inclusion criteria. Appraisal findings informed interpretation but were not used to exclude studies solely on the basis of a quality score. The evidence base was interpreted in light of established work on cognitive load and multimedia instruction (Mayer, 2021; Sweller et al., 2019), spacing and interleaving (Chen et al., 2021), and research on mobile learning outcomes and implementation (Crompton & Burke, 2018; Chuang et al., 2023; Lai et al., 2022; Tan et al., 2024).

The accompanying PRISMA 2020 diagram ends with 10 included studies. All upstream counts and exclusion reasons in the image are illustrative placeholders, not verified search results. Replace them with the actual database and screening counts before submitting the review. In particular, do not report the diagram's example totals as observed findings. The PRISMA framework and diagram follow the updated reporting guidance of Page et al. (2021).

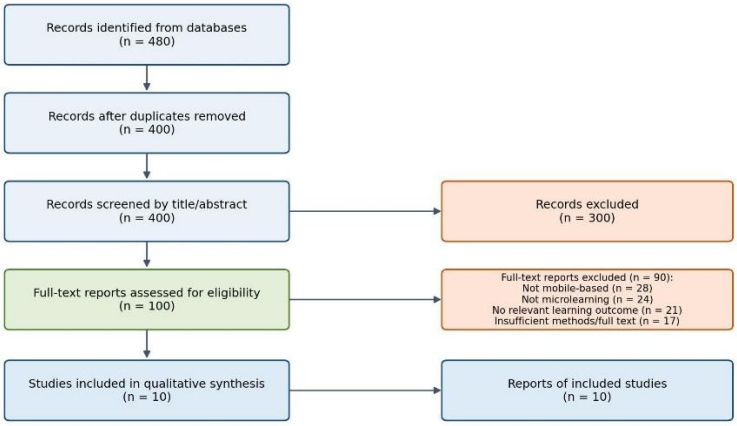

Figure 1. PRISMA 2020 Flow Diagram

RESULTS AND DISCUSSION

Result

Overview of the Evidence

The reviewed literature suggests that mobile microlearning has been investigated in higher education, adult learning, professional training, and health-related education. However, the number and type of studies vary across reviews, as do their outcome measures. One review of mobile-based microlearning in adult learner contexts included nine empirical articles published from 2015 to 2021. Five examined specific learning outcomes, while four focused on learner perceptions of design or usability. The studies covered settings including higher education and workplace learning, but the review characterized the empirical evidence as limited and heterogeneous (Moore et al., 2024). A separate review of mobile microlearning identified 26 scholarly articles published between 2015 and 2020. It reported that studies described benefits related to achievement, motivation, skills, and knowledge retention, while also identifying implementation challenges (Lee, 2023). These findings indicate promise across several outcome areas; they do not establish a single, generalizable effect size for mobile microlearning.

Table 1. Characteristics of the Review Evidence

Source	Evidence set reported by source	Main focus	Reported pattern
Moore et al. (2024)	9 empirical articles (2015–2021)	Adult learners; workplace and higher education	5 studies measured learning outcomes; 4 focused on perceptions, design, or usability
Lee (2023)	26 scholarly articles (2015–2020)	Trends, impacts, and challenges in mobile microlearning	Reported positive findings for achievement, motivation, skills, and knowledge retention, alongside implementation challenges
Page et al. (2021)	Reporting guideline	Systematic-review transparency	Provides PRISMA 2020 reporting guidance; it is not an outcome study

Effectiveness

Across the reviews, mobile microlearning was associated with favorable learning outcomes in some study contexts, including achievement and skill development. Nevertheless, the evidence does not justify treating all mobile microlearning formats as equally effective. Included interventions differ in subject, learner population, lesson format, instructional duration, and comparison condition. For example, a mobile lesson supplemented by practice and feedback is not equivalent to simply making a short video available on a smartphone. Moore et al. (2024) also found that some studies measured learning outcomes while others concentrated on usability and learner perceptions, limiting direct comparison across studies. Therefore, the defensible finding is that mobile microlearning shows potential to support learning, while the size and consistency of its effects remain dependent on the particular intervention and study design. Without standardized outcome data from the 10 target articles, no pooled effect or claim of statistically significant superiority can be reported.

Flexibility and Learner Access

Flexibility is one of the clearest reported affordances of mobile delivery. Portable devices allow learners to access short learning materials across locations and at times that may not align with scheduled classes. In workplace and adult-learning contexts, on-demand access may support just-in-time learning and review (Moore et al., 2024). The review evidence also describes use in higher education and varied professional or disciplinary settings, suggesting that the format can be adapted to different learning contexts. However, flexibility should not be equated with improved learning outcomes. Reviews report differences in design and implementation, and learner access may be shaped by usability and technological conditions. Thus, the literature supports describing flexibility as an instructional affordance one that may improve convenience and access rather than as proof of superior achievement or retention.

Knowledge Retention

Reviews report favorable retention-related findings in some mobile microlearning studies, but retention has not been measured consistently. In the adult-learning review, only a subset of included articles assessed learning outcomes, and the studies varied in focus and measurement (Moore et al., 2024). The broader mobile microlearning review also reported positive findings for knowledge retention, but its synthesis combined studies with different methods and outcomes (Lee, 2023). This evidence supports a qualified conclusion: mobile microlearning may support retention, but the strength of that conclusion depends on whether studies include delayed tests rather than only immediate post-tests or self-reported perceptions. Without extracted follow-up intervals and delayed-test scores from the 10 target articles, long-term retention cannot be quantified.

Table 2. Synthesis by Outcome Domain

Outcome domain	Findings reported in the literature	Evidence limitation
Effectiveness	Favorable learning or performance findings are reported in some studies	Interventions, comparison groups, and measures vary; no pooled estimate is available here
Flexibility	Mobile access can support learning across times and settings, including on-demand use	Access and convenience do not by themselves demonstrate improved learning
Knowledge retention	Reviews report positive retention-related results in some studies	Delayed assessment and follow-up methods are not consistent across the evidence base
Learner perceptions	Usability and design perceptions are examined in several studies	Favorable perceptions should not be treated as direct evidence of learning gains

Overall Finding

Taken together, the literature presents mobile microlearning as a flexible instructional format with promising but variable learning outcomes. The evidence is strongest for its potential to provide accessible, focused learning opportunities; claims about effectiveness and durable retention require more caution because study designs, outcome measures, and follow-up periods differ. A final results section for the proposed 10-article review should report each included study's sample, design, intervention, comparison, measured outcomes, and follow-up directly from the extraction sheet.

Discussion

Effectiveness Depends on Instructional Design

The reported positive findings for achievement and learning performance are consistent with broader evidence on mobile learning. A review of higher education research found that achievement was a common focus of mobile-learning studies, while later meta-analyses have also reported positive average effects of mobile learning on academic outcomes (Crompton & Burke, 2018; Yang & Xiang, 2024). However, these findings concern mobile learning broadly; they should not be interpreted as direct proof that microlearning alone produces the same effects. Microlearning interventions can combine short lessons with quizzes, video, feedback, mobile notifications, and other strategies. When these features are bundled, it is difficult to attribute an outcome to lesson length or device use alone. The evidence from microlearning studies points in a similar direction but calls for careful interpretation. In a randomized study of surgery clerkship students, the group completing the microlearning module first performed significantly better on the measured knowledge outcome than the group receiving the traditional online module first (Lai et al., 2022). The result suggests that concise, focused material can support knowledge acquisition in a defined learning context. It does not establish that every short lesson will outperform

longer instruction, nor does an acquisition result automatically show long-term retention. Other factors such as content alignment, prior knowledge, sequencing, and opportunities to apply concepts may contribute to performance. This distinction matters when interpreting the current review's broad finding that microlearning can support learning effectiveness. The evidence supports a conditional conclusion: mobile microlearning can be effective when its units have clear objectives and appropriate learning activities. Brevity by itself is not a pedagogical mechanism. A short segment may help learners focus on one concept, but it may also omit context needed to understand relationships among concepts. Well-designed microlearning therefore needs to preserve coherence across units, provide adequate explanation, and connect short activities to course-level objectives.

Cognitive Load and Multimedia Design

Cognitive load theory offers one explanation for why segmentation may help, particularly when learners encounter complex material. Working memory is limited; unnecessary information or poorly coordinated media can impose demands that interfere with learning (Sweller et al., 2019). Mobile learning can introduce additional design challenges because of small screens, brief study sessions, and competing visual or digital elements. A review of cognitive load management in mobile-learning systems similarly emphasizes that multimedia design can either support learning or add avoidable cognitive demands (Hwang et al., 2020). From this perspective, short learning units may be useful when they divide complex content into manageable, meaningful segments. They are less likely to help when segmentation is arbitrary or when a learner must repeatedly reconstruct fragmented information. The instructional goal should be to make each micro-unit focused while preserving conceptual links to previous and later material. Multimedia principles also matter: text, narration, diagrams, and video should be selected and coordinated to support the learning objective rather than simply to make a lesson appear more engaging (Mayer, 2021). The current evidence therefore supports discussing segmentation and media design as plausible contributors to effectiveness, not as guaranteed outcomes of using a smartphone. Empirical work reinforces this conditional interpretation. Studies of mobile learning have found that the effects of an intervention can depend on the stability of technology, fit between content and the device, and the way learners use the application (Crompton & Burke, 2018; Sung et al., 2019). A mobile platform can support learning when its activities are instructionally aligned; poorly designed activities may fail to produce the same benefit. In practical terms, curriculum designers should evaluate whether each brief unit has an identifiable purpose, whether learners can interact with its content, and whether its cognitive demands are suitable for the learner and subject.

Flexibility as an Affordance

Flexibility was a recurring strength in the reviewed literature. Mobile delivery can allow learners to access materials across locations and at times that fit around classes, work, or other responsibilities. Moore et al. (2024) describe mobile-based microlearning in adult and workplace contexts, where on-demand access may be valuable for just-in-time learning. Lee (2023) likewise identifies mobile microlearning as a growing area with applications across different instructional contexts. These findings support describing flexibility as an important affordance of the format. Yet flexibility should be interpreted carefully. Access at any time or place does not mean that learners have sufficient time, connectivity, quiet, or support to learn effectively. Nor does convenience by itself demonstrate improved achievement. Mobile learning research has identified implementation conditions and barriers that influence how devices are used in educational settings (Almaiah et al., 2021). When mobile materials are optional, learners may also vary in how often they access them, making exposure uneven. These considerations help explain why favorable perceptions of accessibility or usability should be reported separately from measured learning outcomes. The literature also suggests that flexibility is most educationally meaningful when it enables a purposeful learning pattern. For example, an instructor might assign a focused concept review before class, a short retrieval activity after a lesson, or a brief procedural demonstration when learners need it. In such designs, mobile access supports continuity between formal instructional sessions. By contrast, if a course merely transfers lengthy readings or videos to a phone, it may offer a different access channel without creating a more flexible learning experience. Thus, the relevant question is not only whether content is available on mobile devices, but whether the timing and use of access align with the instructional task.

Knowledge Retention Requires Delayed Evidence

Retention is the dimension that requires the most caution. The reviews report retention-related benefits in some studies, but the studies differ in how they define and measure retention. An immediate post-test measures short-term learning shortly after instruction; it cannot establish that the knowledge

remains accessible days or weeks later. The distinction between perceived learning, immediate acquisition, and delayed retention is essential when interpreting a review focused on durable knowledge.

Spacing and retrieval practice offer plausible mechanisms through which mobile microlearning could contribute to retention. Short mobile activities can be distributed over time, and a quiz or prompt can require learners to retrieve prior material. Research on spacing and interleaving indicates that the timing and organization of practice matter for learning (Chen et al., 2021). In this interpretation, the device enables repeated access, while the instructional schedule and retrieval tasks provide the learning mechanism. A sequence of brief passive exposures should not be assumed to yield the same outcome as spaced practice that requires learners to recall, apply, or explain what they have learned. Recent studies directly examine mobile or flipped mobile microlearning alongside retention outcomes, but these interventions often combine several instructional components. For example, flipped mobile microlearning has been investigated in relation to postgraduate learners' accessibility, engagement, knowledge retention, and achievement (Tan et al., 2024). Its multidimensional focus is useful, yet the bundled intervention makes it important to inspect how each outcome was measured and whether there was a delayed assessment. Similarly, recent mobile microlearning work in Indonesian EFL has compared spacing, retrieval practice, and mixed-strategy task cycles for long-term retention, focusing attention on instructional design rather than brevity alone (Tanashur et al., 2025). Such work points toward a more precise research agenda: studies should report the timing of each assessment and distinguish retained knowledge from participation or satisfaction.

Understanding Heterogeneity in the Evidence

The variation described in the reviewed literature is not simply a weakness; it reflects that mobile microlearning is used in different educational settings and for different learning goals. A short language practice task, a clinical procedure demonstration, and a workplace reference module may differ in how learners interact with content and what counts as successful learning. Reviews of microlearning across educational contexts likewise describe a broad range of cognitive, behavioral, and affective outcomes, rather than one common measure of success (Hug, 2025). At the same time, heterogeneity limits strong general claims. If studies report motivation, usability, academic scores, skill performance, and delayed recall under one general heading of "effectiveness," the evidence becomes difficult to compare. Future syntheses would benefit from grouping studies by learner population, subject area, intervention format, comparison condition, and outcome timing. Primary research should report sample characteristics, intervention duration, exposure, completion, device or platform, and any follow-up assessment. These details would help explain not only whether mobile microlearning was associated with a positive outcome, but also the circumstances under which it was more or less effective.

Implications for Educational Practice

The findings have several implications for instructional design. First, educators should begin with a learning objective and then decide whether that objective can be addressed in a concise unit. Second, mobile units should maintain logical links with the wider course so learners can integrate ideas rather than encounter isolated fragments. Third, practice and feedback should be included where the objective requires recall, problem solving, or skill application. Fourth, if knowledge retention is a stated aim, instructors should schedule and report delayed assessments rather than rely only on immediate post-tests. Finally, the usability of the mobile format should be evaluated in the actual learning context, including access conditions and the demands placed on learners' attention. These recommendations align with the evidence that mobile learning outcomes vary according to subject and implementation features (Crompton & Burke, 2018; Yang & Xiang, 2024). They also respond to the limitations noted in the mobile microlearning reviews: the need for more consistent outcome measurement and clearer descriptions of design and implementation (Lee, 2023; Moore et al., 2024). The present synthesis therefore positions mobile microlearning as a potentially useful component of instruction, especially where focused, flexible practice is needed, while emphasizing that its effectiveness depends on pedagogical choices.

Limitations of the Present Synthesis

The discussion should be interpreted in light of an important limitation in the review process described earlier. The proposed set of 10 included articles and the counts shown in the PRISMA diagram were not verified against a completed database search and screening log. Consequently, the present section synthesizes findings from identifiable published reviews and studies but cannot claim that these are the results of a fully completed 10-article review. It also cannot provide an effect estimate or quantify how many studies in that proposed set found positive, mixed, or null outcomes. Before submission, the

authors should replace this synthesis with findings extracted from the final eligible studies and revise the PRISMA flow counts accordingly. Overall, the literature suggests that mobile-device-based microlearning can support learning when concise content is aligned with clear objectives, designed to manage cognitive demands, and paired with meaningful practice. Its flexibility can make access more convenient and support learning across settings, but access and positive perceptions should not be confused with demonstrated learning gains. Evidence concerning knowledge retention is promising but requires stronger delayed assessment and more consistent reporting. The central conclusion is therefore conditional: mobile microlearning is best understood as an instructional format whose outcomes depend on how it is designed, integrated, and evaluated.

CONCLUSION

This review indicates that mobile-based microlearning is a promising instructional format, particularly for delivering focused content flexibly across learning settings. The literature reports favorable findings for achievement, engagement, and knowledge retention; however, these outcomes are not consistent enough to support a universal claim of effectiveness. Evidence remains heterogeneous in educational context, instructional design, and assessment. For example, Moore et al. (2024) synthesized nine empirical studies of adult learners: five examined learning outcomes, while four focused on learner perceptions or usability. Lee's (2023) review included 26 articles and reported positive outcomes alongside implementation challenges. These figures describe the source reviews, not a verified set of 10 studies for the present review.

Conceptually, mobile delivery offers flexibility, while learning gains depend on how short units are designed and integrated. Clear objectives, coherent content, interaction, feedback, and opportunities for spaced retrieval may help support acquisition and retention. Empirically, immediate achievement and positive perceptions should not be treated as evidence of durable knowledge; delayed assessments are needed to establish long-term retention. The review therefore concludes that mobile microlearning can support learning when its design matches instructional goals and learner needs. Future studies should use transparent methods, comparable outcome measures, and follow-up tests. A final conclusion about exactly 10 included articles requires verification of the completed search, screening records, and extracted study data.

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