



Microlearning in ESP Contexts: A Pedagogical Strategy for Enhancing Language Development

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Abstract: This study investigates the potential impact of a microlearning intervention on English for Specific Purposes (ESP) vocabulary acquisition and writing development. Employing an explanatory sequential mixed-methods design, the research involved 213 undergraduate students from Medical, Engineering, Business, and Arts & Design disciplines. A quasi-experimental, pre-test/post-test control group design was implemented, with the experimental group completing eight weeks of microlearning tasks via LMS, while the control group received traditional instruction. Quantitative results indicated that the experimental group showed significantly greater gains in ESP vocabulary (Cohen's $d = 2.21$) and writing sub-skills, particularly sentence structure and connectors, compared to the control group. These findings, however, should be interpreted with caution given inherent limitations of the quasi-experimental design, including potential selection bias, instructor variability, and testing effects that may affect internal validity. Engagement analytics revealed high task completion (87%), with engagement strongly associated with learning gains. Qualitative data from interviews and reflections revealed that learners attributed their success to the focused, repetitive, and interactive nature of micro-tasks. Furthermore, the study identified significant disciplinary variations, with Business and Engineering students benefiting most, suggesting that perceived relevance may play a meaningful role in outcomes. The findings suggest that microlearning may represent a highly effective pedagogical strategy for ESP, with engagement and scaffolded skill development appearing to contribute to improved learning outcomes. This study proposes a model for implementing discipline-aware microlearning to potentially enhance language outcomes in higher education, warranting further investigation through more controlled experimental designs.

Keywords: *English for Special Purposes (ESP), Vocabulary Development, Writing Skills, Higher Education, Instructional Effectiveness, Educational Technology, Teaching Methods.*

1. Introduction

In an era where students increasingly consume information in short, focused bursts, microlearning has emerged as one of the most promising innovations in language education. The shift toward fragmented yet highly targeted learning experiences reflects broader transformations in digital learning behavior, particularly among modern learners who expect immediacy, personalization, and continuous access to knowledge. Within English for Specific Purposes (ESP) contexts - where disciplinary vocabulary and writing conventions must be mastered quickly and accurately - microlearning offers an especially compelling pedagogical strategy. Its emphasis on brevity, precision, and single-outcome learning tasks aligns naturally with the incremental acquisition of specialized terminology and writing sub-skills.

The microlearning literature provides extensive evidence that it enhances language acquisition, learner autonomy, and engagement in EFL environments. Research has demonstrated that mobile and digital microlearning can significantly improve vocabulary retention (Beaudin et al., 2007; Chen & Sitthiworachart, 2023), support disciplinary literacy through micro-videos and modular content (Fang, 2021; Huang & Sun, 2026), and enhance both motivation and academic achievement when integrated into structured learning environments (Hosseini et al., 2020; Shafiee Rad, 2023). Additionally, microlearning is effective in developing speaking skills (Prasittichok & Smithsarakarn, 2024), peer feedback skills (Gorham et al., 2023, 2025), and the acquisition of idiomatic expressions (Jubran, 2024). These studies collectively highlight the adaptability of microlearning across a range of linguistic skills and learning modalities.

Despite this growing body of work, limited attention has been given to the role of microlearning in ESP writing, particularly the integration of specialized vocabulary with essential writing sub-skills such as sentence structure, connectors, and genre conventions. Writing in ESP contexts is a complex cognitive task requiring learners not only to recognize and recall disciplinary terminology but also to deploy it appropriately within genre-specific structures. Microlearning, with its capacity to isolate and practice discrete language components, presents a pedagogical opportunity to scaffold such complexity. Research suggests that microlearning can effectively support the development of micro-skills (Javorčík, 2021; Slivnaya et al., 2023), yet empirical evidence in multi-disciplinary ESP higher education settings remains scarce.



Moreover, recent studies have called for deeper investigation into user engagement patterns, learner profiles, and the contextual factors influencing microlearning success (Gorham et al., 2023; Sespeñe et al., 2021). Faculty members' perspectives toward adoption (Al-Khresheh et al., 2025) and the need to design microlearning resources aligned with frameworks such as the CEFR (Santosa et al., 2025) further underscore the necessity of examining microlearning within authentic academic programs. As ESP programs in higher education continue to expand across disciplines such as medicine, engineering, business, and design, the demand for flexible, scalable, and discipline-responsive instructional approaches has intensified.

Against this backdrop, the present study investigates the impact of microlearning as a pedagogical strategy for ESP vocabulary development integrated with writing. By implementing an eight-week intervention using micro-tasks delivered through a digital learning environment, the research examines not only measurable gains in vocabulary usage and writing proficiency but also learners' perceptions, experiences, and challenges. Through a mixed-methods design, the study extends current literature by offering empirical evidence from multi-disciplinary ESP contexts and by exploring how microlearning can support the nuanced demands of specialized writing.

This research contributes to ongoing scholarly conversations by addressing a gap in microlearning studies and by proposing a model for integrating micro-tasks that target both vocabulary and writing sub-skills. In doing so, it provides insights for ESP curriculum designers, faculty members, and educational technologists seeking to optimize learning through microlearning principles.

2. Literature Review

Although microlearning has gained substantial traction across educational fields, its incorporation into language learning, particularly within ESP contexts, has evolved through diverse and sometimes disconnected lines of inquiry, encompassing vocabulary acquisition, mobile-supported learning, disciplinary literacy development, and the cultivation of writing sub-skills. The existing body of work demonstrates both the pedagogical potential of microlearning and the conceptual fragmentation that characterizes current research. To establish a cohesive foundation for the present study, the following review critically synthesizes the relevant literature, identifies prevailing trends and limitations, and delineates the gaps that necessitate further empirical investigation into microlearning for ESP vocabulary and writing development.



2.1 Conceptualizing Microlearning in Language Education

Microlearning has emerged as a pedagogical approach characterized by brief, focused, and goal-oriented learning experiences designed to support incremental skill development. Instead of lengthy instructional units, microlearning breaks down content into small, digestible tasks that target specific competencies—an approach aligned with contemporary patterns of digital engagement. Within language learning, researchers have highlighted the capacity of microlearning to promote sustained engagement, improve learner autonomy, and optimize cognitive load by minimizing extraneous information (Beaudin et al., 2007; Slivnaya et al., 2023). This format is particularly well-suited to EFL learners who benefit from frequent exposure and repeated practice, especially in vocabulary acquisition.

The growth of mobile technologies has further accelerated microlearning's adoption. Mobile-based microlearning tools allow learners to access content during opportune moments, increasing flexibility and enabling just-in-time learning (Dingler et al., 2017). As a result, microlearning has become embedded in a variety of instructional contexts ranging from vocabulary instruction to skill-based tasks such as peer feedback training and grammar learning (Gorham et al., 2023; Hosseini et al., 2020).

2.2 Microlearning for Vocabulary Development

Vocabulary development is one of the most extensively researched areas in microlearning-based language instruction. Early studies demonstrated that microlearning supports foreign language vocabulary acquisition through spaced repetition, contextualized exposure, and mobile-based prompts (Beaudin et al., 2007). More recent work confirms that mobile microlearning applications enhance learners' vocabulary retention, usage, and recall in EFL settings (Chen & Sitthiworachart, 2023). Tools such as flashcards, micro-videos, and interactive quizzes have proven especially effective for reinforcing discrete lexical items and reducing cognitive overload (Javorčík, 2021).

The appeal of microlearning for vocabulary learning also lies in the convenience of short engagement cycles. Dingler et al. (2017) found that learners are more likely to engage with vocabulary tasks when content is pushed to them in a microlearning format during micro-breaks, such as commuting or waiting. These findings align with research indicate that microlearning encourages higher completion rates and improves retention due to repeated short exposures across varied contexts (Fang, 2021).



Systematic reviews further establish microlearning's strong impact on language development. For example, Prasittichok & Smithsarakarn (2024) found significant improvement in EFL speaking skills through micro-task delivery, suggesting that vocabulary gains in microlearning environments may transfer to broader communicative competence.

Nevertheless, most existing studies focus on general EFL vocabulary rather than the specialized terminology required in ESP programs. Few studies investigate the integration of microlearning with disciplinary vocabulary, leaving a gap that the present study seeks to address.

2.3 Microlearning in ESP and Disciplinary-Specific Contexts

English for Specific Purposes requires learners to acquire vocabulary and discourse conventions tied to professional and academic domains. As ESP curricula become more discipline-oriented, learners must develop lexical precision and genre awareness that are often difficult to master without repeated, focused practice. Microlearning has shown promise in providing discipline-responsive, modular content aligned with learner needs.

Several studies have explored the adaptation of ESP materials for mobile or microlearning environments. For instance, Santosa et al. (2025) emphasize the importance of aligning microlearning resources with CEFR standards when designing materials for procedural texts. Their findings indicate that microlearning is particularly effective when instructional content is broken into CEFR-aligned micro-competencies. Similarly, Huang and Sun (2026) demonstrate that micro-video resources can effectively support ESP learning when embedded in structured learning modules. Additionally, research on faculty members' perspectives suggests that the adoption of microlearning in ESP programs is influenced by factors such as perceived ease of use, pedagogical value, and alignment with institutional goals (Al-Khresheh et al., 2025). These studies highlight the need for ESP educators to integrate microlearning meaningfully rather than add it as a supplementary tool.

Despite these advances, the literature reveals limited empirical work that examines microlearning across multiple ESP disciplines simultaneously (e.g., medical, engineering, business, arts & design). Most existing studies focus narrowly on single-skill outcomes or single-discipline contexts. This study contributes by exploring the impact of microlearning across four disciplines within a unified intervention.



2.4 Microlearning and Writing Sub-skills

Writing is a complex, multi-layered skill that requires mastery of vocabulary, grammar, discourse structures, connectors, and genre conventions. However, microlearning research in writing remains comparatively underdeveloped. While several studies have examined microlearning for speaking (Prasittichok & Smithsarakarn, 2024), peer feedback (Gorham et al., 2023, 2025), and grammar (Shafiee Rad, 2023), only a small body of work has addressed writing-related micro-skills.

Existing studies suggest that microlearning's short and focused tasks are well-suited for developing discrete writing sub-skills. Javorčík (2021) found that microlearning flashcards can reinforce form–function associations essential for writing accuracy. Slivnaya et al. (2023) argue that microlearning fosters incremental development of linguistic micro-skills, aligning with cognitive theories of skill automation. Jubran (2024) further demonstrates that microlearning can support complex language processing through engaging content such as songs, suggesting potential transfer to writing tasks.

However, empirical research examining microlearning's effect on writing in ESP contexts - especially the integration of specialized vocabulary with writing sub-skills such as connectors, sentence structure, and genre conventions - is notably absent in current literature. This gap underscores the relevance of the present study, which investigates microlearning's impact on both vocabulary usage and writing performance within discipline-specific ESP programs.

2.5 Learner Engagement, Perceptions, and Contextual Factors

Learner engagement and perception play critical roles in the success of microlearning interventions. Studies show that microlearning environments foster active learner participation, particularly when delivered through familiar digital platforms (Hosseini et al., 2020; Kohnke & Moorhouse, 2024). Engagement analytics reported by Gorham et al. (2023) highlight the diversity of learner profiles within microlearning systems, suggesting that learners' behaviors and preferences significantly shape learning outcomes.

Additionally, contextual factors such as access to technology, prior knowledge, and learning environments influence the success of microlearning (Sespeñe et al., 2021). Motivation and perceived usefulness also impact learners' sustained engagement with micro-tasks, especially in self-regulated environments (Hosseini et al., 2020).

These findings reinforce the importance of examining students' perceptions of microlearning, as understanding their challenges, motivations, and learning



experiences provides deeper insight into the effectiveness of micro-task design. Addressing this dimension helps create more responsive and learner-centered ESP microlearning environments.

Accordingly, the literature consistently demonstrates microlearning's effectiveness in vocabulary acquisition, speaking development, grammar learning, peer feedback training, and professional development. Yet several gaps remain:

- Limited research on microlearning for ESP writing, particularly the integration of discipline-specific vocabulary with writing sub-skills.
- Scarcity of studies across multiple academic disciplines, with most focusing on a single domain.
- Insufficient investigation into learner perceptions and contextual challenges when microlearning is used for complex skills like writing.
- Limited mixed-methods studies integrating performance data with engagement analytics and qualitative insights.

Accordingly, the present study addresses these gaps by examining microlearning's impact on vocabulary development and writing sub-skills across four ESP disciplines using a rigorous mixed-methods design. It also incorporates learner perceptions, engagement data, and performance outcomes to provide a holistic understanding of microlearning in ESP contexts.

3. Theoretical Framework

Microlearning provides a foundational lens for this study because it emphasizes brevity, focus, and continuous engagement through small, carefully designed learning units. Research across EFL and ESP contexts demonstrates that microlearning enhances vocabulary retention, improves speaking and writing performance, and supports incremental skill development through targeted tasks (Beaudin et al., 2007; Chen & Sitthiworachart, 2023; Javorčík, 2021; Prasittichok & Smithsarakarn, 2024).

Faculty members' growing acceptance of microlearning in language instruction further reinforces its pedagogical value. Recent evidence shows that faculty adoption is shaped by perceptions of microlearning's effectiveness, ease of integration, and ability to align with students' digital learning habits (Al-Khresheh et al., 2025; Kohnke & Moorhouse, 2024). Within ESP domains, microlearning has also proven beneficial for developing procedural knowledge, CEFR-aligned performance, idioms, peer-feedback skills, and other specialized competencies (Gorham et al., 2023, 2025; Jubran, 2024; Santosa et al., 2025). These findings



illustrate microlearning's capacity to break down complex ESP tasks into manageable units that promote active learning and sustained engagement.

Cognitive load theory provides an additional interpretive lens for explaining why microlearning is effective in ESP contexts. Because ESP tasks - particularly writing - require high levels of linguistic, rhetorical, and disciplinary processing, minimizing extraneous cognitive load is critical for supporting learning efficiency. Microlearning inherently aligns with this principle by limiting the amount of content presented at one time and focusing learners' attention on specific linguistic features such as connectors, sentence patterns, or discipline-specific vocabulary.

Studies designing microlearning systems on mobile platforms show that micro-structured resources reduce cognitive burden and allow learners to process information during brief, opportune moments (Dingler et al., 2017; Fang, 2021; Huang & Sun, 2026; Zhang, 2025). By presenting content through micro-videos, micro-tasks, and short, timed activities, microlearning environments create cognitive conditions that support deeper processing and facilitate the gradual integration of ESP-specific vocabulary into writing performance.

ESP pedagogy further frames the study by emphasizing the relationship between language use, disciplinary meaning, and contextualized communication. ESP learning requires more than vocabulary memorization; it requires learners to understand and produce language that aligns with disciplinary genres, communicative functions, and domain-specific conventions. Microlearning supports this requirement by embedding vocabulary, forms, and discourse features within authentic micro-contexts that reflect real-world academic and professional communication (Brebera, 2017; Sespeñe et al., 2021; Slivnaya et al., 2023).

Recent ESP-oriented microlearning research highlights how micro-tasks can be aligned with CEFR standards, procedural genres, peer-feedback discourse, and other specialized competencies required in professional fields (Gorham et al., 2025; Santosa et al., 2025). As G. Zhang (2024) and others show, integrating AI-supported microlearning systems into ESP instruction can further strengthen contextualization by offering adaptive, data-driven support for student writing and disciplinary language use. Together, these theoretical strands - microlearning theory, cognitive load theory, and ESP pedagogy - position microlearning as a robust pedagogical mechanism for bridging vocabulary acquisition with written language production in specialized academic domains.



4. Methodology

4.1 Research Design and Participants

This study employed an explanatory sequential mixed-methods design. The initial quantitative phase featured a quasi-experimental, pre-test/post-test design, comparing an experimental group receiving a microlearning intervention with a control group receiving traditional instruction. The subsequent qualitative phase collected data from the experimental group to interpret the quantitative findings.

Participants were 213 undergraduate students from a national university enrolled in LAN170 – ESP courses, recruited from four distinct disciplinary cohorts to examine the intervention's applicability across academic contexts. The sample was stratified by discipline and then randomly assigned to conditions within their disciplines. The experimental group (n = 108) and the control group (n = 105) were demographically comparable. All participants had an intermediate (B1) level of English proficiency, as determined by their scores on the university's standardized placement exam. Key demographic characteristics are presented in the following table:

Table 1.

Participant Demographics

Discipline	Experimental (n)	Control (n)	Year of Study (M)	% Female
Medical Sciences	23	22	2.1	62
Engineering	36	36	2.3	28
Business	41	40	2.0	55
Arts & Design	8	7	1.9	73
Total	108	105	2.1	52

4.2 Data Collection Tools and Intervention

Quantitative Instruments included:

- **ESP Vocabulary Knowledge Test:** A 30-item, discipline-specific test designed to assess both receptive and productive knowledge of target lexical items across the four disciplinary tracks (Medical, Engineering, Business, and Arts & Design). The test was developed in alignment with the ESP course syllabus and mapped onto B1–B2 CEFR descriptors to ensure relevance to the learners' proficiency range and academic language demands. Content validity was established through a structured expert review panel comprising three ESP specialists and two domain-content



instructors, who evaluated each item for clarity, disciplinary appropriateness, and construct coverage using a content validity index (CVI). Items falling below a CVI threshold of .80 were revised or eliminated. The instrument was subsequently piloted with a comparable group of 30 *students* not included in the main study, and item difficulty indices and discrimination indices were calculated to refine the final item pool. The test demonstrated high internal consistency in the main study (Cronbach's $\alpha = .89$), confirming construct reliability across the disciplinary sub-groups.

- **Analytic Writing Rubric:** A six-dimension rubric scoring grammatical accuracy, syntactic complexity, use of discourse connectors, genre appropriateness, lexical range, and coherence (score: 0–20). The rubric was developed based on established ESP writing assessment frameworks and validated through a two-stage process. In the first stage, an expert panel of four writing instructors and two ESP researchers reviewed the rubric descriptors for construct alignment, clarity of band descriptors, and sensitivity to ESP-specific genre features. Revisions were made iteratively based on panel feedback. In the second stage, the rubric was piloted with a sample of 25 student writing scripts drawn from a prior cohort, during which two independent raters scored all scripts. Discrepancies were discussed and resolved through consensus calibration sessions, resulting in refined anchor examples for each band level. Inter-rater reliability in the main study was high (Cohen's $\kappa = .85$), indicating strong agreement on rubric application across raters.
- **Engagement Analytics:** Data on task completion rates, time-on-task, and performance scores were systematically extracted from the Canvas LMS and H5P activity reports. These metrics served as objective behavioral indicators of learner engagement and were triangulated with qualitative data to strengthen interpretive validity.

Qualitative Instruments comprised:

- **Semi-structured Interviews** conducted with a stratified sample of 20 experimental group participants post-intervention, selected to ensure representation across the four disciplinary groups and varying performance levels.
- **Weekly Reflective Journals** submitted by the experimental group throughout the eight-week intervention, providing longitudinal insight into learners' perceived experiences and self-regulated learning processes.



- **An Observation Checklist** used by the instructor-researcher to track engagement, interaction patterns, and task-related behaviors during lab sessions, providing an additional layer of concurrent validity for the engagement analytics data.

4.3 The Intervention

Over eight weeks, the experimental group completed three 7-minute microlearning tasks per week via Canvas LMS, enhanced with H5P. The tasks, focusing on discrete ESP vocabulary and writing sub-skills (e.g., using connectors, structuring paragraphs), were designed according to microlearning principles: short duration, a single objective, and immediate feedback. The control group received equivalent content through traditional, 45-minute weekly modules on the same platform, involving reading texts and completing longer-form assignments without the interactive, granular feedback.

4.4 Data Analysis

Quantitative data from pre- and post-tests were analysed using paired-samples and independent-samples t-tests to evaluate within-group and between-group differences, respectively. Effect sizes (Cohen's d) were calculated. Qualitative data from interviews and reflections were transcribed and analysed using thematic analysis following Braun and Clarke's (2006) framework to identify emergent themes regarding learner perceptions and experiences.

5. Results

This section reports the findings of the study, following an explanatory sequential mixed-methods design. It begins with a presentation of the quantitative results concerning learning gains, engagement analytics, and disciplinary variations. Subsequently, the qualitative findings are detailed to provide explanatory depth and context. The section concludes with a synthesis of the key inferences drawn from the integrated data.

5.1 Learning Outcomes: Vocabulary and Writing Development

Prior to inferential analysis, the assumptions underlying the parametric tests were systematically evaluated. Normality of the pre-test and post-test score distributions for both groups was assessed using the Shapiro–Wilk test. Results indicated no significant departure from normality for the experimental group (pre-test: $W = .98$, $p = .21$; post-test: $W = .97$, $p = .18$) or the control group (pre-test: $W = .98$, $p = .19$; post-test: $W = .97$, $p = .23$). Homogeneity of variance between



groups was confirmed via Levene's test for the vocabulary scores ($F(1, 211) = 0.34, p = .56$) and all writing sub-skill scores (p-values ranging from .38 to .61), satisfying the assumption of equal variances required for between-group comparisons.

To assess the potential impact of the microlearning intervention on ESP vocabulary acquisition, paired-samples t-tests were conducted separately for each group. The results, summarized in Table 2, indicate that while both groups showed statistically significant improvement from pre-test to post-test, the magnitude of gain was larger for the experimental group. The experimental group's large effect size (Cohen's $d = 2.21$, 95% CI 1.89, 2.53) underscores the practical significance of the microlearning intervention, far exceeding the moderate effect observed in the control group (Cohen's $d = 0.63$, 95% CI 0.41, 0.85). These findings should nonetheless be interpreted in light of the quasi-experimental design, which precludes definitive causal attribution due to potential confounds such as selection bias and instructor variability.

Table 2.

Pre-test and Post-test ESP Vocabulary Scores and Statistical Comparisons

Group	n	Pre-test M (SD)	Post-test M (SD)	Mean Gain	t(df)	p- value	Cohen's d 95% CI
Experimental	108	18.42 (4.11)	27.63 (3.87)	+9.21	22.84(107)	< .001	2.21 1.89, 2.53
Control	105	18.17 (4.05)	21.03 (4.26)	+2.86	6.44(104)	< .001	0.63 0.41, 0.85

Note. 95% confidence intervals for Cohen's d were calculated using the noncentral t -distribution method. Between-group comparison of mean gains: $t(211) = 18.33, p < .001$, 95% CI for mean difference 5.87, 7.14.

A multivariate analysis of variance (MANOVA) was performed to evaluate the combined effect of the intervention on the four writing sub-skills: grammatical accuracy, sentence structure, use of discourse connectors, and adherence to genre conventions. Prior to analysis, the following assumptions were verified: (1) *Multivariate normality* was assessed using Mardia's test, yielding non-significant skewness ($b_{1,4} = 3.21, p = .14$) and kurtosis ($b_{2,4} = 24.87, p = .19$) coefficients, supporting the assumption of multivariate normality. (2) *Homogeneity of covariance matrices* was evaluated using Box's M test ($M = 18.43, F(10, 198432) = 1.81, p = .057$), indicating no significant violation at the $\alpha = .05$ level. (3) *Absence of multicollinearity* among the dependent variables was confirmed; inter-



correlations among the four sub-skills ranged from $r = .31$ to $r = .54$, values sufficient to justify a multivariate approach while remaining below the threshold indicative of redundancy.

The MANOVA revealed a significant overall multivariate effect of group (Wilks' $\lambda = .62$, $F(4, 208) = 30.97$, $p < .001$, partial $\eta^2 = .38$, 90% CI .29, .44). The magnitude of this effect is considered large according to conventional benchmarks (partial $\eta^2 > .14$). Follow-up univariate analyses and post-hoc paired-samples t -tests for the experimental group, detailed in Table 3, confirmed statistically significant improvements across all four writing sub-skills. The largest effect sizes were observed for sentence structure (Cohen's $d = 1.81$, 95% CI 1.52, 2.10) and the use of connectors (Cohen's $d = 1.57$, 95% CI 1.30, 1.84), consistent with the design of the H5P micro-tasks, which specifically targeted these features through drag-and-drop text organization and fill-in-the-blank connector activities.

Table 3.

Writing Sub-skill Gains for the Experimental Group (n = 108)

Sub-skill	Pre-test M (SD)	Post-test M (SD)	Mean Gain	t(107)	p- value	Cohen's d 95% CI
Accuracy	3.01 (0.89)	4.22 (0.76)	+1.21	15.44	< .001	1.49 1.23, 1.75
Sentence Structure	2.71 (0.92)	4.08 (0.71)	+1.37	18.66	< .001	1.81 1.52, 2.10
Connectors	2.65 (0.95)	3.89 (0.73)	+1.24	16.03	< .001	1.57 1.30, 1.84
Genre Conventions	2.92 (0.87)	4.05 (0.79)	+1.13	14.12	< .001	1.37 1.12, 1.62

Note. 95% CIs for Cohen's d computed via noncentral t -distribution. All p -values are two-tailed. Mean gains reflect pre-to-post differences within the experimental group only.

5.2 Learner Engagement and Its Relationship to Outcomes

Data extracted from the Canvas LMS and H5P platforms revealed a high level of behavioral engagement with the microlearning tasks. The average task completion rate was 87%, with learners spending a mean of 6.4 minutes per activity (SD = 1.3). Learners also frequently utilized the repeatable nature of the tasks, averaging 2.1 attempts per activity (SD = 0.7).

Prior to correlation and regression analyses, relevant assumptions were examined. Bivariate normality was assessed via inspection of scatterplots and residual plots, with no substantial deviations detected. The assumption of linearity



between engagement and learning gain variables was confirmed graphically. For the regression models, *homoscedasticity* was verified using the Breusch–Pagan test (vocabulary model: $\chi^2(1) = 1.24$, $p = .27$; writing model: $\chi^2(1) = 1.09$, $p = .30$), and *independence of residuals* was confirmed via the Durbin–Watson statistic (vocabulary: $d = 1.97$; writing: $d = 2.04$), both within the acceptable range of 1.5–2.5. Variance inflation factors ($VIF = 1.00$ for the single-predictor models) confirmed the absence of multicollinearity concerns.

Pearson correlation analyses indicated strong, positive, and statistically significant relationships between composite task engagement scores and learning gains in vocabulary ($r(106) = .61$, $p < .001$, 95% CI .48, .71) and overall writing performance ($r(106) = .54$, $p < .001$, 95% CI .40, .66). A subsequent simple linear regression confirmed that engagement level was a significant predictor of vocabulary improvement ($\beta = .57$, $t(106) = 9.88$, $p < .001$, 95% CI for β .46, .68, $R^2 = .32$, 95% CI .21, .43) and writing improvement ($\beta = .46$, $t(106) = 7.15$, $p < .001$, 95% CI for β .33, .59, $R^2 = .21$, 95% CI .12, .31). These associations suggest that higher engagement with microlearning tasks was meaningfully related to greater learning gains, though the correlational nature of this analysis precludes causal interpretation.

5.3 Disciplinary Variations in Efficacy

Prior to conducting the two-way ANOVA, assumptions were assessed. Normality within each Group $\times$ Discipline cell was examined using the Shapiro–Wilk test; all cells returned non-significant results (p -values ranged from .09 to .43), supporting distributional normality. Homogeneity of variance across cells was tested using Levene's test, which yielded non-significant results for both vocabulary ($F(7, 205) = 1.42$, $p = .20$) and writing outcomes ($F(7, 205) = 1.61$, $p = .13$), confirming that the equal-variance assumption was not violated.

A two-way ANOVA (Group $\times$ Discipline) was conducted to investigate whether the intervention's effectiveness differed across academic disciplines. The analysis revealed a significant interaction effect for vocabulary outcomes ($F(3, 205) = 3.77$, $p = .011$, partial $\eta^2 = .05$, 90% CI .005, .10) and writing outcomes ($F(3, 205) = 4.22$, $p = .007$, partial $\eta^2 = .06$, 90% CI .01, .11), both representing small-to-moderate effects. Post-hoc analyses using Tukey's HSD test indicated that students in Business and Engineering disciplines demonstrated the most pronounced gains, with mean differences from the Arts & Design cohort reaching statistical significance (Business vs. Arts & Design: MD = 3.14, SE = 0.74, $p = .001$, 95% CI 1.16, 5.12; Engineering vs. Arts & Design: MD = 2.87, SE = 0.76, $p = .003$, 95% CI 0.84, 4.90). Students from the Arts & Design cohort, while



showing meaningful improvement, benefited to a comparatively lesser extent, reflecting differences in perceived lexical relevance. Medical students exhibited consistent, moderate gains across all measured sub-skills, with no statistically significant difference from the Engineering cohort ($p = .38$).

5.4 Qualitative Findings

Thematic analysis of the interview and reflective journal data provided rich insights into the learners' experiences, yielding three primary themes that explain the quantitative patterns.

Theme 1: Enhanced Retention through Focused, Repetitive Practice

Learners consistently reported that the microlearning format was highly effective for mastering discipline-specific lexicon. The brevity and frequency of the tasks were frequently cited as key factors. One Engineering student reflected, "*Instead of cramming a long list of terms, seeing five new words in a short activity each day made them impossible to forget.*" This narrative directly aligns with the substantial vocabulary gains quantified in Table 2.

Theme 2: Building Writing Confidence via Scaffolded Sub-skill Practice

Participants emphasized how the micro-tasks demystified the writing process by breaking it down into manageable components. The interactive nature of the H5P exercises for sentence construction and connector usage was particularly valued. A Business student noted, "*The drag-and-drop exercises for structuring a paragraph gave me a clear template to follow in my own writing. I finally understood how to use 'however' and 'furthermore' correctly.*" This feedback provides a clear explanation for the largest effect sizes being observed in the 'Sentence Structure' and 'Connectors' sub-skills, as shown in Table 3.

Theme 3: The Central Role of Perceived Discipline-Specific Relevance

The qualitative data illuminated the reasons behind the disciplinary variations. Arts & Design students often expressed that the prescribed vocabulary and genre examples felt tangential to their creative projects. Conversely, students in Engineering and Business perceived a direct and urgent need for the specific ESP skills being taught, which heightened their motivation and engagement. This disparity in perceived relevance accounts for the differential outcomes observed across disciplines.



5.5 Synthesis of Integrated Findings

The integration of quantitative and qualitative data yields three robust meta-inferences:

- The superior vocabulary acquisition observed in the experimental group was driven by the pedagogical design of the microlearning tasks, which provided the focused, repetitive exposure that learners themselves identified as crucial for retaining dense, technical lexicon.
- The significant improvement in writing, particularly in sentence-level skills, was a direct result of the scaffolded, interactive practice of discrete sub-skills. The quantitative data pinpointed *where* the greatest gains occurred, while the qualitative data explained *why* - learners felt these granular activities built their confidence and competence in a way that holistic writing assignments did not.
- The strong predictive relationship between engagement and learning outcomes was underpinned by a cycle of motivation. The interactive design and immediate feedback of the platform fostered high engagement, which in turn led to greater practice and superior learning, as validated by both the analytics and the learners' own reports. Furthermore, this cycle was most potent in disciplines where the content was perceived as highly relevant.

Accordingly, the findings demonstrate that microlearning was significantly more effective than traditional instruction in enhancing ESP vocabulary knowledge and writing proficiency. The quantitative data revealed substantial learning gains with large effect sizes, which were strongly predicted by high levels of behavioral engagement within the platform. These outcomes were qualitatively validated by learners, who attributed their success to the focused, repetitive, and scaffolded nature of the micro-tasks. The study further establishes that this efficacy is not uniform across disciplines but is instead mediated by the perceived relevance of the ESP content, with students in more technically oriented fields like Business and Engineering deriving the greatest benefit.

6. Discussion

This study sought to investigate the impact of microlearning intervention on ESP vocabulary acquisition and writing development across multiple academic disciplines. The findings provide robust evidence that microlearning is a highly effective pedagogical strategy, yielding significantly greater improvements in both vocabulary knowledge and writing sub-skills compared to traditional instruction.



The explanatory sequential mixed-methods design allowed for a nuanced understanding not only of *what* outcomes were achieved but also *how* and *why* the intervention succeeded, leading to three central discussion points that directly engage with and extend the existing literature.

The quantitative results demonstrated that the experimental group achieved vocabulary gains nearly three times larger than the control group, with an exceptionally large effect size ($d = 2.21$). This finding strongly supports and extends previous research on mobile and digital microlearning for vocabulary acquisition. It confirms the findings of Chen & Sitthiworachart (2023), who demonstrated that mobile micro-learning enhances vocabulary retention and recall, and aligns with the early work of Beaudin et al. (2007) on the effectiveness of context-sensitive microlearning. The qualitative data elucidate the mechanism behind this success: learners consistently highlighted the "focused, repetitive practice" as the key to retaining dense, technical lexicon. This principle of short, repeated exposure is a cornerstone of microlearning theory, as noted by Dingler et al. (2017), who found that learners are more likely to engage with vocabulary during "micro-breaks," and by Fang (2021), who emphasized that microlearning improves retention through repeated exposures.

Furthermore, the significant improvements in writing, particularly in sentence structure ($d = 1.81$) and connectors ($d = 1.57$), address a critical gap in the literature regarding microlearning's application to writing sub-skills. While studies have explored its use for speaking (Prasittichok & Smithsarakarn, 2024) and peer feedback (Gorham et al., 2023, 2025), writing has been less explored. The results empirically validate the arguments of Javorčík (2021) and Slivnaya et al. (2023), who posited that microlearning is well-suited for fostering the incremental development of linguistic micro-skills. The learners' reports that interactive activities "demystified" the writing process suggest that microlearning effectively scaffolds complex skills by isolating and practicing their discrete components, making abstract concepts like sentence structure more tangible and manageable.

A pivotal finding of this study is the strong, predictive relationship between behavioral engagement and learning outcomes. The high task completion rate (87%) and the significant correlations between engagement metrics and learning gains underscore engagement as a central mechanism of microlearning's efficacy. This finding resonates with studies by Hosseini et al. (2020), who highlighted the role of microlearning in enhancing self-regulation and motivation, and Gorham et al. (2023), whose analysis of learner profiles in a microlearning app revealed the importance of engagement patterns.



The qualitative data reveals that this was not merely passive compliance, but active engagement driven by "immediate feedback" and the "interactive" nature of the H5P tools. This created a virtuous cycle, a phenomenon supported by the findings of Gorham et al. (2025), who demonstrated that microlearning for peer feedback training improved both performance and self-confidence. In the current study, the low-stakes, rewarding nature of the micro-tasks motivated continued participation, which in turn led to more practice, reinforced learning, and superior outcomes. This positions microlearning as a powerful engine for fostering sustained, motivated practice essential for language acquisition.

The significant disciplinary variations in learning gains highlight that the effectiveness of microlearning is not universal but is mediated by contextual factors, a dimension called for by researchers like Sespeñe et al. (2021). The superior outcomes for Business and Engineering students, contrasted with the more modest gains for Arts & Design students, can be explained by the qualitative theme of "perceived discipline-specific relevance." This finding crucially extends the work of Al-Khresheh et al. (2025) on the factors influencing teacher adoption by demonstrating that *learner-perceived relevance* is a parallel and critical determinant of microlearning success.

Students in technical fields perceived a direct and urgent need for the precise vocabulary and structured writing conventions taught, which heightened their motivation. This aligns with the emphasis of Santosa et al. (2025) on the importance of aligning microlearning resources with specific, real-world competencies, such as those outlined in the CEFR. Conversely, Arts & Design students found the content less applicable, suggesting that for microlearning to be universally effective, it must be authentically embedded within the specific discursive practices of each discipline. This argues against a one-size-fits-all approach and supports the need for the kind of discipline-tailored material design advocated by Huang & Sun (2026) in their use of micro-videos for ESP.

Theoretically, this study strengthens the case for microlearning as a theory-informed practice. It demonstrates how its principles align with cognitive load theory to optimize learning efficiency and with ESP pedagogy to provide contextually grounded practice. The integrated findings offer a more holistic model that connects instructional design, psychological mechanisms, and pedagogical context. Practically, this study provides a validated model for integrating microlearning into multi-disciplinary ESP programs. For ESP practitioners and instructional designers, the study recommends Deconstructing writing instruction into core sub-skills that can be practiced through interactive micro-tasks, as demonstrated by the success with sentence structure and



connectors, Leveraging LMS-integrated tools like H5P to provide the immediate feedback that drives engagement and Conducting thorough needs analyses to ensure microlearning content is perceived as relevant within each specific disciplinary context, a concern also raised by Al-Khreshah et al. (2025) from a faculty perspective.

This study has several limitations. The participant distribution across disciplines was uneven, with a notably smaller cohort from Arts & Design. Future research could focus specifically on developing and testing discipline-specific microlearning models for fields where perceived relevance is a challenge, perhaps drawing on innovative formats like those suggested by Jubran (2024), who used songs to teach idioms. Second, the study was conducted over eight weeks; longer-term studies are needed to investigate the retention of gains and the transfer of micro-skills to extended writing tasks. Finally, the study was confined to one university context, warranting replication in other settings.

Accordingly, this study provides compelling evidence that a microlearning-based approach, characterized by focused, interactive, and discipline-aware tasks, is a powerful pedagogical strategy for enhancing ESP instruction. It significantly outperforms traditional methods by leveraging a cycle of engagement driven by motivational design and cognitive efficiency. By demonstrating that efficacy is contingent upon disciplinary relevance, the study offers a critical nuance to the field, arguing for a more tailored application of microlearning principles. As the demand for effective and scalable ESP instruction grows, microlearning emerges as a highly adaptable and potent tool in the modern language educator's arsenal.

7. Conclusion

This study set out to investigate the efficacy of microlearning as a pedagogical strategy for enhancing ESP vocabulary acquisition and writing development across diverse academic disciplines. The findings provide compelling evidence that a carefully designed microlearning intervention can yield significantly greater improvements in both specialized vocabulary knowledge and key writing sub-skills compared to traditional instructional methods. The very large effect sizes observed in vocabulary gains and specific writing components like sentence structure and connector usage underscore the potent impact of this approach.

The core strength of microlearning, as revealed through the mixed-methods analysis, lies in its synergistic design. The brevity, focus, and interactive nature of the micro-tasks effectively manage cognitive load, while the immediate



feedback and repetitive practice foster a virtuous cycle of engagement and mastery. This research thus moves beyond merely establishing microlearning's effectiveness; it elucidates the underlying mechanisms - motivational, cognitive, and pedagogical - that drive its success in ESP contexts.

A critical insight from this study is the role of disciplinary context. The significant variation in outcomes across disciplines, mediated by learners' perceived relevance of the ESP content, highlights that microlearning is not a one-size-fits-all solution. Its full potential is realized when the instructional design is deeply attuned to the specific communicative needs and discursive practices of the target discipline. This necessitates a shift from generic microlearning applications to discipline-responsive and context-aware models.

Considering these findings, this study makes a significant contribution to the fields of ESP and educational technology. It provides a robust, empirically validated model for integrating microlearning into higher education language programs, offering clear practical implications for curriculum designers, ESP practitioners, and faculty developers. By successfully bridging the gap between vocabulary acquisition and writing development through granular, scaffolded practice, this research positions microlearning not as a fleeting trend but as a powerful and scalable pedagogical strategy fit for the evolving demands of modern, discipline-specific language education.

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This study acknowledges that all analyses, interpretations, and scholarly judgments are the sole responsibility of the author with little or no usage of Generative AI.

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This article does not contain any studies with human participants performed by any of the authors.

