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The Effectiveness of Quizlet-Based Flashcard Learning in Improving Medical Vocabulary Among Allied Health Science Students

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ABSTRACT: Vocabulary knowledge is a critical determinant of academic and clinical competence among medical and allied health students, yet empirical evidence on the effectiveness of digital flashcard tools for discipline-specific medical vocabulary remains limited. This study investigated the effectiveness of the Quizlet flashcard application in enhancing medical vocabulary skills among 80 first-year allied health science students drawn from five departments: Radiology, Medical Laboratory Technology, Optometry, Clinical Psychology, and Operation Theatre and Anesthesia Technology. A single-group pre-test/post-test design was employed, with vocabulary knowledge assessed across four sub-dimensions: Recognition, Meaning, Word Formation, and Contextual Use, using a researcher-developed 30-item multiple-choice test (Cronbach's $\alpha = 0.854$). Participants engaged in a 20-day structured intervention incorporating Quizlet's Flashcards, Learn, Match, and Test modes. Paired-samples t-tests revealed statistically significant improvements across all four sub-dimensions and in overall composite vocabulary scores, which rose from a pre-test mean of 19.72 to a post-test mean of 29.31 (out of 30), $t(79) = 18.16$, $p < .001$. The largest gains were observed in Contextual Use and Word Formation, the two dimensions with the lowest pre-test means, suggesting a ceiling-proximity effect in which weaker baseline domains showed the greatest room for improvement. These findings extend prior research on digital flashcard-based vocabulary learning, conducted predominantly in general English as a Foreign Language contexts, into the domain of specialized medical English, and support the integration of Quizlet-based interventions into allied health curricula as an effective, low-cost supplement to traditional vocabulary instruction.

KEYWORDS: Medical Education, E-Learning, Quizlet, Mobile Assisted Language Learning, Digital Flashcards, Self-Efficacy

I. INTRODUCTION

Vocabulary knowledge constitutes a foundational component of language proficiency, underpinning learners' capacity to comprehend, retain, and apply subject-specific terminology across academic and professional domains (Mohamed et al., 2026). For medical students, whose academic and clinical success depends heavily on the accurate use of specialized medical terminology, vocabulary acquisition assumes a particularly critical role (Le & Miller, 2025). Medical English features a dense lexicon of technical terms, many of Greco-Latin origin, that learners must recognise and use accurately in written documentation, oral case presentations, and patient communication (Le & Miller, 2023). Deficiencies in medical vocabulary have been associated with reduced confidence in clinical communication and difficulties in comprehending discipline-specific texts, underscoring the need for effective, sustainable vocabulary instruction strategies within medical education curricula (Hashemi & Hadavi, 2015).

Traditional approaches to vocabulary instruction, such as rote memorization through word lists and bilingual glossaries, have been widely critiqued for their limited effectiveness in promoting long-term retention (Sevenster et al., 2012). In response, spaced repetition and digital flashcard-based learning have gained prominence as evidence-based alternatives, drawing on principles of distributed practice and retrieval practice to strengthen lexical encoding and retention over time (Theofilogiannakou & Samuelson, 2026). Among the digital tools available, Quizlet has emerged as one of the most widely adopted flashcard applications in language and content-area instruction, offering learners multiple modes of engagement, including flashcards, matching games, and adaptive practice tests, that support repeated retrieval of target vocabulary (Sevigny et al., 2024) .

Despite growing interest in mobile-assisted vocabulary learning, empirical research examining the specific impact of Quizlet on medical vocabulary acquisition among medical students remains comparatively limited (Waluyo & Bucol, n.d.-a). Existing studies on Quizlet's effectiveness have largely focused on general English as a Foreign Language (EFL) contexts or non-specialized vocabulary sets, leaving a gap in understanding how such tools perform when applied to the dense, technical lexicon characteristic of medical English (Barr, n.d.; Oktaviani & Isdaryanti, 2024, 2024).

The present study addresses this gap by investigating the effectiveness of the Quizlet flashcard application in enhancing vocabulary skills among medical students. Specifically, the study seeks to determine whether structured engagement with Quizlet-based vocabulary sets produces measurable improvement in medical students' vocabulary knowledge, as evidenced through pre-test and post-test performance. In doing so, the study aims to contribute empirical evidence to the growing body of literature on mobile-assisted language learning (MALL) and to offer practical insights for integrating digital flashcard tools into medical English curricula.

This study is guided by the following objectives:

1. To assess the effectiveness of technology-integrated learning in improving the medical vocabulary skills of Allied Health Science students.
2. To examine the improvement vocabulary knowledge in word recognition, meaning, word formation, and contextual use following the technology-integrated intervention.

II. LIETRATURE REVIEW

A. Digital Flashcards and Vocabulary Acquisition

Digital flashcard tools have increasingly been examined as a mechanism for enhancing vocabulary retention among second-language learners, with research consistently linking their effectiveness to underlying spaced repetition principles (Zarrati et al., 2024). (Huang et al., 2025; Teymouri, 2024a) compared academic vocabulary gains among 112 Iranian undergraduate students assigned to smartphone-based digital flashcards, computer-based digital flashcards, and traditional paper-based flashcards over a five-week self-directed learning period. Their findings indicated that digital flashcard use, regardless of platform, produced measurable gains in academic vocabulary knowledge, with device type also shown to influence outcomes.

Mohammadi (2023) examined the comparative effects of digital flashcards, paper flashcards, and a word-list control condition on the receptive and productive academic vocabulary of 86 Iranian EFL university students across a five-week quasi-experimental intervention. Their results demonstrated that learners using digital flashcards achieved significantly greater improvement in both receptive and productive vocabulary knowledge than those using paper flashcards or word lists alone, reinforcing the pedagogical value of digital, technology-mediated repetition over static study formats.

The specific effectiveness of the Quizlet platform has also received direct empirical attention. Chaikovska & Zbaravska (2020)employed an experimental design with 52 EFL learners and found that the group using online Quizlet flashcards significantly outperformed the conventionally taught group, offering early evidence for Quizlet's specific pedagogical value. Similarly, Yowaboot & Sukying (2022)found that Thai EFL primary learners taught using digital flashcards significantly outperformed a control group, with students also reporting favorable attitudes toward the tool.

Further evidence comes from Rahmawati, Mujiono, and Liskinasih (2022), who found that Socrative-based digital flashcards produced significantly higher vocabulary acquisition than conventional PowerPoint-based flashcards among Indonesian junior high school learners. Chaikovska & Zbaravska (2020) found Quizlet-based practice effective in strengthening undergraduates' vocabulary ahead of a formal state English examination. Together, these studies span learners from primary school to university level and consistently show digital flashcard platforms, including Quizlet, outperforming conventional instruction.

B. Self-Regulation and Mobile-Assisted Vocabulary Learning

Beyond direct vocabulary gains, digital flashcard interventions have also been linked to improvements in learner self-regulation (Le & Miller, 2023; Li & Hafner, 2022; Okumuş Dağdeler, 2023). Teymouri (2024 and Zhou & Zhou (2026) investigated the impact of mobile-assisted academic vocabulary learning using digital flashcards on university students' self-regulatory capacity, finding that structured engagement with digital flashcards supported the development of independent, self-directed learning behaviour alongside vocabulary growth. This finding is relevant to medical education contexts, where students must manage substantial, discipline-specific vocabulary loads with limited direct instructional time, making personalized learning strategies particularly valuable (Koleini et al., 2024; Lei et al., 2022).

Further supporting the mobile-learning paradigm, investigated out-of-classroom English vocabulary learning through mobile-assisted digital flashcards, reporting that learners achieved meaningful vocabulary gains when using mobile applications independently outside formal classroom settings. This is directly relevant to flashcard applications such as Quizlet, which are typically used in self-paced, out-of-class contexts (Gürkan, 2018; Xodabande et al., 2022).

C. Medical and Discipline-Specific Vocabulary Challenges

Distinct from general academic vocabulary, medical vocabulary poses unique acquisition challenges due to its density and specialized lexical structure. Hsu (2013) analyzed millions of words from medical research articles and textbooks to identify important academic vocabulary used in the medical field. Although general academic word lists, such as (Coxhead, 2000) Academic Word List (AWL), provide useful vocabulary for academic communication across disciplines, they may not fully cover the specialised lexical demands of medical texts.

This distinction is also supported by research on first-year medical students. Gaffas (2025) found that the high density of technical and sub-technical vocabulary in medical coursework can increase students' stress and create difficulties in comprehension. Taken together, this body of literature underscores both the scale of the vocabulary challenge facing medical students and the potential of structured, spaced-repetition-based digital tools to address it is a gap the present study aims to investigate specifically through the Quizlet application (Özdemir & Seçkin, 2024).

Although previous studies have highlighted the potential of technology-enhanced learning and digital applications for vocabulary development, limited attention has been given to the use of Quizlet for developing medical vocabulary among medical students. In particular, empirical evidence a needed on whether Quizlet-supported learning can improve students' medical vocabulary performance. Addressing this gap, the present study examines the improvement in medical vocabulary following the use of Quizlet as an Education 4.0 learning application.

Based on the identified research gap, the following research question was formulated:

RQ1: To what extent does technology-integrated learning improve the medical vocabulary skills of Allied Health Science students?

RQ2: Is there a significant difference between pre-test and post-test performance across the four dimensions of medical vocabulary knowledge?

III. METHODOLOGY

A. Research Design

This study employed a single-group pre-test/post-test experimental design to evaluate the effectiveness of the Quizlet flashcard application in enhancing vocabulary skills among medical students. This design was selected to measure within-group change in vocabulary knowledge following a structured intervention, without a separate control group. Vocabulary knowledge was assessed across four sub-dimensions Recognition, Meaning, Word Formation, and Contextual Use in addition to an overall composite score, enabling a multidimensional evaluation of vocabulary development.

B. Participants

Participants were selected from the total population of first-year students admitted across five allied health science departments: Radiology, Medical Laboratory Technology (MLT), Optometry, Clinical Psychology, and Operation Theatre and Anesthesia Technology for the academic year. Using random sampling, half of the total admitted students (N = 160) were selected, yielding a final sample of 80 students (40 male, 40 female) distributed across the five departments. Informed consent was secured from all participants prior to data collection.

C. Instrument

Vocabulary knowledge was assessed using 30 items Multiple Choice Question (MCQ) test, structured around four sub-dimensions:

Sub-dimension	*Number of Items*	*Marks Allocated*
Recognition	4	8
Meaning	4	8
Word Formation	4	7
Contextual Use	4	7
Total	16	30

These four parameters draw on the frameworks of vocabulary knowledge proposed by Nation (2001) and LaBontee (2019) which conceptualize word knowledge in terms of form, meaning, and use .Recognition reflects the receptive dimension identifying and comprehending a word's spoken or written form before being able to produce it independently. Meaning involves understanding the form–meaning relationship, the concept a word signifies, and its associations with other words. Word Formation falls under "knowledge of form," covering awareness of prefixes, suffixes, and roots that allow learners to derive related word forms. Contextual Use aligns with "knowledge of use," involving a word's grammatical functions, collocations, and

the register or frequency constraints governing its appropriate use. The instrument demonstrated good internal consistency, with a Cronbach's alpha value of 0.854, while its content validity was established through expert review.

D. Intervention Procedure

The intervention consisted of a 20-day structured vocabulary-learning program delivered through the Quizlet application, with one session administered per day. Target medical vocabulary items relevant to participants' respective allied health disciplines were compiled into Quizlet study sets. Each session incorporated multiple Quizlet study modes Flashcards, Learn, Match, and Test combining both self-paced independent study and instructor-guided components to reinforce vocabulary retention and application.

E. Data Collection

The 30-item MCQ vocabulary test was administered as a pre-test immediately prior to the start of the 20-day intervention and as a post-test immediately following its completion, under identical test conditions to control for extraneous variables.

F. Data Analysis

Pre-test and post-test scores were analysed using paired-samples *t*-tests via SPSS to determine whether statistically significant differences existed between pre- and post-intervention vocabulary performance, both across the four sub-dimensions and for the overall composite score. Mean differences, standard deviations of the differences, *t*-values, and *p*-values were computed for each dimension. Statistical significance was set at $p < .05$.

IV. RESULTS

This study examined the effectiveness of the Quizlet flashcard application in enhancing medical vocabulary skills among 80 first-year allied health science students, using a single-group pre-test/post-test design. Paired-samples *t*-tests were conducted to determine whether statistically significant differences existed between pre-test and post-test scores across four vocabulary sub-dimensions Recognition, Meaning, Word Formation, and Contextual Use as well as for the overall composite vocabulary score. Results are presented in Table 1.

Table 1: Paired-Samples t-Test Results for Pre-Test and Post-Test Vocabulary Scores

Aspect	*Pre-test M*	*Post-test M*	*MD*	*SD*	*t*
Recognition	5.61	7.84	2.23	1.39	14.37
Meaning	5.08	7.42	2.34	1.46	14.34
Word Formation	4.72	7.16	2.44	1.52	14.34
Contextual Use	4.31	6.89	2.58	1.58	14.61
Overall Vocabulary	19.72	29.31	9.59	4.72	18.16

A. Recognition

Results indicated a statistically significant increase in students' vocabulary recognition scores from pre-test ($M = 5.61$) to post-test ($M = 7.84$), $t(79) = 14.37$, $p < .001$, with a mean gain of 2.23 points. This suggests that the Quizlet-based intervention was effective in improving students' ability to identify target medical vocabulary items.

B. Meaning

A statistically significant improvement was also observed in students' comprehension of word meanings, with scores rising from $M = 5.08$ at pre-test to $M = 7.42$ at post-test, $t(79) = 14.34$, $p < .001$ ($MD = 2.34$). This indicates that repeated exposure to vocabulary through Quizlet's flashcard-based study modes supported deeper semantic understanding of medical terms.

C. Word Formation

Students' knowledge of word formation including morphological structures such as prefixes, suffixes, and roots common in medical terminology increased significantly from $M = 4.72$ to $M = 7.16$, $t(79) = 14.34$, $p < .001$ ($MD = 2.44$). This was the second-largest mean gain among the four sub-dimensions, suggesting that the intervention was particularly effective in building learners' morphological awareness of medical vocabulary.

D. Contextual Use

The largest mean gain across all sub-dimensions was observed for contextual use, which increased from $M = 4.31$ to $M = 6.89$, $t(79) = 14.61$, $p < .001$ ($MD = 2.58$). Given that this dimension had the lowest pre-test mean among the four, this finding suggests that students' ability to apply vocabulary appropriately within sentence.

*E.**Overall Vocabulary***

Overall composite vocabulary scores increased significantly from a pre-test mean of 19.72 (out of a maximum of 30) to a post-test mean of 29.31, representing a mean gain of 9.59 points, $t(79) = 18.16$, $p < .001$. The large *t*-value and consistently significant results across all four sub-dimensions provide strong evidence that the 20 day Quizlet-based intervention produced a substantial and statistically significant improvement in medical vocabulary knowledge among the allied health science student sample.

V. DISCUSSION

RQ1: To what extent does technology-integrated learning improve the medical vocabulary skills of Allied Health Science students?

The magnitude of gain observed in the present study is notably larger than that reported in several comparable investigations of digital flashcard use in non-medical contexts, a difference that merits closer examination. (Huang et al., 2025) and (Teymouri, 2024b)in their comparison of smartphone-based, computer-based, and paper-based flashcards among 112 undergraduates, reported measurable but comparatively modest academic vocabulary gains over a five-week period, with device type moderating the size of the effect rather than producing uniformly large improvement. By contrast, the present intervention produced a substantially larger mean gain (9.59 points on a 30-point scale, representing roughly a 32-percentage-point improvement) within a shorter, 20-day window. This divergence may be attributable to several factors: first, the present study's target vocabulary was drawn from participants' own disciplinary curricula, which likely enhanced motivational relevance and reduced the cognitive burden of contextualizing new terms; second, the inclusion of instructor-guided components alongside self-paced Quizlet modes may have provided a scaffolding effect absent from purely self-directed comparison studies; and third, medical and allied health vocabulary, despite its lexical density, is frequently reinforced through concurrent coursework, clinical terminology exposure, and laboratory instruction, potentially producing a synergistic effect that general academic vocabulary interventions do not benefit from.

Similarly, (Xodabande et al., 2025) quasi-experimental comparison of digital flashcards, paper flashcards, and word-list instruction among 86 EFL university students found that digital flashcards outperformed the other two conditions but did not report gains of the magnitude observed here. The present study's more compressed but more intensive intervention schedule daily sessions incorporating four distinct Quizlet modes rather than periodic, single-mode engagement may account for this difference, suggesting that intervention intensity and modal variety, rather than tool choice alone, may be significant moderators of vocabulary gain in technology-mediated learning.

The present findings also extend the self-regulation learning. Whereas (Mohammadi et al., 2024) parallel outcome alongside vocabulary gain, the present study did not measure self-regulation directly; however, the hybrid self-paced and instructor-guided structure of the intervention suggests that the vocabulary gains reported here may have been achieved through a blended regulatory model rather than through learner autonomy alone. This raises an important distinction from prior mobile-assisted vocabulary learning research, much of which examined tools used entirely outside formal instructional oversight. Future research disaggregating the relative contributions of self-paced versus instructor-guided components would help clarify this mechanism.

Finally, in relation to Hsu's corpus-based delineation of medical academic vocabulary as a lexical subset distinct from general academic word lists, the present results provide direct empirical support for the claim that medical vocabulary, despite its distinct morphological and semantic demands, is nonetheless responsive to the same spaced-repetition principles that underlie general vocabulary flashcard interventions. This is a meaningful contribution, as it had previously remained an open question raised implicitly by (Waluyo & Bucol, n.d.-b) observation of a research gap in this area whether tools validated primarily on general or academic vocabulary would transfer effectively to the denser, Greco-Latin-derived lexicon of medical English. The present findings suggest they do, and arguably to a greater degree.

RQ2: Is there a significant difference between pre-test and post-test performance across the four dimensions of medical vocabulary knowledge?

This differentiated pattern of gain across sub-dimensions offers a point of comparison with (Ghafar, 2023) findings on technical and sub-technical vocabulary recognition among first-year medical undergraduates, which identified vocabulary density as a source of comprehension difficulty and student stress, but did not examine whether structured intervention could differentially close gaps across vocabulary sub-skills. The present study extends this line of inquiry by demonstrating that a single, uniform intervention rather than one differentiated by sub-skill can nonetheless produce proportionally greater improvement in the more cognitively demanding dimensions of word formation and contextual use. This is a theoretically significant finding, as it suggests that repeated, varied retrieval practice (via Quizlet's Flashcards, Learn, Match, and Test modes) may inherently target generative and applied vocabulary knowledge more effectively than it targets recognition-level knowledge, simply because recognition-level knowledge leaves less room for measurable improvement once a reasonably competent baseline is established.

This pattern also complicates a straightforward reading of (Vnučko, 2026; Zarrati et al., 2024) research, both of which frame digital flashcard tools primarily as vehicles for strengthening lexical encoding at the recognition and meaning level. The present

results suggest that, at least in a medical vocabulary context, the pedagogical value of such tools may lie more substantially in their capacity to build morphological and contextual competence—arguably the more clinically consequential dimensions of vocabulary knowledge—than in reinforcing surface-level recognition, which students may partially acquire through incidental exposure regardless of intervention.

VI. CONCLUSIONS

The heading of the Conclusion section must be numberedThis study set out to examine the effectiveness of the Quizlet flashcard application in enhancing medical vocabulary knowledge among first-year allied health science students, addressing a gap in the literature concerning the applicability of digital flashcard-based interventions to dense, discipline-specific vocabulary. Using a single-group pre-test/post-test design, the study found statistically significant improvements across all four measured dimensions of vocabulary knowledge Recognition, Meaning, Word Formation, and Contextual Use as well as in overall composite scores, following a 20-day structured intervention. The magnitude of these gains, particularly in the more cognitively demanding dimensions of word formation and contextual use, indicates that Quizlet's combination of retrieval-based study modes is well suited to the acquisition demands of specialized medical terminology, extending prior findings from general EFL and academic vocabulary contexts into the medical education domain.

These findings carry practical implications for allied health curriculam. Given the substantial vocabulary load medical students must acquire within compressed instructional timeframes, structured digital flashcard interventions particularly those combining self-paced and instructor-guided components offer an accessible, low-resource means of supplementing traditional vocabulary instruction. Curriculum designers in medical and allied health programs may consider integrating short, daily Quizlet-based vocabulary sessions as a supplementary rather than replacement strategy for existing terminology instruction.

The study is nonetheless limited by its single-group design, which precludes causal attribution in the absence of a control group, and by its relatively short intervention period and single-institution sample, which may constrain generalizability. Future research should incorporate control-group comparisons, examine retention over longer post-intervention intervals, and investigate the relative contributions of self-paced versus instructor-guided engagement to the gains observed. Despite these limitations, the present findings contribute meaningful empirical evidence supporting the integration of mobile-assisted, flashcard-based vocabulary tools into medical English instruction.

VII. LIMITATIONS

This study has several limitations. It employed a single-group pre-test/post-test design without a control group, limiting the ability to rule out maturation or practice effects as alternative explanations for the observed gains. The sample was drawn from a single institution, which may limit generalizability to other contexts, and the 20-day intervention period did not allow for assessment of long-term vocabulary retention. Additionally, vocabulary knowledge was measured solely through an MCQ format, which captures receptive rather than productive vocabulary skills, and the combined use of multiple Quizlet study modes (Flashcards, Learn, Match, Test) made it impossible to isolate which mode contributed most to the gains observed.

VIII. RECOMMENDATIONS FOR FUTURE RESEARCH

Futur

e research should incorporate a control group to more clearly establish Quizlet's causal contribution to vocabulary gains, include a delayed post-test to assess long-term retention, and use productive vocabulary measures (e.g., writing or speaking tasks) alongside MCQs. Studies could also isolate individual Quizlet study modes to identify which are most effective, and expand sampling across multiple institutions to improve generalizability

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The heading of the Acknowledgment section and the References section must not be numbered.

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