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RESEARCH ARTICLE

Can Mobile-Assisted Language Learning Help Improve Hong Kong Secondary School Students' Vocabulary Attainment?

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Abstract: This paper investigates the efficacy of Quizlet, a mobile-assisted language learning (MALL) application, in enhancing the vocabulary usage of English language learners in Hong Kong. Utilizing a quantitative research design, the study collected and analyzed baseline data before and after the implementation of Quizlet to evaluate its influence on student results. The analysis sought to identify any statistically significant differences in performance that could be attributed to the use of the MALL tool.

The results indicated that while some learners experienced individual progress, there was no conclusive evidence to suggest that Quizlet usage led to a significant improvement in overall student grades. This finding points to the potential variability in the effectiveness of MALL tools and highlights the need for a more nuanced understanding of how such technologies can be integrated into language learning practices.

Acronyms: Mobile assisted language learning (MALL), Chinese medium of instruction (CMI), Territory-wide System Assessment (TSA)

Keywords: MALL, mobile-assisted language learning, Quizlet, self-directed study, Territory-wide System Assessment (TSA)

Introduction

The mastery of English is essential for students in Hong Kong, not only for academic achievement but also as a requisite for professional success. Despite its status as an official language and the medium of instruction in tertiary education, there is a concerning disconnection with students' perception of English as a functional tool beyond examination purposes (Evans & Morrison, 2017; Lee, 2021). Current educational models, with their deep roots in colonial history, emphasize summative assessments, often at the expense of genuine language acquisition and motivation to learn (Lee, 2021).

The English-as-a-second-language (ESL) teaching approach in Hong Kong is characterized by a teacher-centered paradigm that focuses more on error correction than on fostering a nurturing environment for developing writing competencies. This model has been found to impact student confidence negatively and, coupled with the pressure from high-stakes assessments like the Territory-wide System Assessment (TSA) and Hong Kong Diploma of Secondary Education (HKDSE) exams, creates a high-pressure educational climate that prioritizes performance over learning (Qian, 2008).

The TSA, designed as a diagnostic tool, has inadvertently contributed to a competitive atmosphere among schools, affecting teaching methods and diminishing student engagement due to its perceived implications on school rankings (The Education Bureau of the Hong Kong SAR Government, 2023; Qian, 2008).

The unforeseen disruption caused by the COVID-19 pandemic led to an accelerated transition to online learning, unveiling vulnerabilities within the ESL educational system, particularly in teaching methods geared towards productive language skills (Har, 2022; Lo & To, 2023). This period of educational upheaval has underscored the need for innovative pedagogical solutions.

In response to these challenges, mobile-assisted language learning (MALL) has emerged as a promising avenue to enrich students' English writing skills. MALL utilizes mobile devices to facilitate personalized learning experiences, offering interactive and engaging opportunities for students to practice and improve their English writing outside the traditional classroom setting. Quizlet, for instance, provides a platform for self-directed vocabulary expansion through interactive exercises and immediate feedback, addressing the need for enhanced language proficiency (Har, 2022).

This study evaluates the effectiveness of self-directed Quizlet use in improving vocabulary usage among Hong Kong secondary students, contributing to the understanding of technology-assisted learning in challenging ESL contexts. The research could significantly impact language teaching and learning in Hong Kong. Confirming Quizlet's efficacy for vocabulary acquisition may lead to more autonomous learning and a shift towards digitally enhanced education, harnessing technology to develop independent, skilled language learners.

The central question guiding this study is, "Does self-directed MALL improve students' topic-specific vocabulary in writing assessments in Hong Kong secondary schools?" The hypothesis posits that students who engage in a self-paced MALL program will demonstrate significant improvements in their vocabulary usage, as evidenced in their TSA writing assessments. This hypothesis is supported by the studies of Yassin and Abugohar (2022), Jiang and Liou (2022), and Katemba (2021), who all concluded that MALL improved vocabulary usage.

Literature Review

English Language Teaching in Hong Kong

The mastery of English is crucial for students in Hong Kong, not only for academic achievement but also as a prerequisite for professional success. Prior to 2010, the Hong Kong Education Bureau (EDB) implemented the Medium of Instruction (MT) policy, which regulated the language of instruction in schools. However, this policy faced critiques and challenges, prompting the EDB to introduce the Fine-Tuning Medium of Instruction (FTMOI) policy in 2010.

The FTMOI policy significantly changed Hong Kong's language education landscape, allowing schools to conduct English medium instruction (EMI) classes if they met EDB requirements like having 85% EMI-capable students per class and ensuring teachers' English proficiency. The policy aimed to improve students' English skills while preserving their mother tongue, hoping to increase motivation and engagement, which had declined under the previous MT policy.

However, a disconnect persists between students' view of English as a functional tool beyond exams and the desired English proficiency outcomes (Evans & Morrison, 2017; Lee, 2021). Hong Kong's education models, rooted in colonial history, emphasize high-stakes assessments like the TSA and HKDSE, which prioritize English proficiency, vocabulary, and writing. Yet, common teaching approaches, such as teacher-centered methods focusing on error correction, may not effectively promote genuine language acquisition and motivate students to develop vocabulary and writing skills beyond examination purposes.

This disconnect between teaching methods and the desired learning outcomes highlights the need for innovative pedagogical solutions that can support students in developing their English language skills, particularly in the areas of vocabulary and writing, which are critical for academic and professional success in Hong Kong. The introduction of MALL tools like Quizlet could address this need by providing students with interactive, self-paced platforms to expand their vocabulary knowledge and practice vocabulary usage in a more engaging and personalized manner. As discussed in the MALL Vocabulary section, research has demonstrated the potential benefits of MALL interventions in enhancing vocabulary acquisition and long-term retention.

While the FTMOI policy's outcomes have been mixed, with some benefits evident and ongoing concerns about student participation and language-related challenges (Chan, 2014; Cheng, 2022), a preliminary analysis of HKDSE results from 2012, 2019, and 2023 indicates an initial improvement in English proficiency from 2012 to 2019, followed by a decline in most grade categories after the COVID-19 pandemic. This decline is noteworthy considering the competitive nature of university admissions, especially in top institutions, which require higher English grades for competitive courses.

Table 1
Diploma of Secondary Education Grades 2012–2019

Grade	Change
5** Grade	From 0.7% to 1.0%
5* Grade +	From 3.1% to 3.9%
5 Grade +	From 7.6 % to 9.7%
4 Grade +	From 23.3% to 27.5%
3 Grade +	From 49.3% to 53.8%

Table 2
Diploma of Secondary Education Grades 2019–2023

Grade	Change
5** Grade	From 0.7% to 1.0%
5* Grade +	From 3.1% to 3.9%
5 Grade +	From 7.6 % to 9.7%
4 Grade +	From 23.3% to 27.5%
3 Grade +	From 49.3% to 53.8%

By investigating the efficacy of Quizlet in improving topic-specific vocabulary usage among Hong Kong secondary school students, this study aims to contribute empirical evidence on the potential of MALL tools to supplement traditional teaching methods and bridge the gap between current practices and the desired learning outcomes related to vocabulary and writing proficiency. The findings of this research could inform educational strategies and support the integration of technology-assisted learning approaches to foster more effective language acquisition, aligning with the expectations and requirements of the TSA and HKDSE examinations.

MALL Advantages and Disadvantages

MALL has become a significant innovation in applied linguistics, integrating mobile technologies into language learning to enhance acquisition outcomes. This paper explores MALL's definition, theoretical foundations, advantages in facilitating learning, and challenges to further development.

MALL involves using portable mobile devices like smartphones and tablets to support language education. It is defined as the intersection between mobile technologies and language instruction, with the goal of promoting accessibility and practical application of learning (Trifonova & Ronchetti, 2003; Triyoga et al., 2023). Initial research focused on vocabulary, but the field has since expanded to encompass other language skills like listening, speaking, writing, and pronunciation (Karakaya & Bozkurt, 2022).

Constructivist and sociocultural theories underpin MALL's focus on context-based, situated learning (Kukulska-Hulme, 2020). MALL leverages mobile devices' portability to enhance proficiency and autonomous learning through meaningful, accessible practice in real-world settings, aligning with theories of learning through social interaction and contextual immersion.

MALL offers many benefits for learners and the learning process. It increases flexibility by allowing access to content anytime, anywhere (Liaw, 2017; Rachman et al., 2023). Engaging multimedia and gamified features maintain interest and motivate regular practice (Pebiana & Febria, 2023; Rachman et al., 2023), leading to notable gains in vocabulary and speaking skills (Al-Shehab, 2020; Malekzadeh & Najmi, 2015; Pebiana & Febria, 2023; Rachman et al., 2023).

MALL creates a supportive environment through instant feedback and social connections, fostering a sense of community that sustains motivation (Thomas & Muñoz, 2016; Zou & Li, 2015). It enhances learner autonomy by putting control in students› hands and allowing practice in diverse settings (Klopfer et al., 2002; Kukulska-Hulme, 2009), bridging the gap between classroom exercises and practical language use (Pebiana & Febria, 2023). Data from learner interactions on MALL platforms enable personalized feedback and tailored instruction (Derobertmasure & Robertson, 2014; Liu & Kleinsasser, 2015), and the incorporation of varied pedagogical theories ensures MALL can meet diverse needs (Rajendran

& Yunus, 2021). However, challenges remain, such as inconsistent access to technology, potential distractions, and limited face-to-face interaction (Zou & Li, 2015).

MALL has transformed language education through innovative integration of mobile technologies. However, to fully realize its potential, both benefits and limitations must be adequately addressed.

While research has primarily focused on advantages, dedicated examination of disadvantages is also needed. Technology and infrastructure barriers, like unreliable internet and device compatibility issues, present significant obstacles. Inconsistent access disrupts interactivity and diminishes the learning experience (Ganapathy et al., 2016; Hashim et al., 2017; Nuraeni et al., 2020; Rachman et al., 2023).

Individual learner differences must also be considered, as applications require customization for diverse needs and preferences (Rachman et al., 2023). Psychological barriers could deter engagement, such as fear of device damage especially outdoors. Proper curriculum alignment is equally important to prevent distraction and ensure technology enhances rather than detracts from language acquisition (Rachman et al., 2023).

The successful implementation of MALL demands addressing technological access, tailoring solutions to learner profiles, and adapting pedagogical practices. While dedicated research on disadvantages is still emerging, a holistic understanding of both benefits and challenges provides a more informed foundation for leveraging mobile technologies innovatively yet judiciously in language education. With continued progress surmounting limitations, MALL shows tremendous potential as a transformative learning model. In the context of this discussion, "transformative" refers to the significant shift in accessibility, engagement, and pedagogical innovation that MALL introduces to language education. MALL transcends traditional classroom boundaries, offering learners immediate access to a wealth of resources and interactive learning experiences that were previously inconceivable. This shift is transformative in the sense that it alters the structural and operational dimensions of language learning, making it more flexible, personalized, and aligned with the digital habits of contemporary learners.

Use of MALL for Writing

A substantial body of research has investigated the impact of MALL on developing writing abilities in English language learners. Ansari et al.'s (2023) literature review spanning 2019–2022 articles consistently highlighted MALL's benefits for writing. Dewi et al.'s (2020) study provided empirical evidence that MALL improved students' organization and structuring of written compositions, which are fundamental skills for effective writing. By guiding learners systematically through the writing process, MALL scaffolds the development of coherent, well-structured texts (Dewi et al., 2020). It also supports mastery of grammar and diction, intricacies that often challenge ESL students (Al-Shehab, 2020). MALL's interactive, collaborative features foster motivation through real-time discussions, idea sharing, and feedback on writing (Al-Hamad et al., 2019). This dynamic approach cultivates writing abilities while motivating sustained language learning. Vocabulary acquisition is also crucial for writing proficiency, and studies show MALL enriches students' lexicons through applications like YouTube, dictionaries, and flashcard tools (Pingmuang & Koraneekij, 2022). The extensive feedback mechanism corrects grammar, spelling, conjugation, and vocabulary errors, providing information to adjust writing (Dwigustini et al., 2021). While research converges on MALL's efficacy, studies focus on different aspects of writing, suggesting that MALL offers a suite of tools tailored to specific objectives rather than a single solution.

Use of MALL for Vocabulary Learning

The application of MALL tools has shown considerable promise in enhancing vocabulary acquisition for second-language learners. Okumuş Dağdeler et al. (2020) conducted a quasi-experimental study to evaluate the impact of the CollocatApp mobile application on collocation knowledge. Their findings revealed that while the experimental group utilizing the app experienced significant short-term gains in receptive collocation knowledge surpassing the control group using worksheets, there was no significant difference between the groups in productive knowledge gains. Notably, the receptive knowledge gains achieved through the app were not well retained over time, suggesting that mobile apps may be more advantageous for receptive rather than productive vocabulary learning.

In an analysis examining the overall effect of MALL interventions on second-language vocabulary learning, Lin and Lin (2019) reported a medium to large positive effect compared to non-MALL conditions. Their analysis indicated that mobile apps were more effective than SMS/multimedia messaging service modes, and the effect sizes were moderated by factors such as task autonomy, with higher autonomy tasks yielding larger effects compared to lower autonomy tasks.

Xodabande and Atai (2022) conducted an experimental study with Iranian university EFL students, assigning an experimental group to use the AWL Builder mobile app and a control group to utilize traditional textbooks for academic vocabulary learning. Their results demonstrated that the mobile app group achieved significantly greater gains in academic vocabulary compared to the control group. Furthermore, while both groups exhibited some decline in vocabulary knowledge over time, the mobile app group maintained higher scores than the control group.

Naz et al. (2022) investigated the impact of the online mobile game Kahoot on vocabulary learning among undergraduate ESL students in Pakistan. Employing an experimental design with a control group receiving traditional paper-based instruction, they found that students utilizing Kahoot achieved significantly higher vocabulary scores on posttests. The gamified features of Kahoot were reported to enhance engagement, motivation, and retention, aligning with theoretical frameworks that emphasize guided, rewarding learning experiences.

These studies collectively underscore the potential of MALL tools to augment vocabulary learning outcomes in various contexts. While mobile apps appear to offer advantages in areas like receptive knowledge, engagement, and long-term retention, the specific effects may be influenced by factors such as task design, learner autonomy, and the duration of the intervention. Nonetheless, the integration of MALL into vocabulary instruction presents opportunities for leveraging technology to facilitate more interactive, personalized, and engaging language acquisition experiences.

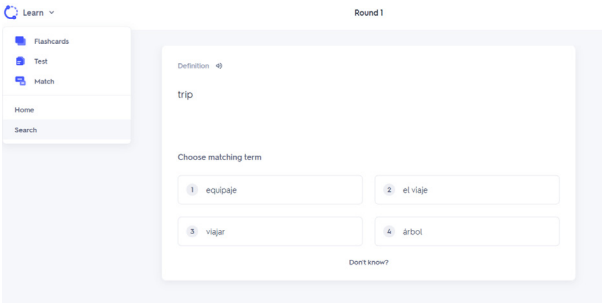
Quizlet

The advancement of MALL applications has transformed language instruction worldwide. Among these technologies, Quizlet stands out as a popular online learning platform and mobile application designed to facilitate study and review through interactive study modes and gamification elements.

Quizlet has been shown to bolster reading comprehension by facilitating memory and understanding of pertinent vocabulary, including synonyms and antonyms (Aprilani & Suryaman, 2021). Beyond rote memorization, it fosters a deeper grasp of language nuances, an invaluable skill. Learning vocabulary in full contextual sentences via Quizlet, replete with collocations, has also demonstrated clear advantages over isolated word learning in bolstering retention and comprehension (Solhi Andarab, 2019). This insight aligns with my research focus on contextual vocabulary acquisition.

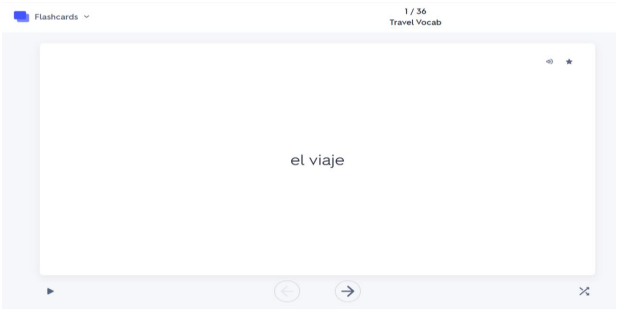
The four modes students had access to during this study are the Learn, Flashcards, Test, and Match modes.

Figure 1
Quizlet Learn Mode



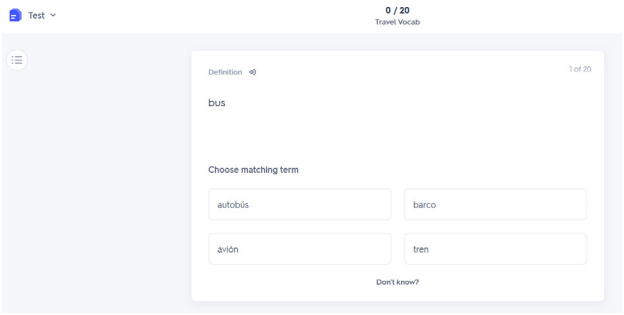
Note. Learn mode, which uses spaced repetition and multimedia cues to reinforce knowledge through adaptive drilling.

Figure 2
Quizlet Flashcard Mode



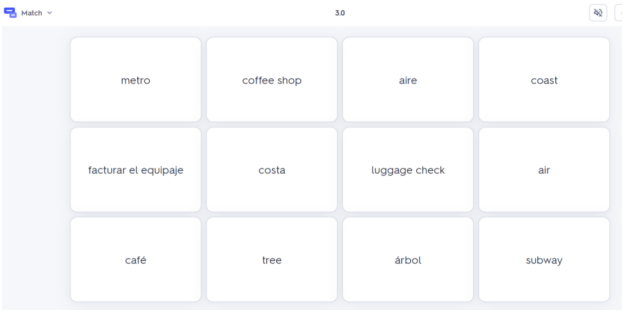
Note. Flashcards mode, a digital replication of traditional flash-card memorization methods.

Figure 3
Quizlet Test Mode



Note. Test mode, offering various question types to assess vocabulary knowledge and prepare for assessments.

Figure 4
Quizlet Match Mode



Note. Match mode, introducing a gamified element where users race against the clock to match terms to their corresponding definitions.

These modes leverage principles like active recall, gamification, and multimodal presentation to create an engaging and interactive learning experience. The versatility of these modes, as detailed by Nguyen et al. (2023), supports varied learning processes and accommodates different learner preferences.

On the Quizlet mobile app, students could access their study sets on the go, enabling seamless vocabulary review and practice anywhere, anytime. The app also includes audio pronunciations, images, and the ability to create multimedia flash cards, making it a versatile tool for language learning.

With its user-friendly interface, gamified study modes, and integration of multimedia resources, Quizlet offers a unique approach to vocabulary acquisition, accommodating different learning styles and preferences within a single platform.

Methodology

This study employed a quasi-experimental pretest/posttest design to investigate the impact of self-directed MALL on topic-specific vocabulary use in writing assessments. The study aims to examine if MALL usage could improve inclusion of target words.

A quasi-experimental design allowed objective measurement of changes over time within existing class structures. Assessments occurred at 2- and 4-week intervals to sufficiently expose the participants to the MALL intervention between tests. The study was conducted at a public secondary school located in Ma On Shan, Hong Kong, with a predominantly local student population whose first language is Cantonese or Putonghua. The participants were 20 students from two classes, Form 2 and Form 3 (ages 12–14), identified as the top academic performers in their respective year groups. These classes were selected because the school operates with a Chinese medium of instruction, offering English language education solely during designated English classes. This educational setting provided a unique opportunity to examine the impact of MALL in an environment where students' exposure to English outside the classroom is minimal.

Data were collected through a baseline assessment, two posttests, and recording of self-reported Quizlet sessions. Repeated measures analysis of variance (ANOVA) statistically analyzed changes in writing scores based on app usage. The analysis included data from all 10 students in Class A ($N = 10$) as well as Class B ($N = 10$).

Integrating the research into regular 80-min weekly classes addressed time constraints. Individual consent was waived with school approval on the basis that data would remain anonymous.

One limitation of this study is the absence of a control group, which restricts the ability to make generalizations about the effects of the MALL intervention in comparison to other approaches or no intervention. It is important to acknowledge that this study can only provide insights into the impact of Quizlet within the specific context and sample but cannot conclusively determine its effectiveness relative to alternative methods.

Other limitations included self-reported usage metrics and a single-school sample. However, contextual factors like minimal English exposure increased the intervention›s significance. Results

aimed to provide insights for vocabulary instruction and MALL adoption.

Figure 5
School's Writing Assessment Rubric

[redacted] MEMORIAL SECONDARY SCHOOL
2022 -2023 First Term Examination
Form 2 English Language -Paper 2
Marking Scheme
Content (C)

Scores	Descriptors
19-20	• Content is very extensive and entirely fulfils the requirements of the task • Totally relevant • All ideas are well developed • Creativity and imagination are consistently shown when appropriate
16-18	• Content is extensive and entirely fulfils the requirements of the task • Totally relevant • Most ideas are well developed • Creativity and imagination are shown when appropriate
13-15	• Content fulfils the requirements of the task • Totally relevant • Main ideas are well developed • Creativity and imagination are shown when appropriate
10-12	• Content addresses the requirements of the question • Mostly relevant • Some ideas are developed in detail • Creativity and imagination are shown in several parts when appropriate
7-9	• Content is limited • Some relevant points • Some ideas but few are developed •
4-6	• Content shows very limited attempts to fulfil the requirements of the task • Intermittently relevant • A few ideas but none developed
1-3	• Content is inadequate and heavily based on the task prompt(s) • Very few relevant points • Ideas lack details
0	• Irrelevant or memorised • Totally copied from the task prompt • No attempt

Figure 6
Baseline Assessment

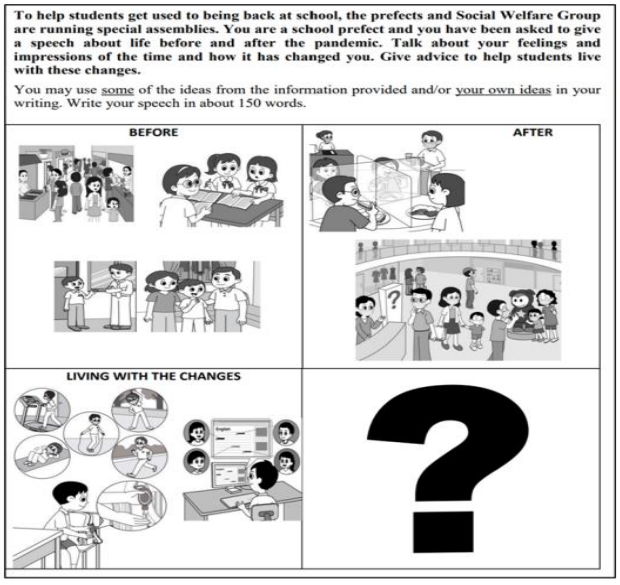
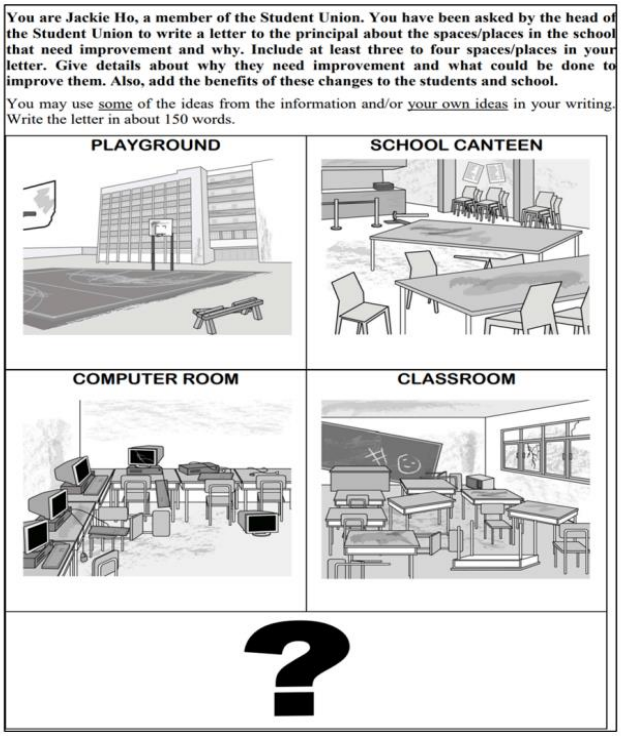


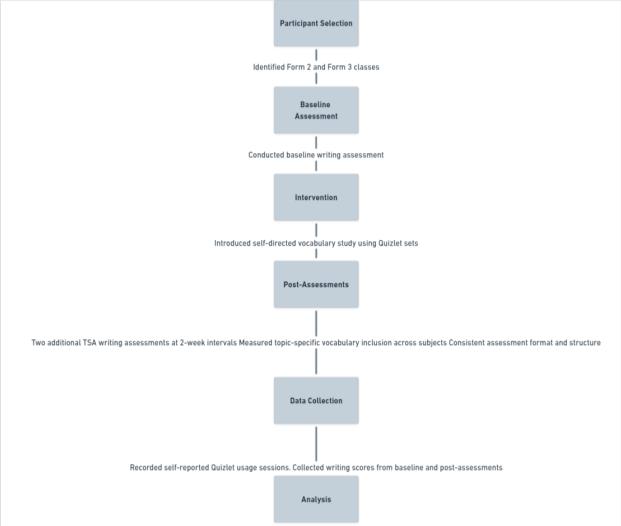
Figure 7
Posttest 1

Figure 8
Posttest 2



Following baseline testing (Figure 6), an intervention introduced self-directed vocabulary study using tailored Quizlet sets (independent variable) addressing topic vocabularies. Two subsequent assessments (Figures 7 & 8) measured changes in students' writing performance (dependent variable) through the school's rubric criteria (Figure 5). Repeated measures evaluated the intervention's impact on target word inclusion during assessments at different time points. Integrating the study within regular lessons addressed time constraints. The full procedure is highlighted in Figure 9.

Figure 9
Flowchart of Steps Taken



ANOVA Assumptions and Between-Subjects Factors

Assumptions.

Class A. The study rigorously examined the assumptions of one-way ANOVA for Class A, focusing on the normality of distribution and the homogeneity of variances. The Shapiro–Wilk test was employed to assess the normality of the data across three test sessions, yielding the following *p*-values:

Baseline: $p = 0.189$
Test 2: $p = 0.216$
Test 3: $p = 0.837$

These *p*-values are all above the typical alpha level of 0.05, suggesting that the data do not significantly depart from a normal distribution for any of the testing sessions.

Furthermore, Levene's test for homogeneity of variances resulted in a *p*-value of 0.693. This value being higher than the conventional threshold of 0.05 indicates that there is no significant evidence against the assumption of homogeneity of variances across the groups. Thus, for Class A, both assumptions required for the one-way ANOVA—normality and homogeneity of variances—appear to be satisfied based on the results of these tests.

Class B. In Class B, the Shapiro–Wilk test for normality was conducted to evaluate the distribution of scores at different testing times. The results were as follows:

Baseline: $p = 0.8689$
Test 1: $p = 0.8689$
Test 2: $p = 0.8689$

With all *p*-values exceeding the 0.05 alpha level, we fail to reject the null hypothesis of normality. This indicates no significant deviation from normality for the Baseline, Test 1, and Test 2 sessions.

Levene's test for homogeneity of variances was also performed, which produced a test statistic of 0.0 and a *p*-value of 1.0. Given that this *p*-value is greater than 0.05, we again fail to reject the null hypothesis, signifying that the variances are equal across the different groups for Baseline, Test 1, and Test 2.

Therefore, for Class B, the data meet the one-way ANOVA assumptions of both normality and homogeneity of variances, indicating that the methodological prerequisites for this statistical test have been met.

Results

Class A Results

The descriptive statistics for Class A's grades are as follows: the mean score was 10.5, the median score was 11, the standard deviation was 2.21, and the range of scores was 9. These statistics indicate a moderate level of performance variability within the class.

Table 3
Class A Student Performance

Student ID	Baseline Score	Test 2 Score out of 20	Was Self-Directed Study Completed?	Test 3 Score out of 20	Was Self-Directed Study Completed?
1	13	14	Yes	15	Yes
2	11	12	Yes	13	No
3	12	13	No	14	Yes
4	11	12	No	12	Yes
5	12	12	Yes	12	Yes
6	6	6	No	6	No
7	11	11	No	11	No
8	10	10	Yes	9	Yes
9	10	10	Yes	10	No
10	9	10	Yes	11	Yes

Note. Self-directed study not applicable to the baseline.

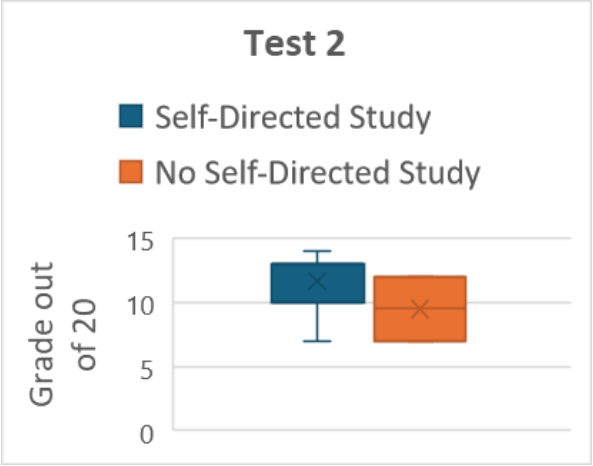
The above table provides a detailed view of the performance metrics for Class A, offering insights into the central tendencies and variability of the students' scores across the testing sessions.

A one-way ANOVA was conducted to assess the impact of self-directed study on the students' grades. The analysis yielded an F-statistic of approximately 1.43 and a p-value of approximately 0.256. With the p-value being greater than the alpha level of 0.05, the results indicate that there is no statistically significant difference in the assessment scores due to the self-directed study. Therefore, we fail to reject the null hypothesis, suggesting that there is no evidence that the use of Quizlet for self-directed study significantly affected the students' performance. The repeated measures ANOVA revealed no significant main effect of time on assessment scores: $F(2, 18) = 1.43$, $p = 0.256$, partial eta squared ($\eta^2 p$) = 0.137. Although the main effect was not statistically significant, the partial eta squared value of 0.137 suggests a medium effect size, indicating that time may have had a modest impact on assessment scores that warrants further investigation with a larger sample size.

To visually represent the grade distribution and the potential effects of self-directed study, four box plots were constructed.

Figure 10 illustrates the distribution of scores for Test 2, comparing students who participated in self-directed study to those who did not.

Figure 10
Box Plot Comparing Self-Directed Study in Test 2

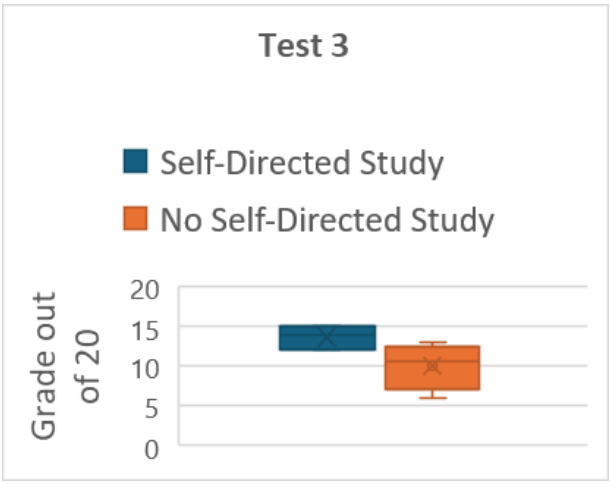


The data indicate that the highest score in Test 2 was achieved by Student 1, who scored a 14 and did engage in self-directed study. On the other hand, the lowest score was recorded by Student 6, who scored a 6 and did not engage in self-directed study. However, among the middle-scoring students, there does not appear to be a clear correlation between self-directed study and test scores. For instance, Student 2 (scored 12, studied), Student 3 (scored 13, studied), and Student 10 (scored 10, studied) engaged in self-directed study, while Students 4 (scored 12, did not study) and 7 (scored

11, did not study) did not, yet they all scored within a similar range. Similarly, Students 8 (scored 10, studied) and 9 (scored 10, studied) engaged in self-directed study but did not score higher than some students who did not engage in self-directed study.

Figure 11 provides a similar comparison for Test 3 scores, again contrasting students who engaged in self-directed study with their counterparts.

Figure 11
Box Plot Comparing Self-Directed Study in Test 3

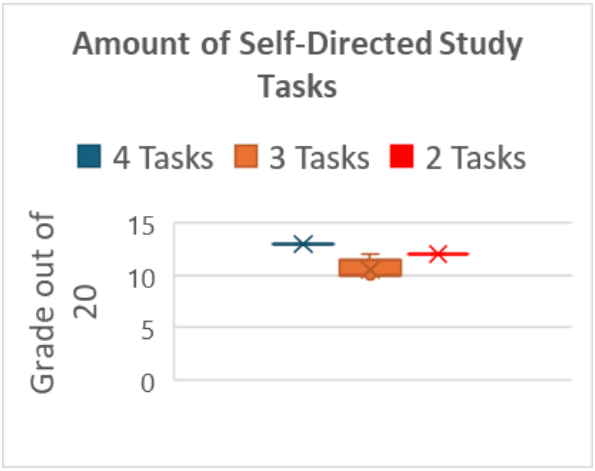


The highest score for Test 3 was again achieved by Student 1, who scored a 15 and engaged in self-directed study. The lowest score was again by Student 6, who scored a 6 and did not engage in self-directed study. Among the middle-scoring students, no clear correlation between self-directed study and test scores is evident. Students 2 (scored 13), 3 (scored 14), and 10 (scored 11) engaged in self-directed study and scored within the middle range, while Students 5 (scored 12), 7 (scored 11), and 9 (scored 10) did not engage in self-directed study and scored within the middle range. Additionally, Student 8 (scored 9) engaged in self-directed study but scored lower than in the previous test. This suggests that while self-directed study may have had a positive impact for some Class A students, as seen with the highest scorer, it does not uniformly predict higher scores among all students.

The forthcoming analysis will examine the correlation between the number of completed self-directed study tasks and individual test scores to discern any significant patterns or associations.

Figure 12 focuses on Test 2 scores from only those students who completed self-directed study, categorized by their engagement level with the different learning modes in Quizlet.

Figure 12
Box Plot Comparing Completion Rate of Self-Directed Study in Test 2



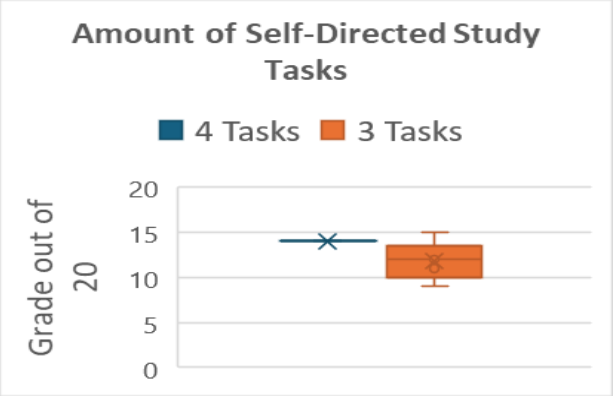
Done 4 Tasks: The high-achieving student, who excelled in the baseline, scored 13 in Test 1 after engaging with four categories of self-directed study tasks. Their performance suggests that a high level of engagement in self-directed study, combined with a history of high achievement, may lead to superior academic outcomes.

Done 3 Tasks: The students who completed three categories of study tasks exhibited a range of scores (12, 10, 10, 10), which suggests that while they engaged significantly with self-directed study, the breadth of study task completion alone does not guarantee higher performance.

Done 2 Tasks: The single student who completed two categories of study tasks achieved a score of 12. This score matches the highest score among the students who completed three categories and exceeds the scores of the others in the same group. This outcome indicates that the number of study categories completed is not a definitive predictor of test success.

Figure 13 mirrors the previous plot for Test 3 scores, providing insights into the relationship between the extent of Quizlet engagement and the students' performance.

Figure 13
Box Plot Comparing Completion Rate of Self-Directed Study in Test 3



Done 4 Tasks: A student who completed four self-directed study tasks scored 14. This indicates a high level of engagement in self-directed study, which seems to correlate with a strong performance, although not the highest score for this test.

Done 3 Tasks: The students who completed three self-directed study tasks have a range of scores: 15, 12, 12, 9, and 11. Notably, the student who scored 15 and is the same individual who scored 13 in Test 1 completed three tasks for this test. This high score, despite engaging in fewer tasks than in Test 1, suggests that the number of tasks may not be as critical as the effectiveness or quality of the study tasks completed. The other scores in this group show significant variation, further indicating that factors other than the sheer number of completed tasks influence test performance.

A brief overview of some of the students highlights the following:

Student 1: Student 1's consistent improvement across each test session while engaging in self-directed study, with scores increasing from 13 to 15, suggests a positive correlation between self-directed study and test performance.

Student 6: Student 6's lack of improvement, with scores remaining at 6 across all test sessions without engaging in self-directed study, highlights the potential need for additional support or alternative learning strategies.

Student 8: Student 8's decrease in score from 10 to 9 despite engaging in self-directed study is counterintuitive, suggesting that other factors may be affecting their learning and need investigation.

Student 9: Student 9's stagnant scores, despite changes in self-directed study engagement, indicate that self-directed study did not have a discernible impact on their performance or other factors were at play.

Student 10: Student 10's improvement from a baseline score of 9 to 11 by Test 3, while consistently engaging in self-directed study, suggests that self-directed study was beneficial and could be considered a success story of the intervention.

Class B Results

This section presents the findings from the analysis of Class B's performance in language assessments. The descriptive statistics for Class B's grades are as follows: the mean score was 10, the median score was 13, the standard deviation was 2.83, and the range of scores was 9. These statistics indicate a moderate level of performance variability within the class.

The table above summarizes the performance metrics for Class B, highlighting the central tendencies and variability of the students' scores across the testing sessions. A one-way ANOVA was performed to evaluate the impact of self-directed study on the students' grades. The analysis resulted in an F-statistic of 3.1835 and a p-value of 0.0856. Given that the p-value exceeds the alpha threshold of 0.05, the findings suggest that there is no statistically significant effect of self-directed study on assessment scores. Consequently, we do not reject the null hypothesis, implying that the implementation of Quizlet for self-directed study did not significantly influence student performance. The repeated measures ANOVA revealed no significant main effect of time on assessment scores: $F(2, 18) = 3.18$, $p = 0.086$, partial eta squared (η^2p) = 0.261. While the main effect did not reach statistical significance, the partial eta squared value of 0.261 suggests a large effect size. This implies that time had a substantial impact on assessment scores, but the study may have been underpowered to detect a significant effect due to the small sample size.

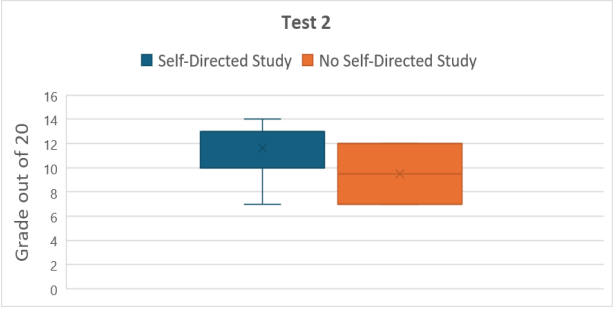
Figure 14 depicts the score distribution for Test 2, contrasting students who engaged in self-directed study with those who did not.

Table 4
Class B Student Performance

Student ID	Baseline Score	Test 2 Score out of 20	Was Self-Directed Study Completed?	Test 3 Score out of 20	Was Self-Directed Study Completed?
1	13	14	Yes	16	Yes
2	13	13	Yes	16	Yes
3	10	12	No	13	No
4	10	13	Yes	13	No
5	7	10	Yes	10	Yes
6	10	7	Yes	7	Yes
7	10	10	Yes	10	Yes
8	13	7	No	7	No
9	7	7	Yes	13	Yes
10	13	10	Yes	13	No

Note. Self-directed study not applicable to the baseline.

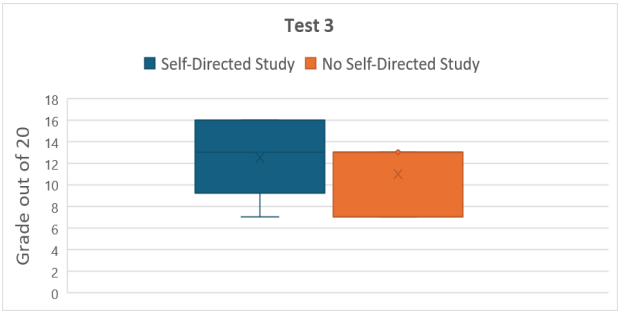
Figure 14
Box Plot Comparing Self-Directed Study Engagement in Test 2



The data reveal that the highest score in Test 2 was attained by Student 1, who earned a 15 and had participated in self-directed study. Conversely, the lowest score was observed for Student 6, who scored a 7 and did not participate in self-directed study. However, among students with mid-range scores, a definitive correlation between self-directed study and test outcomes is not evident. For example, Student 2 (scored 13, studied), Student 3 (scored 14, studied), and Student 10 (scored 11, studied) were involved in self-directed study, while Students 4 (scored 13, did not study) and 7 (scored 12, did not study) were not, yet all these students achieved scores within a comparable range. Similarly, Students 8 (scored 11, studied) and 9 (scored 11, studied) took part in self-directed study but did not outperform some of their peers who did not engage in self-directed study.

Figure 15 offers a comparison for Test 3 scores, differentiating between students who engaged in self-directed study and those who did not.

Figure 15
Box Plot Comparing Self-Directed Study in Test 3



In Test 3, the top score was once more secured by Student 1, who achieved a 16 and participated in self-directed study. The lowest score was again recorded by Student 6, who scored a 7 and did not engage in self-directed study. Within the middle range of scorers, a distinct correlation between self-directed study and test scores remains elusive. Students 2 (scored 14), 3 (scored 15), and 10 (scored 12) were involved in self-directed study and scored in the middle range, while

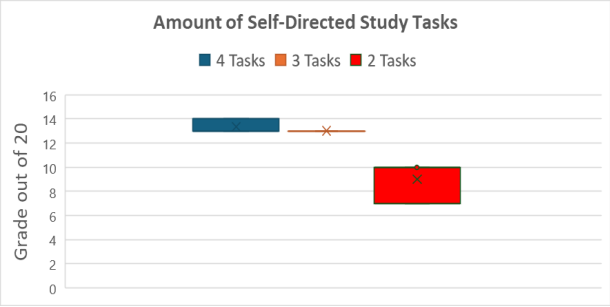
Students 5 (scored 13), 7 (scored 12), and 9 (scored 11) did not engage in self-directed study and also scored within this range. Moreover, Student 8 (scored 8) participated in self-directed study but scored lower than in the previous test. These outcomes suggest that while self-directed study may have been beneficial for some students in Class B, as exemplified by the highest scorer, it does not consistently translate to higher scores across the board.

To further understand the influence of self-directed study on academic achievement, subsequent analysis will examine the relationship between the volume of study tasks completed and individual test scores.

Figure 16 focuses on Test 2 scores from only those students who completed self-directed study, categorized by their engagement level with the different learning modes in Quizlet.

Figure 16

Box Plot Comparing Completion Rate of Self-Directed Study in Test 2



Done 2 Tasks: The students who completed two self-directed study tasks scored 10 and 7. These scores are on the lower end compared to those who completed more tasks. This might suggest that minimal engagement in self-directed study is not as effective as more extensive engagement.

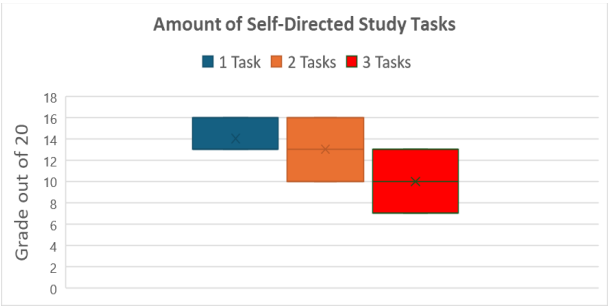
Done 3 Tasks: The students who completed three self-directed study tasks both scored 13. These scores are quite competitive, matching some of the scores of students who completed more tasks. This suggests that completing a moderate number of study tasks can be effective, potentially indicating that these students were more focused or efficient in their study strategies.

Done 4 Tasks: The students who completed four self-directed study tasks scored 14 and 13. The student with the score of 14 is among the highest scorers, indicating that a higher number of tasks completed can correlate with higher test scores. The score of 13 is consistent with the scores of students who completed three tasks, which may imply that the effectiveness of the study tasks or the individual's study approach is also important.

Figure 17 mirrors the previous plot for Test 3 scores, providing insights into the relationship between the extent of Quizlet engagement and the students' performance.

Figure 17

Box Plot Comparing Completion Rate of Self-Directed Study in Test 3



Done 3 Tasks: Students who completed three self-directed study tasks scored 13 and 7. The score of 13 suggests that a higher number of tasks can be associated with good performance, but the score of 7 indicates that the quality and relevance of the tasks may be more critical than the quantity.

Done 2 Tasks: Students who completed two self-directed study tasks scored 16 and 10. The score of 16 matches the highest score reported, suggesting that completing two tasks can lead to top performance. The score of 10 highlights the variability in outcomes.

Done 1 Task: Students who completed one self-directed study task scored 16, 13, and 13. The score of 16 indicates that a single well-chosen task aligned with the student's learning needs can lead to excellent performance, supported by the two scores of 13.

A closer look at individual student performance reveals the following:

Student 1: Showed consistent improvement across each test session while participating in self-directed study. The scores rose from 13 to 16, indicating a potential positive relationship between self-directed study and test scores.

Student 6: The absence of score improvement, with marks persistently at 7 across all test sessions without

self-directed study, raises concerns and underscores the possible necessity for additional support or different educational strategies.

Student 8: Despite engaging in self-directed study, this student's scores declined from 13 in the baseline to 7 and 7 in Test 2 and Test 3. This unexpected drop suggests that factors other than self-directed study might be influencing their academic performance.

Student 9: The stagnation of scores, regardless of their engagement in self-directed study, is puzzling. The consistent score of 13 across all tests suggests that self-directed study did not have a noticeable effect on their performance or other variables were influential.

Student 10: This student's progress from a baseline score of 10 to 13 by Test 3, while consistently engaging in self-directed study, is noteworthy and implies that self-directed study may have been advantageous.

Discussion

This section presents a comparative analysis evaluating the impact of self-directed study using Quizlet on the academic performance of students in Class A and Class B. The aim is to discern whether using Quizlet as a study aid translates to measurable improvements in student grades and to what extent individual and class performance are affected. The analysis scrutinizes the collected data to provide insights into Quizlet's utility in educational settings.

The findings from this study align with the existing literature, which suggests that the effectiveness of MALL tools like Quizlet can vary depending on various factors.

Consistent with the observations made by Lin and Lin (2019), the results from both Class A and Class B indicate that the overall effect of Quizlet on vocabulary acquisition and academic performance was not statistically significant. This aligns with their analysis, which reported medium to large positive effects of MALL interventions compared to non-MALL conditions but also highlighted the moderating influence of factors such as task autonomy, vocabulary measurement methods, and the duration of the intervention.

The absence of a clear correlation between the number of Quizlet tasks completed and higher scores in both classes resonates with the findings of Okumuş Dağdeler et al. (2020). Their study revealed that while mobile app interventions led to significant short-term gains in receptive vocabulary knowledge, these gains were not well retained over time, and there were no significant differences in productive knowledge gains compared to traditional methods.

Table 5
Comparative Table of Key Findings

Finding	Class A	Class B
Statistical significance of Quizlet on grades	No significant effect ($p = 0.256$)	No significant effect ($p = 0.0856$)
Highest scorer	Student 1 (score: 15) engaged in self-directed study.	Student 1 (score: 16) engaged in self-directed study.
Lowest scorer	Student 6 (score: 6) did not engage in self-directed study.	Student 6 (score: 7) engaged in self-directed study.
Correlation between Quizlet task completion and higher scores	No clear correlation observed	No clear correlation observed
Impact of higher Quizlet task completion	Mixed results, with some students scoring high and others scoring low regardless of task completion	Mixed results, with some students scoring high and others scoring low regardless of task completion

The mixed results observed in both Class A and Class B, where some students experienced improvements while others did not, despite varying levels of engagement with Quizlet, are consistent with the variability reported in the literature. Factors such as individual learner differences, motivation levels, and the quality of engagement with the MALL tool, as highlighted by Rachman et al. (2023) and Xodabande and Atai (2022), could explain the inconsistencies in outcomes.

The finding that the highest scorers in both classes engaged in self-directed study using Quizlet aligns with the positive effects of MALL interventions reported by studies like Naz et al. (2022) and Xodabande and Atai (2022). These studies demonstrated that gamified and interactive MALL tools could enhance engagement,

motivation, and long-term retention of vocabulary, which may have contributed to the success of the top-performing students in this study.

Supplementary Role of Quizlet

Quizlet should be viewed as a supplementary tool rather than a standalone solution for vocabulary acquisition and academic performance enhancement. While the study aimed to assess the impact of self-directed Quizlet usage, the findings suggest that it may be more effective when combined with other educational resources and teaching strategies.

Quizlet could serve as a valuable complement to traditional classroom instruction, providing students with an interactive platform for reinforcing and practicing the vocabulary introduced during lessons. By integrating Quizlet as part of a multifaceted approach to language learning, educators can leverage its strengths while mitigating its limitations. For instance, Quizlet's gamified features and self-paced nature could be balanced with direct teacher guidance, collaborative activities, or assessments that measure deeper levels of vocabulary comprehension and application.

Limitations

The study's findings are contextualized within several limitations that may impact their generalizability and interpretation. The small sample size (N = 10) in both Class A and Class B may have affected the ability to detect significant effects of self-directed study on student performance. The limited number of participants reduces the statistical power of the analysis, increasing the likelihood of Type II errors. Additionally, the relatively short duration of the study may not have allowed for a thorough assessment of the long-term effects of Quizlet on self-directed study habits and vocabulary attainment.

Another limitation is the inability of Quizlet to track the precise amount of time students spent on tasks, restricting the analysis from considering the depth of engagement with the study material. Merely quantifying the number of tasks completed does not provide a comprehensive understanding of the students› level of commitment and the quality of their interactions with the self-study materials.

Furthermore, the study did not account for individual differences in student motivation towards self-directed learning. The lack of significant differences in overall class performance could potentially be attributed to varying levels of student motivation. Some learners may have embraced Quizlet as a valuable resource, dedicating substantial time and effort to the self-study activities, while others might have approached the tool with minimal engagement. This disparity in motivation levels could explain the inconsistent results, where some highly motivated individuals experienced notable improvements, while others showed little or no change in their academic performance. Addressing this limitation in future studies could involve incorporating strategies to foster and sustain student motivation, such as gamification elements, personalized feedback loops, or collaborative learning components. Direct teacher facilitation and guidance throughout the self-study process may also help maintain student engagement and reinforce the value of self-directed learning.

The comparative analysis of Class A and Class B was unable to conclusively support the hypothesis that the use of Quizlet for self-directed study significantly enhances student grades. However, these limitations highlight the need for further research with larger sample sizes, longer study durations, and more comprehensive methods for monitoring student engagement and motivation.

Conclusion

In conclusion, this study delved into the role of Quizlet, a MALL tool, in supporting self-directed language study and its impact on the writing skills of learners in Hong Kong. Through a comparative analysis of two classes, the research scrutinized the relationship between Quizlet usage and student academic performance. While the findings did reveal some instances of individual improvement, the study did not establish a statistically significant link between Quizlet use and overall enhancement of student grades. Consequently, the verdict on the effectiveness of Quizlet in this context remains inconclusive.

However, this research holds significant implications for language teaching and learning in Hong Kong. It contributes to the limited but growing body of knowledge on the effectiveness of MALL tools, particularly in the domain of writing skills, within the region. By providing localized insights into the use of Quizlet, the study aids in understanding its potential and limitations as a learning aid within the unique linguistic and educational landscape of Hong Kong.

Furthermore, this research underscores the necessity of adopting a nuanced approach to technology

integration in language education. It emphasizes the importance of language teachers in Hong Kong integrating MALL tools like Quizlet to complement traditional teaching methods, particularly in reinforcing vocabulary and grammar concepts. However, educators should recognize the diverse impacts of these tools and provide a balanced approach that accommodates different learning styles and needs.

Moving forward, future research should address the limitations encountered in this study. Subsequent studies should incorporate control groups to enable direct comparisons between MALL interventions and traditional teaching methods or no intervention. Randomized controlled trials or quasi-experimental designs with control groups can strengthen the evidence on the efficacy of MALL tools like Quizlet. Additionally, longitudinal studies with control groups are needed to evaluate the long-term impacts of MALL interventions on language learning outcomes.

By employing larger sample sizes and conducting longitudinal studies, more definitive insights into the long-term effects of MALL tools on language learning can be obtained. Additionally, incorporating qualitative research methods, such as interviews and focus groups, can provide a deeper understanding of student perceptions and the qualitative aspects of learning experiences with MALL. Furthermore, investigating the role of teacher mediation in the use of MALL tools and its impact on student outcomes is an important avenue for future research. Exploring different MALL tools and their specific features in relation to language skill development can also contribute to expanding the understanding of technology-assisted learning.

From a practical standpoint, this study provides valuable insights for language teachers in Hong Kong on the potential benefits and limitations of integrating Quizlet as a supplementary tool in their teaching practices. Language educators can use these findings as a starting point for carefully evaluating and monitoring the effectiveness of MALL tools like Quizlet in their specific classroom contexts.

Overall, this study serves as a foundation for further research and enhances the literature on MALL and its practical applications in language pedagogy. It encourages language teachers to embrace MALL tools as valuable complements to traditional teaching methods and emphasizes the need for continuous research and evaluation to optimize their effectiveness in language education.

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N/A

Statement of Originality

The author of this manuscript attests that this work is the result of original study, that it is not currently under review in other journals, that it was not published before in any format except in abstract form in conferences/university repositories, and that its similarity index with a similarity detection software is 10% or below.

Declaration of Conflict of Interest

The author of this manuscript declares that he has no conflicts of interest.

Declaration of AI use

The author declares that AI (Claude) was used for the purpose of spell-checking and grammar revisions. The Julius AI program was used for the ANOVA.