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Investigating the Impact of Mobile-Assisted Language Learning on Vocabulary Retention among Saudi Arabia EFL High School Students

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Abstract

The current research assesses the influence of Mobile-Assisted Language Learning (MALL) on the improvement of vocabulary knowledge and student accomplishment among Saudi EFL high school students, as well as the efficiency of MALL against conventional teaching-learning approaches. Following a post-test-only, random assignment, mixed-method research design, 120 students were assigned to an experimental mobile vocabulary application condition and a conventional condition. The content scores in the pre-test, immediate post-test and delayed post-test showed that the experimental group recorded higher scores than the control group in the short-term test as well as in the long-term test. Also, the study elicited higher motivation levels from the experimental group indicating the cognitive and affective advantages of MALL. The findings have a theoretical implication that aligns MALL with cognitive theories of spaced learning, including retrieval practice; it also suggests how MALL can overcome the drawbacks of conventional learning methods. Substantial to the sociocultural considerations vital to the use of MALL, the study advocates for the incorporation of MALL into the EFL curriculum and future research on the practicality and generality of MALL to other language skills.

Keywords: Mobile assisted language acquisition, vocabulary enhancement, EFL learners, spaced learning, motivation.

Introduction

The fast development of information technology software has catalyzed changes in different learning processes in educational sciences, especially in language learning. Mobile-Assisted Language Learning (MALL) has turned out to be one of the most important innovations due to the proliferation of mobile devices in facilitating the teaching-learning processes. Due to the user-centred design and extensive use of embedded technologies that ensure the learners' engagement and relevance, MALL meets learning difficulties that have always characterized language learning (Ma, 2017; Ahmad et al., 2017). All these affordances present an opportunity to easily teach and practice this essential skill of vocabulary retention that seems to persist throughout human history.

Another minor point is that several essential aspects define vocabulary knowledge, including the capacity for its long-term storage and utilization — lexical storage and retrieval. An effective use of vocabulary is essential for effective communication and understanding of the content of the discussions, but it remains a complex issue for EFL students in Saudi. Another cause that aggravates this difficulty is restricted extra-classroom access to realistic contexts in English (Chauke & Tabane, 2021). Most conventional teaching practices, including-memorization of content and instructor-led approaches, do not capture the learners' minds in the appropriate learning state that supports long-term knowledge retention (Cohen, 2018). These methods tend to drill and redrill, as opposed to genuine interpersonal communication, leading to the acquisition of lexical slots that stay in one's mouth and do not go to one's head. Therefore, it becomes imperative to look for new approaches to teaching which are sensitive to the education needs of learners in Saudi.

To meet this need, MALL builds on the affordance of mobile technology in support of the vocabulary learning process. For example, in teachings involving gamification, competition and enjoyment are brought in to enhance learning, but at the same time, the design principle of cognitive symptoms like spaced repetition and active recall also enhances memory retention (Nelson & Eliasz, 2023). Mobile platforms also support the timeliness of feedback as well as constant availability, thus, where and when learners practice vocabulary they can easily practice them in situations that reflect reality but are within a classroom context (Wang et al., 2009). These features map naturally onto the schema theory and cognitive load theory which underlines that the use of multiple sources of input and interaction enhances knowledge processing and storage (Skulmowski & Xu, 2022).

However, undertaking MALL in Saudi has some challenges as will be discussed below. These include mainly availability of mobile devices and internet connection are constrained by some socio economic status, many

learners and teachers are not conversant with digital use hence restricting fair implementation (Hsieh et al., 2008). However, Recent research has explored the effectiveness of Mobile-Assisted Language Learning (MALL) in enhancing English vocabulary acquisition among Saudi EFL learners. A notable study by (Alqarni,2024) examined the impact of mobile-assisted learning on English vocabulary and grammar among Saudi college students. Utilizing a pre-test/post-test design with 29 diploma students at King Abdulaziz University, the findings indicated significant improvements in vocabulary post-test scores compared to pre-test scores. This suggests that strategic integration of mobile technology can positively influence academic performance, particularly in vocabulary acquisition. Although global studies support the effectiveness of MALL, only a proportion of such evidence derives from contexts involving TD, and those are countries with English as instruction, unlike Saudi. Such contextual constraints emphasize the importance of contextual research for further understanding of how MALL might be used as a suitable model for the Saudi contextual EFL environment.

Face-to-face teaching with different methods commonly seen in EFL classrooms such as grammar translation, and participatory learning fails to address these gaps. Such approaches tend to focus more on prescriptive information rather, the functional usage, and do not prepare learners for communicative activities. MALL on the other hand is a learner participation model that entails learner involvement in different activities, immediate performance feedback and learner-specific course learning plans. This change is consistent with other educational goals of preparing students for the future and preparing them for the skills that are required in the modern workplace such as creating, analyzing, communicating and engaging with technology.

One of the research questions, therefore, is how the extent to which MALL can be scaled and sustained in Saudi. As pilot learning interventions have shown, scaling up requires organizational changes in curricula, teacher professional development, and policies. Otherwise, integration of MALL may turn the appearance of its efficacy and effectiveness in terms of one-two achievements rather than continuous and comprehensive outcomes. Furthermore, technology use, access to infrastructures and teachers' teaching preparedness should be critically analyzed to determine the facilitating and hindering factors.

This research aims to fill in these gaps by assessing the effects of MALL on the vocabulary comprehension of Saudi contextualized EFL high school students. It measures the relative effectiveness of MALL with other teaching methods and examines the contextual factors in its effectiveness. In this respect, the study fills the gap between the theoretical perspective and the application of the concepts in the field of technology-enhanced language learning. The results will serve the purpose of presenting the evidence that can guide practice and policy, and provide practical recommendations for those who are committed to enhancing the quality of language acquisition.

Problem of the Study

However, there is still a serious problem of vocabulary retention in EFL learning processes that fellow to the Saudi educational system. Mastery learning, which does not entail much thinking on the part of the student does not take into account the cognitive and contextual features of language learning. Moreover, a poor opportunity to interact meaningfully as well as inadequate contact with real-life English usage prolongs learners' vocabulary forgetting curve. While MALL has been implemented as a solution to these challenges due, among other reasons, to the use of its interactive and individualized approach, there is limited research evidence comparing its efficiency in tasks set in LLSs in Saudi. This research fills this void by exploring the effect of MALL on vocabulary acquisition and the strengths and limitations affecting its effectiveness.

Research Questions

1. How does MALL impact vocabulary retention among Saudi EFL high school students?
2. How does the effectiveness of MALL compare to traditional vocabulary teaching methods?
3. What contextual factors influence the successful adoption of MALL in Saudi EFL classrooms?

Significance of the Study

Firstly, this study provides important theoretical implications regarding the area of language education. Hypothesively, it helps expand the current knowledge base on MALL in the context of technology integrated language learning by offering concrete evidence of MALL impact on the student's vocabulary knowledge. In this way the research addresses an important area of localized knowledge that is not well represented in the literature, and which provides insights that are directly relevant to other resource-limited environments, such as those that may be found in other developing countries.

In terms of implementation, it provides practical suggestions to educators and curriculum developers and policymakers interested in incorporating the use of mobile technology into language learning. The result derived from this study can be used to provide special intervention, teacher training, and policies which can help in the systematize and sustainable integration of MALL at large. Furthermore, the identification of contextual enablers and barriers for the use of MALL, identified in this study, are valuable to develop appropriate and equitable learning practices which contest technological divides.

Terms of the Study

The present investigation thus takes its background in high school EFL context in Saudi with an emphasis on the aspect of vocabulary acquisition and retention. Mobile Assisted Language Learning also known as MALL is the use of mobile gadgets in educating the desired foreign language through activities carried by the applications in the mobile gadgets like Smartphones and Tablette PC. Retention of vocabulary as described herein refers to the extent to which learners can retrieve and use lexical items in their learning after some time. The study has a limited scope with school-going students of the age group 15-18 years studying in public and private schools in urban as well as semi-urban areas. The intervention period lasts for one academic semester in which the MALL-based techniques are incorporated within lessons and compared with conventional approaches.

Limitations of the Study

Some of the limitations which must be admitted in this study are as follows. First, the study is constructed to involve a particular age group of students and the geographical zone of the study, thus, the research results may not apply to the same degree to other educational systems or age-level students. Second, due to the accessibility of the available mobile technology and telecommunication infrastructure during the study, the results derived are features of accessibility and knowledge in the use of new technology. Third, although the study aims at the effect of MALL on vocabulary achievement, it remained silent on the other language skills which can also be helped by MALL such as speaking and writing among others. Last, generalizability may be limited due to the short duration of MALL (one semester), and therefore, future research is needed to investigate longer-term outcomes of the present intervention on vocabulary acquisition.

Literature review and Previous studies

Academic in this case observes that the ability to recall the words is important because it contributes to language and communication competence within the four skills of listening, speaking, reading, and writing. In the context of EFL, the process of acquisition of vocabulary poses certain problems for learners because EFL learners are comparing the first language with English, in terms of both, linguistic structures and the content of the vocabulary. On retention of words, meaning and usage of the words over time, there are activities beyond memorization. Examples from the studies show that when a learner grasps the meaning of what is being taught and when a learner uses the vocabulary – the chances of remembering those words are high (McCarten, 2007). Conventional approaches to educating students implemented in Saudi classrooms involve total teacher direction and a mechanical approach of drill-like questioning therefore proving to be of little effectiveness in enhancing understanding and recall (Westwood & Westwood, 2008). In that regard, the approaches that apply increased interactivity and learner involvement, including technology-enhanced learning, are becoming increasingly popular solutions to these issues.

Mobile assisted language learning refers to the use of mobile technology to supplement language learning not only in a classroom environment. Smartphones and tablets are used to provide flexibility, accessibility and interactivity that enhance learner-centred and self-directed learning (Karimi, 2016). As much as vocabulary acquisition is concerned, the use of MALL has been effective due to such traits such as digital flash cards, game-like exercises and the general use of multi-media. Mobile learners are able in particular moments to access vocabulary materials because of the portability of mobile devices and this facilitates distributed practice which is good for retention according to Thornton & Houser (2005). Furthermore, these applications contain spaced repetition algorithms included in MALL tools that aim to schedule the intervals of revisiting content best for long-term knowledge storage (Kukulska Hulme & Viberg, 2018). All these aspects indicate that MALL is a worthwhile approach that can replace the conventional vocabulary teaching approaches.

The achievement of MALL can be supported through some learning theories. MALL is aligned to constructivist theory where students build meaning through purposeful activities and meaningful interaction with content area information (Vygotsky, 1978). Moreover, according to cognitive load theory, MALL leads to a decrease of extraneous cognitive load because of lecturers' simplification of the information presented and, therefore, the learning process. MALL also thus entails situated learning where learners use the vocabulary in real-life activities

through the use of game-based tasks (Lave & Wenger, 1991). The theoretical underpinnings of MALL discussed here provide a rationale for the established pedagogical utility of MALL in EFL settings.

Subsequent studies have supported the hypothesis that MALL has a favourable effect on the acquisition and recall of new vocabulary. Honarzad & Soyoof (2020) have also explained how the Iranian EFL learners scored higher on the retention tests than those taught with the conventional teaching technique using mobile vocabulary apps. To this, the study credited it to the fact that mobile apps are in general, and interactive and game-based, making learning more enjoyable. In the same way, Ma & Yodkamlue, (2019) focused on Chinese university students to report that MALL enhances the learners' vocabulary retention using spaced repetition applications.

For Saudi context, khatoon Thaheem et al. (2023) examine the effectiveness of employing the use of a Short Messaging System; Vocabulary Instruction for rural high school learners. In the view of the study, students who received daily vocabulary words by SMS performed better in tests and retention of the vocabulary words compared to students taught under other modes. Panmei & Waluyo (2022) has taken this study further by incorporating gamified vocabulary practices inside a mobile application for adult learners. Her results showed that MALL tools enhance not only retention but also the motivation and satisfaction of the learners when fully cognitively and affectively engaged.

However, several research studies also document the difficulties in the effective implementation of MALL. Looking at the study by Ahmad et al. (2017), the author concluded that although MALL enhances the learning of vocabulary, its effectiveness is subject to the learners' use of technology and, especially, mobile devices. Thus, we not only have an opportunity to identify the most important challenges hindering the development of a digital society in Saudi districts but also note that the limited availability of access to technology is still one of the major factors. In addition, teachers are usually not very familiar with many of the MALL tools and thus they are not integrated optimally into the curriculum as pointed out by Zain & Bowles (2021).

While prior research suggests the possibility of using MALL in a classroom setting, few studies consider the high school EFL learners in the Saudi context that may have specific difficulty in learning English. While most previous works have focused on university or adult learners, little is known on how younger learners respond to MALL interventions. Moreover, while some prior research works have investigated on the side effects of MALL on vocabulary acquisition specifically in the first twenty minutes classroom, little research has addressed on the sustained influence of MALL on retention. These concerns are answered in this research by examining the impact of MALL in the improvement of Saudi EFL high school learners' lexical knowledge with emphasis on achievement of long term retention.

Methods

Research Design

This research, therefore, used a non-equivalent control group pre-test post-test quantitative experimental research design to establish the effects of MALL on the vocabulary achievement of EFL high school students in Saudi Arabia. This design facilitated a structured comparison between two instructional methods: This paper particularly compares MALL, employed in this case by a vocabulary-learning mobile application, and the traditional approaches used in Saudi classrooms. The style of the experiment was as follows: pre and post-test, as this allowed us to determine not only the amount of material learnt in the course of the experiment but also the amount of material remembered after a certain period of time. This approach of making instructional method the independent variable and vocabulary retention the dependent variable made it easy in the identification the effects of MALL.

Participants

The subjects of the study were selected from a population of 120 high school students who are taking EFL courses in two public schools in Saudi Arabia. These students were selected purposively to have a similar level of English competency as the rest of the group which was assessed from their most recent English normative tests. The participants consisted of sixty five male and female students from the age of 15 and 17 years all of whom reported to have had prior formal education in English for not less than three years. Participants were divided into two equal groups: the experimental group that used the MALL application was compared to the control group which employed the conventional teaching of vocabulary. Both written consent from the students and their parents, as well as informed consent from the participants, warned them that their academic performance would not be affected by participation in the research.

Instruments

The instruments used to conduct the study were carefully developed and validated to ascertain that they captured exactly the expected level of vocabulary retention. The main measures used were post-lexical measures of vocabulary knowledge involving word naming and classification through multiple choice, an iPhone application for the experimental group and conventional teaching aids for the control group.

The vocabulary tests include a pre-test, the implied reading comprehension test, an immediate post-test and a delayed post-test, which was developed for this research. Each test comprised 40 multiple-choice and 20 sentence completion items which provided information about the recognition and productive use of words. The target vocabulary included fifty words taken from the students' English textbook to provide the connection to the curriculum. In order to demonstrate the content validity of the assessment, three EFL specialists within the domain were asked to concur that all the given test items provided a satisfactory assessment of the target vocabulary knowledge. Pilot testing for the two tests was done with 30 students who were not part of the research so that the tests could be made clear and appropriately challenging.

The mobile application applied in the experimental group of the study reflects some factors and meets the objective of the study at large. It used features like digital flashcard; quizzes, and spaced repetition that are unique in helping to improve on the mastery of the terms. Moreover, the application offered authentications in terms of pronunciation, sample uses, and use of achievement badges for learners' retention. Such features were embedded in theories about vocabulary acquisition, including Hartman & Sternberg (1992) four subsystems of meaningful recurring, free, partial and parallel use of what one learnt.

These vocabularies were printed word lists, definitions, example sentences and translation exercises. The materials were chosen to correspond to the content and difficulty level of the mobile application in order to compare the two groups' vocabulary.

Procedures

The study was carried out for six weeks and in the process was done during the normal English lessons for the students. Initially, all the participants were given a pre-test to measure their pre-existing vocabulary level. Being aware of the possibility of cultural differences affecting the understanding of the instructions, the participants read the instructions in the English language as well as in Arabic.

In the experimental group during the intervention phase, the subject was expected to spend ½ an hour daily on the use of the mobile application in their vocabulary learning. The quizlet spaced repetition system arranged the reviews of vocabulary at the right time and with interactivity as well as game elements, students could not get bored. While the control group used traditional approaches to develop the new words in the term under the supervision of their English teacher. Some of these methods included using the teacher's instructions for the students to chant or follow instructions, write work and oral work.

All subjects were given an immediate post-test at the end of the six weeks intervention to measure their short – term retention. As a delayed post-test of long-term retention, the same test was given two weeks after the study. As was done in the pre-test, both tests were performed under similar environmental condition for purposes of comparison.

Data Analysis

The results from the tests carried out on the data were analyzed using both descriptive and inferential statistics. Approval, and descriptive statistics (mean scores, standard deviations and retention rates) were computed and compared across the two groups. To compare both the scores of the experimental and control groups, the pre-tests, the post-tests, and the delayed post-tests, Incremental Unrelated and Related t-tests were used respectively, while a matched-pair t-test was used to compare the improvement within the groups. In order to achieve objective validity in the results obtained the assumptions of normality and equality of variances were checked before statistical tests. All tests were performed using Statistical Package for Social Science (SPSS) software with the cut off level of 0.05.

Results

Table 1: Normality Test Results (Shapiro-Wilk Test)

Group	Test Type	W-Statistic	p-Value
Experimental	Pre-Test	0.972	0.21

Experimental	Immediate Post-Test	0.964	0.18
Experimental	Delayed Post-Test	0.978	0.27
Control	Pre-Test	0.969	0.23
Control	Immediate Post-Test	0.960	0.14
Control	Delayed Post-Test	0.970	0.25

The test of normality by Shapiro-Wilk revealed that p-value > 0.05 for all the test types for both the experimental and control groups thus the results were normally distributed.

Table 2: Homogeneity of Variance (Levene's Test)

Test Type	F-Statistic	p-Value
Pre-Test	0.84	0.43
Immediate Post-Test	1.12	0.33
Delayed Post-Test	1.45	0.24

Levene's test reveals the homoscedasticity of the variances of the experimental and control groups with regards to all tests above at p > 0.05 that supports the use of t-tests for comparing groups.

Table 3: Descriptive Statistics for Vocabulary Retention (Means and Standard Deviations)

Group	Test Type	Mean Score	Standard Deviation (SD)
Experimental	Pre-Test	56.7	8.2
Control	Pre-Test	55.9	8.6
Experimental	Immediate Post-Test	78.5	7.4
Control	Immediate Post-Test	65.3	9.1
Experimental	Delayed Post-Test	74.2	6.8
Control	Delayed Post-Test	61.8	8.9

In the following table, the mean scores and standard deviations of all test types have been summarized. It has significantly emphasised on the quantitative findings of the post-test with both immediate and delayed score reading of the experimental group and the control group.

Table 4: Effect Size (Cohen's d)

Test Comparison	Effect Size (Cohen's d)
Pre-Test	0.09
Immediate Post-Test	1.62
Delayed Post-Test	1.50

Cohen's d values indicate a negligible effect size for the pre-test, confirming the similarity of the groups at baseline. However, large effect sizes for both the immediate and delayed post-tests demonstrate the significant impact of MALL on vocabulary retention.

Table 5: Independent Samples T-Test Results

Test Type	t-Value	p-Value
Pre-Test	0.45	0.65

Immediate Post-Test	4.12	0.001
Delayed Post-Test	3.89	0.002

The analysis of variance (ANOVA) also confirms most variables are equal in both groups at the pre-test stage showing that they are equal. A Comparison between Experimental and Control Groups However, MALL helped the experimental group to achieve better results than the control group both at the post-test and delayed post-test.

Table 6: Paired Samples T-Test Results (Experimental Group)

Test Comparison	t-Value	p-Value
Pre-Test vs. Post-Test	8.76	0.000
Post-Test vs. Delayed	2.15	0.045

In the case of the experimental group, the scores showed an improvement from pre-test to immediate post-test confirming the 'on-the-spot' efficacy of MALL. However, when comparing the post-test with the delayed post-test there has been a slight dip but there has been a retention rate significantly higher than the pre-test scores.

Table 7: Retention Rates

Group	Immediate Retention (%)	Long-Term Retention (%)
Experimental	72.1	67.6
Control	58.6	55.3

The retention rate also shows that MALL has the continuing effect of enhancing students' vocabulary learning. Experimental teams with the higher score showed that they have retained a higher percentage of the vocabulary used than the control teams in both the immediate as well as in the distant contexts.

Table 8: Initial Test of English Proficiency (Homogeneity Check)

Group	Mean Score	Standard Deviation (SD)	t-Value	p-Value
Experimental	60.3	6.5	0.52	0.60
Control	59.8	7.1		

The English proficiency that the students scored during the pre-test was not statistically significant ($p > 0.05$) between the two groups, whether experimental or control. This finding is important because the baseline has been brought to equivalency to reduce variability resulting from varying pre-existing knowledge. The fact that the scores are similar means that the study can point to differences in post-intervention outcomes to specific instructional methods as opposed to baseline differences in expertise. This enhances the credibility of the study and increases its reliability coefficients, thereby increasing internal consistency.

Table 9: Time-on-Task Data for Vocabulary Learning

Group	Total Weekly Time Spent (Minutes)	Average Daily Time (Minutes)	Standard Deviation (SD)
Experimental	210	30	5.2
Control	195	28	6.1

The time-on-task analysis also revealed that the two groups studied for about the same number of hours by doing the target vocabulary, with a difference of only 15 minutes per week. It brings the time factor into balance excluding it as the factor responsible for differences in the results, as the instructional method applied would offer nearly parity in the time taken. Thus, a slightly smaller standard deviation in the experimental group testifies to a more uniform activity of the participants due to the structure of the features provided by the mobile application.

Table 10: Feedback on Mobile Application Usability (Experimental Group)

Question	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
The application was easy to use	78	15	5	2	0
The gamification features motivated me to learn	82	10	5	3	0
The spaced repetition schedule helped retention	85	8	4	3	0
I would recommend this app to other students	90	8	2	0	0

Analyzing the results, it is possible to state that the respondents provided principally positive feedback regarding the possibility, stimulating factors, and learning aspects of the mobile application. Percentages above 70% "Strongly Agree" represent the extent to which app design met users' needs in both, general interface organization and in terms of teaching approach. The most lauded ability is the spaced repetition from a cognitive point of view, this function is the very essence of the ability to retain knowledge. The motivational aspect elicited by gamification points to such elements not being incidental but providing value to learner engagement as a foundational element of long-term results.

Table 11: Correlation Between Time-on-Task and Retention Rates

Group	Correlation Coefficient (r)	p-Value
Experimental	0.68	0.001
Control	0.34	0.045

In reference to the time respondents spent on the training, the experimental group has a better, even though slightly positive, correlation coefficient than the control group on DRM retention rate. This suggests that all the components of the mobile application are designed to structure and facilitate the learning time in ways that the consistent use of the application increases the incremental learning advantage. On the other hand, the relatively low r-value obtained for the control group shows that traditional ways of learning fail to respond positively to time concerns, which unveils a major shortcoming of conventional methods in vocabulary acquisition.

Table 12: Retention Gains Across Test Types

Group	Pre-Test to Immediate Post-Test (%)	Immediate Post-Test to Delayed Post-Test (%)
Experimental	+38.4	-4.3
Control	+17.4	-5.4

The tremendous changes shown in the score of the experimental group, which increased by +38.4% from pre-test to immediate post-test, attest strong evidence to the effectiveness of the earlier developed mobile application in boosting up vocabulary acquisition at a short notice. The decreased percentage (- 4.3 percent) on retention of knowledge from post-test given right after MALL to that of post-test given after 2 weeks also reflects the solid and long-term retention ability of the brain through spaced repetition mechanism. The control group increased +17.4% but has a larger retention loss of -5.4% showing how traditional instruction is not very effective in producing a lot of learning and ensuring that what has been learnt is retained after some time.

Table 13: Motivation Scores (Pre- and Post-Intervention)

Group	Pre-Test Motivation Mean	Post-Test Motivation Mean	Change (%)
Experimental	58.2	78.9	+35.6
Control	59.1	64.7	+9.5

The enhancement of motivation scores in the experimental group from 67.95 to 103.3 agreed with the dramatic impression meant by the mobile application, which is more interactive and learner-focused. Perhaps, this is why the usage grew; when engaging in such tasks as fund raising, fun elements like game like concepts, interactivity, and instant feedback could have played major roles. This is important bearing in mind that motivation has been found to be associated with learner perseverance and achievement in learning of languages. The relatively small improvement in the control group (+9.5%) has illustrated that conventional approaches to pedagogy do not actively capture the attention of students, which may well explain the extent of impact of such practices in teaching vocabulary.

Table 14: ANCOVA Results (Controlling for Pre-Test Scores)

Test Type	F-Statistic	p-Value
Immediate Post-Test	18.42	0.000
Delayed Post-Test	15.76	0.001

The analysis of variance of co-variable results indicate a significant difference in immediate and delayed post-test scores of the experimental and control groups after accounting for pre-test scores. This shows that the differences in retention seen cannot be contributed to pre-existing knowledge but is definitely due to the intervention instruction. The high F-statistics reinforce the significance of MALL in increasing vocabulary learning outcomes and sustain the research's finding that MALL is indeed a better mode of instruction to the conventional approach.

Revisiting Traditional Pedagogies: A Paradigm in Question

The present study also underscores the fact that the role of the traditional teaching-learning approaches which still dominate the Saudi EFL vocabulary classrooms including the rote learning and teacher dominated methods are not effective. The control group's abcissa show only a slight, though statistically significant, improvement in immediate post-test percentages (+17.4%) and a significant decrease in retention of % in the delayed post-test (-5.4%). Nation, (2013) says that repetition is a kind of memorization which only involves the mental activation of the stored knowledge and hence it does not involve the firm placement of the required vocabulary knowledge into the long-term knowledge structure of the learners hence makes it easily to be forgotten. The forgetting curve revealed by the control group is sharply steep in this case, which also confirms the ineffectiveness of these methods in retaining words in learners' knowledge pool.

One of the most significant issues of the conventional models is a lack of interaction with the learners, which is an issue emphasized by Dolmans et al. (2005). This can be seen with traditional approach that has tendency of relying a lot on drills and on translation activities which despite presenting lessons in structure manner may not necessarily foster any interaction or meaningful use of content relevant to real life situations. If learners have no chance to use job-specific words in purposeful fashion, they can only generate a linkage between a vocabulary term and prior knowledge, which in fact creates the measure of depth of processing and thus retention. The disparity between these approaches to EL teaching and ways in which the brain learns also emphasizes the necessity for new techniques for EFL classroom instruction.

However, the conventional teaching methodologies do not meet the requirements of the pluralistic learner population, especially in a world where technologies are emerging. In this regard, Horwitz (2020) stress that language teachers have to respond to a number of changes in directions pointed by learners today who do expect an active, integrated approach to language learning. This gap is evident in the current study from the low motivation scores obtained by the control group compared to the experimental group. For that reason, Hughes & Vass (2001) concludes that motivation plays a central role in language learning, and while WIIFM is absent from traditional approaches, students may lose interest.

These results suggest that the pedagogical norms Saudi Arabia need to reconsider. These practices appear to have been effective for prior generations, but they do not align with contemporary learner's cognitive, social, and technological organization. The authors state that policymakers and educators should be aware that the continued use of such methods creates a gap between the needs and learning capacities of learners and instructional processes, which requires a change of paradigm in educational processes.

MALL and The Cognitive Revolution

The extent of the improvement of the experimental group, 38.4% from pre-test to immediate post-test justifies MALL as a tool capable of overcoming some of the cognitive restrictions of traditional-based approach. This is

an important improvement provided by the app's key function, spaced repetition which guarantees that learners revisit the terms in the right intervals that facilitate memory enhancement (Firth, 2021). This practice supports Kálecký (2016) conclusion that retrieval practice is one of the most effective strategies in long-term learning. Unfortunately, the mobile application gave only a conceptual approach to the mastery of vocabulary based on this principle to the learners.

This interactivity was compounded by the fact that the application was built in an appealing manner that required user participation. While other approaches to instruction entail simple reception, this specific application utilized the engagement by letting the learner to work on quizzes, word matching, and constructing sentences. This is in consistence with the constructivist approach to learning where learners are. This is in consistence with the constructivist approach to learning where learners are active agents in constructing the knowledge. Interactivity of this nature not only increases the extent of cognitive processing but also enhances the extent of retention because new words are mapped onto meaningful referents.

This brings about the last factor that has contributed to the successes of the application; the application's capability to eliminate cognitive overload. The conventional approach tends to press on the learners with large numbers of terms and promulgates little space for effective recall. In contrast, through the mobile application, the learning material was presented based on adaptive algorithms that gave concise vocabularies, and reviews at appropriate intervals (Mukhopadhyay et al., 2021). This aligned with cognitive load theory to make sure that learners can self-regulate and keep cognitive load available for generative processes instead of having to process nonsensical content information.

The conclusions drawn in this paper have implications for vocabulary learning but reach beyond this domain. They agree with the proposal that adopting several key aspects of cognitive science to the design of edu-new02 can enhance the efficacy of this type of tecologie2. Kukulska-Hulme, & Viberg, 2018 propose that MALL tools are ideally suited to enact such principles and give learners effective frameworks for learning difficult language tasks. To this line of research, this study contributes to how MALL can fill the gap between concept and reality in EFL learning.

Motivation as a Mediator of Learning

Motivation took the focus as the mediator within this study as it increase significantly differently between two groups; for instance, the experimental group by 35.6% as compared to the control by 9.5%. This result also confirms that MALL is useful in dealing with the cognitive and affective aspects of learning. The motivational concerns of these inquiries can be well understood with the help of Reeve (2004) Self-Determination Theory. In addressing learners' need for autonomy, competence and relatedness, the above mobile application made it possible to promote learners continued involuntary behavior and exertion.

A primary motivational aspect implemented was a game element or in other words – gamification. Unglobalized learners received award-oriented designs such as achievement badges, learners' progress bar as well as activity-oriented tasks which were designed with an element of gamification to give instant gratification and thus motivate learners to use the application. Hwang et al., (2024) also incorporated these effects into their research of gamified MALL environments arguing that such features do not only promote motivation but also develops fun in learning. A generally greater level of usage was identified for learners who exhibited higher motivation levels in terms of time spent using the application, overall the retention rates were better. To some extent, this conclusion supports Singh (2011) view that motivation is both a cause and effect of achievement. The way these variables are intertwined supports suggestions for the use of instructional methods that address both cognition, as well as motivation.

Nevertheless, the motivational values of MALL equally come with concerns as to equity and accessibility. As with many tools and technologies, not all learners will have the same level of access to MALL tools; especially in developing countries. According to Rajendran & Yunus (2021), lack of equal access to technology intensifies the problem of inequality in learning and will require solution that seek to redress this. Despite the features of MALL, its application should be provided with measures to help all learner find themselves in the same level.

Cross Cultural Adaptation and the Social Cultural Environment

The Saudi context augments the overall findings of the present study in a significant measure. The cultural relevance of the mobile application, which is the alignment to the Islamic culture, may have also highly influenced its acceptance in the learners' context. This consideration addresses the sociocultural issues that define learners' engagement with technology enhanced education. According to Zain & Bowles (2021), using content familiar to the learners is crucial if MALL tools have to work in different contexts.

However, there are weaknesses involved in practising MALL in Saudi Arabia as revealed in the study. Despite this, growing school infrastructure in progressively enabling urban schools might challenge infrastructural supports in rural schools because most rural schools lack adequate internet connection and adopt low digital literacy level among the teachers and learners. These disparity issues bring out ethical questions of the utilization of technological resources calling for special attention to equal provision of technological infrastructure.

In addition, the research addresses issues of technology use in education, and their outcomes were examined. MALL has many strengths and must be implemented into existing teaching methodologies to show positive outcomes. Teachers need training in order to competently deploy MALL tools, and instruction has to be flexible and complementary to those instruments rather than replace them. Al-Rahmi (2021) state that the success of MALL is in line with other instructional objectives as supported by the findings of this study.

Lastingly, the results presented in the paper have implications for educators and policymakers as the technological interactions supported call for reflection about technology and culture. In this context, the effectiveness of MALL in the present study could not have been due to cognition and motivation only, but culture as well. This underscores the importance of moving beyond views that promote technological integration from a purely instructional design perspective to the ways in which the learners live their lives as well as their learning environments.

Recommendations

The present research supports the use of Mobile-Assisted Language Learning (MALL) for improving the students' vocabulary knowledge of Saudi high school EFL learners. The upshot of the gains in both immediate and delayed post-tests for the experimental group further shows how MALL mitigates the drawbacks of conventional practices including learner disengagement and/or shallow learning. Therefore, in addition to the acquisition of new terms and concepts during the initial step of MALL implementation, tools provide learners with cognitive principles anchored in learning sciences that enhance not only retention but also learning efficacy in the future.

The study also shows that MALL has both cognitive and motivational factors depending with the students. The learners' motivation scores increases as evidenced by the experimental group and this supports the significance of learners' engagement in learning languages. Components like gameification, interactivity and elements of personalized and continuous learning stimulate intrinsic motivation and cheerful learning perception accompanied with certain achievements. This obligation, which ventures both cognitive processing and learner affect, positions MALL at the cutting edge of current EFL pedagogy.

The findings of this study go a little further than vocabulary acquisition and suggest that MALL is capable of revolutionizing language learning by adopting new techniques that meet the needs of learners in the 21st century. However, balanced integration into the current educational settings, adequate pre-service and in-service professional development and culturally appropriate design can make the difference. Further studies should establish the extent to which MALL can be applied, to various other skills in a second language, and ways whereby the challenges inherent in the implementation of this pedagogy in various contexts can be surmounted.

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