

A Review on Vocabulary Learning-Designed MALL Applications in the EFL Context

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Abstract—This review synthesizes the role of applications designed for vocabulary learning in Mobile-Assisted Language Learning (MALL) in previous studies in the EFL (English as a Foreign Language) context from 2010-2022, according to a set of criteria: (quasi) experimental studies, open access peer-reviewed articles and book chapters, types of applications installed on smartphones, vocabulary learning in the EFL context, students, and publication period (2010-2022). Specifically, the paper emphasizes the role that vocabulary learning-tailored applications have played in impacting learners' EFL vocabulary learning (henceforth EFLVL) process. The papers that have met the criteria (51 out of 146) were examined using a set of categories: context of the study, level of education, types of applications, learning impact, major, and gender. The analysis showed that specifically designed mobile applications play an important role in boosting learners' EFL vocabulary knowledge, motivation, attitudes, and perceptions. Research gaps and future recommendations are suggested based on the findings.

Index Terms—applications, mobile-assisted language learning, review, vocabulary learning

I. INTRODUCTION

Mobile technology has been introduced to almost all sectors of our life, and education is no exception (Celik & Yavuz, 2018). This is due to the unique features that these devices offer (such as mobility) so people can use them anytime and anywhere. Learning vocabulary through mobile devices has received significant attention from researchers in the past two decades; more specifically, there has been extensive research on the use of mobile technology for learning English as a foreign language (EFL). In order to emphasize the benefits and drawbacks of mobile devices in the EFL context, the existing research on utilizing mobile devices in EFLVL requires a synthesis. Therefore, the current study reviewed designed mobile applications devoted to vocabulary learning in the EFL context; the existing research on the use of mobile applications on EFLVL was reviewed in various aspects, such as research features and learning impact to assess the effectiveness of mobile applications in boosting vocabulary learning in the EFL context, provide suggestions to apply such applications in vocabulary learning, and highlight research gaps for future investigation.

II. LITERATURE REVIEW

A. EFL Vocabulary Learning

Learning vocabulary is a critical issue in learning English as a Foreign Language (EFL). In order for a learner to speak, write, read, or listen in English, they must have a good command of vocabulary to better understand and communicate in that language. However, the process of EFLVL may be hindered by various obstacles such as demotivation, lowered interaction, and decreased engagement, as it is widely claimed that learners learn vocabulary in class for exams and grades, but rarely maintain that vocabulary for the long term. This claim pushes teachers to go further and cultivate in learners the love of words and their importance in every practice of the EFL learning process. This can be achieved by engaging learners in attractive and pleasing modes of learning such as games and animations as well as augmented and virtual reality centered on topics they like. Therefore, stakeholders, namely teachers, need to ensure that learners maximally benefit from in-class education through practicing the targeted vocabulary in the outside world (Nisbet & Austin, 2013). Learners and educators cannot sit aside and merely observe the technological changes in education; they must explore and attempt to utilize these technologies (Deng & Trainin, 2015). For ensuring an effective educational process for vocabulary, Graves (2009) proposed a four-pillar model for instruction: teaching individual vocabulary, learning vocabulary strategies such as games, flashcards, and dictionaries, making language experiences available through listening, speaking, reading, and writing, and raising awareness of word usage and meaning in learners. This model can be best utilized by putting mobile technologies such as mobile applications in the learners' hands, to stimulate their desire to employ the vocabulary they learn in real life and thus feel the benefits of the vocabulary-learning process.

B. Mobile Applications

At present, technology is being introduced in all parts of our life due to its numerous advantages, such as ease of use, access anytime and anywhere, efficiency, safety, time and cost savings, etc. The English language is considered an

important part of the technological world; therefore, learners need to master the English language to interact and communicate with friends, classmates, teachers, and people on social media, as well as search for information, make purchases, etc.

A mobile application is a software program for a mobile phone operating system (Nisbet & Austin, 2013). A high percentage of students, especially in wealthier countries, have smartphones connected to the internet. Thus, they can make use of these devices to download free applications to assist them in learning, memorizing, recalling, and employing new words effectively. Nisbet and Austin (2013) argue that mobile applications can be effective means for vocabulary improvement among EFL learners. There has been a large positive connection between mobile technology use and the EFLVL process (Lin & Lin, 2019).

With the advent of mobile technology and learners' urgent need to improve their EFL vocabulary knowledge, stakeholders must consider the benefits of this technology being in the learners' hands and work on solutions that draw their attention to improve their EFLVL process. Some solutions include using mobile devices to write software in different modes, such as games, flashcards, animations, and virtual reality, to help learners acquire more vocabulary. Alzahrani (2015) argued that mobile technologies help develop vocabulary in the EFL context through short messages, games, and digital flashcards. Ball (2011a) argued that technology can contribute to language learning by enhancing learner autonomy, transferring skills to other parts of life, increasing learners' interaction and engagement, boosting their motivation, providing them with quick feedback, and tracking their progress easily. Yudinseva (2015) synthesized the role of games in terms of EFLVL enhancement and suggested effective strategies, such as word repetition, use of contextual clues, interaction with native speakers of the English language, and images.

The employment of mobile applications depends on the design of the application. While some applications are commercially programmed, others are made based on the context of the material, especially those designed and used by researchers. Commercial mobile applications for vocabulary improvement impose challenges, such as a lack of opportunity to produce in the target language, absence of context to present in the new vocabulary, and a lack of instruction on some aspects of word knowledge (Pires, 2018). Celik and Yavuz (2018) argued that mobile applications for vocabulary learning are classified into literal and contextual. The literal applications include learning vocabulary in isolation through tools such as lists and flashcards whereas contextual applications assist learners with vocabulary acquisition through strategies such as guessing, predictions, previewing, making inferences, etc.

In light of the existing literature on EFL vocabulary learning and the related use of mobile technology, this review contributes to the literature by examining the research features and impact of mobile applications specifically designed for EFLVL in previous research from 2010-2022. Therefore, this review aims to answer the following research questions:

1. What are the research features of the reviewed studies on vocabulary learning-designed applications in EFL contexts?
2. In what ways do mobile applications designed for vocabulary learning impact learners' vocabulary learning process in EFL contexts?

III. METHODS

A. Data Collection

A two-step filtering process was carried out in searching for the previously published related studies on the use of mobile applications in the EFLVL process. While searching for the related studies, the title and abstract of the study were checked against the proposed criteria. After the initial screening, the study was downloaded, and a thorough investigation following the criteria for inclusion was applied.

In searching for the related studies, some key terms were employed, including vocabulary learning, vocabulary acquisition, mobile-assisted language learning, mobile applications vocabulary learning/ development, dictionaries, flashcards, and games. Also, the key terms were combined to find the targeted papers. The main search engines used to search for the papers included Google scholar, researchgate, academia, ScienceDirect, Sage Open, Springer, ProQuest, EBESCOhost, Eric, IGI InfoSci Journals, Tylor & Francis Online, and IEEE Access through Saudi Digital Library (SDL).

In order to meet the exclusion and inclusion criteria of papers, the following table (Table 1) shows the inclusion criteria used in this review.

TABLE 1
INCLUSION CRITERIA OF THE STUDIES

N	Category	Criteria
1	Research design	Quasi-/experimental studies
2	Publication	Open access articles or book chapters published in peer-reviewed journals.
3	Period	Between 2010-2022
4	Field of study	EFL vocabulary learning
5	Technology	Vocabulary learning-designed applications installed on smartphones

The study aims to analyze the studies carried out on the impactful role of mobile applications on EFLVL. Therefore, the review's criteria have included quasi-experiments and true experiments in papers published as book chapters and articles in open access, peer-reviewed journals between 2010 and 2022. Also, the review considered the studies that focused on specifically tailored mobile applications devoted exclusively to vocabulary learning. In addition, the review included only studies on learning vocabulary in English as a second language (EFL). The data collection resulted in 146 studies. After applying the inclusion and exclusion criteria, 51 articles were selected to be analyzed in the review: book chapters (N = 2) and journal articles (N = 49).

B. Data Analysis

The research features in the coding sheet were developed based on the study by Persson and Nouri (2018). These features must exist in any study. The coding sheet analyzed 51 studies that met the inclusion criteria. In addition to the research features, it included basic information such as the title, author, publication type, and year. Each publication had a coding sheet. Table 2 shows the major features synthesized in the review.

TABLE 2
RESEARCH FEATURES OF THE EXAMINED STUDIES

N	Category	Details	Purpose
RQ1	What are the research features of the reviewed studies on vocabulary learning-designed applications in EFL contexts?		
1	<i>Educational level</i>	- Level (school, university)	- sheds light on research areas and existing gaps for research in the future
2	<i>Instrumentation</i>	- Instruments used in the studies to address the research questions	- sheds light on research areas and existing gaps for research in the future
3	<i>Context of the study</i>	- The country where the reviewed studies took place	- emphasizes the regions and countries that take care of investing in mobile applications to facilitate the learning of EFL vocabulary
4	<i>Participants' genders</i>	- Gender (male, female, both)	- assists in revealing any differences in EFL vocabulary learning based on gender
5	<i>Course subject</i>	- The learning subject in which learners utilized mobile applications to improve their EFL vocabulary learning	- helps highlight how effective mobile applications were in vocabulary learning based on the learning subject
6	<i>Treatment period</i>	- How much time the treatment programs lasted in the examined studies	- helps assess the effectiveness of the treatment period on learners' use of mobile applications to learn vocabulary in EFL contexts
7	<i>Mode and type of applications</i>	Software (researcher-developed, commercial, etc.)	- sheds light on specific mobile applications used and highlights future research gaps
RQ2	In what ways do smartphone applications designed for vocabulary learning impact learners' vocabulary learning process in EFL contexts?		
8	<i>Vocabulary Learning impact</i>	- Listing the findings of the impact of mobile devices EFLVL process in EFL contexts	- overviews the impact of using mobile devices in EFL contexts on the EFLVL process (RQ2)

Table 2 includes the suggested research features to be examined in this review in finding answers to the research questions. The research features will explore the educational levels, both non-tertiary ("school") and university. Also, the research methods—quantitative, qualitative, or mixed—will be investigated. In addition, the context of the studies will be synthesized, as well as the participants' gender. Furthermore, the course subjects and treatment period will be analyzed to check the effectiveness of time on the learners' use of mobile applications in the EFLVL process. Moreover, the type of mobile applications and modes of learning will be studied to uncover the learners' improvements in EFLVL concerning knowledge, motivation, attitudes, and perceptions. Finally, the review will scrutinize the impactful role of mobile applications on the EFLVL process.

For the purpose of data collection and analysis, a coding sheet was prepared and checked via inter-coding reliability. Another rater coded a sample (11 out of 51) of the criteria-met studies using the sheet. The rapprochement between the two raters reached .92.

IV. RESULTS

RQ 1: *What are the research features of the reviewed studies on vocabulary learning-designed applications in EFL contexts?*

A. Educational Level

The table below (Table 3) displays the educational level examined in the reviewed studies (N = 51).

TABLE 3
EDUCATIONAL LEVEL

Educational Level	Number	Percentage
Tertiary level	36	71%
Nontertiary (school) level	15	29%
Overall	51	100%

According to Table 3, 36 out of 51 studies examined the use of mobile applications designed for vocabulary learning in the EFL context at the tertiary level of higher education institutions. This number (N = 36) represents 71% of the reviewed studies whereas only 15 (29%) studies were conducted at the school level.

B. Instrumentation

Table 4 shows the research design methods applied in the reviewed research. The methods come under three classifications: quantitative instruments, qualitative instruments, and mixed methods. The quantitative methods came first: Thirty (69%) studies utilized quantitative instruments such as tests, questionnaires, or checklists. The use of tests, such as pre-post-delayed tests was reported in all the quantitative studies.

TABLE 4
INSTRUMENTATION

Instrumentation	Instruments	Frequency	Overall	Percentage
Quantitative instruments	Test	17	30	69%
	Questionnaire & test	11		
	Test & checklist	2		
Mixed methods	Test, interview, & open questionnaire	5	17	33%
	Test & open questionnaire	3		
	Test & interview	3		
	Observation, interview, & questionnaire	1		
	Open & closed questionnaires	1		
	Interview, test, & diaries	1		
	Test, focus group, observation, & self-reflection	1		
	Test, logs, & observation	1		
	Questionnaire, interview, observation, & test	1		
Qualitative instruments	Interview	2	4	8%
	Observation & interview	1		
	Records	1		
Overall			51	100%

The use of mixed methods, such as tests, interviews, questionnaires, observation, and reflections was reported in 17 (33%) studies. Only four studies (8%) applied qualitative instruments—interviews, observation, and records. The use of tests received the majority share, with 44 out of 51 (78%) of the reviewed studies reporting this instrument. This result is not surprising, as the most examined studies explored learners' EFL vocabulary knowledge and retention through mobile applications.

C. Context of the Studies

Table 5 overviews the context of prior research on using mobile applications designed specifically for EFL vocabulary learning (EFLVL). As seen in the table below, all the reviewed studies centered on three continents: Asia, Europe, and Africa. Asia came in first place with 35 (69%) studies, followed by Europe with 13 (25%) studies, while Africa came in last place with only three (5%) studies.

TABLE 5
CONTEXT OF THE STUDIES

Country	Frequency	Total	Continent	Percentage
Taiwan	8	35	Asia	69%
China	7			
Saudi Arabia	5			
Iran	4			
Malaysia	3			
Japan	3			
Indonesia	3			
Oman	1			
Thailand	1			
Turkey	9	13	Europe	25%
Spain	2			
Netherlands	1			
Czech Republic	1			
Egypt	2	3	Africa	5%
South Africa	1			
Total	52	51	3	100%

At the level of countries, the review process revealed that 15 countries are interested in researching vocabulary learning via mobile applications. Specifically, Turkey (Europe) was reported as the most active and interested country in researching the utilization of mobile applications in learning EFL vocabulary, followed by Taiwan (N = 8) and China (N = 7) in Asia. Oman and Thailand in Asia, the Netherlands and the Czech Republic in Europe, and South Africa in Africa were the least reported countries, with (N = 1) for each. These results may reflect the amount of importance and interest that learning vocabulary mediated by mobile applications in EFL contexts has for these countries.

D. Gender

Figure 1 depicts the genders of the participants who had contributed in past research on mobile applications for learning EFL vocabulary.

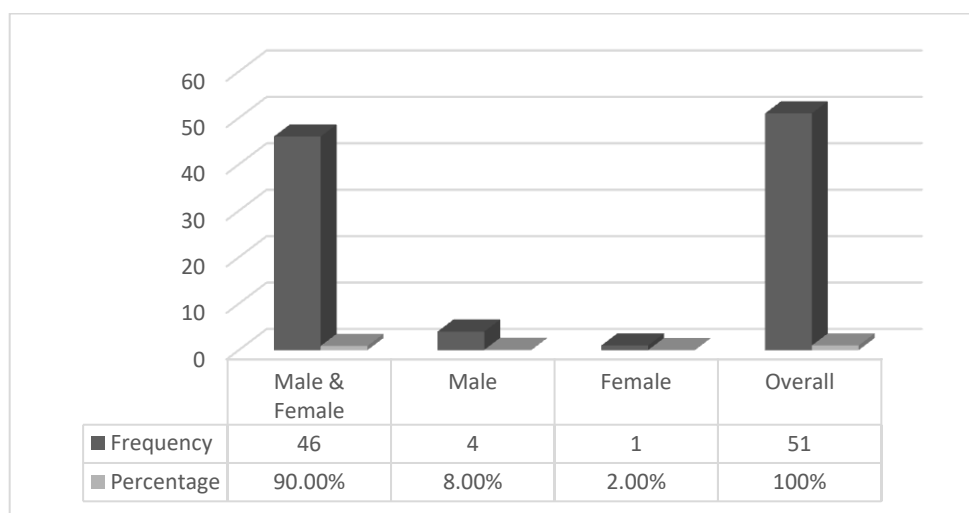


Figure 1 Participants' Genders in the Examined Studies

Figure 1 shows that the majority of the reviewed studies (N = 46: 90%) had both genders—males and females—whereas four studies (8%) in Saudi Arabia were sampled exclusively from male students. Only one (2%) study in Iran had female participants. According to the analysis of the coding sheet, the studies that had only male or only female participants were located in countries such as Saudi Arabia and Iran, where the education system is gender-segregated due to religious beliefs.

E. Subject

Figure 2 displays the course subjects where mobile applications were utilized to learn EFL vocabulary in prior research.

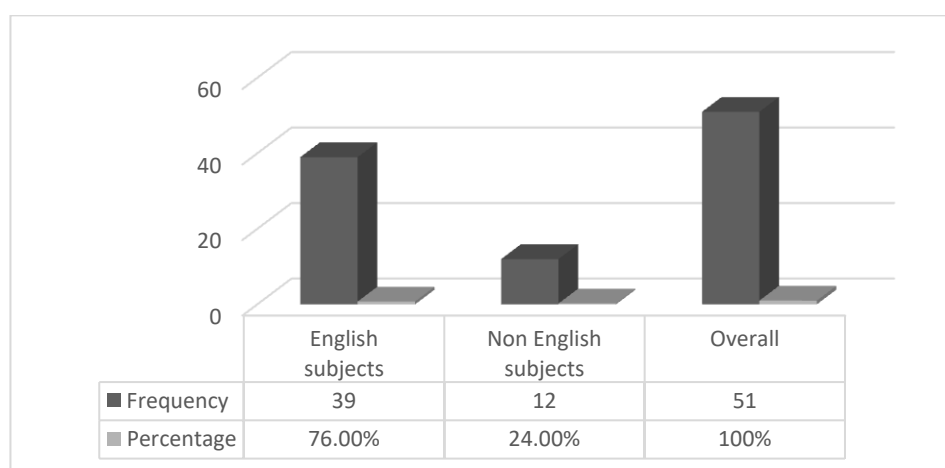


Figure 2 Course Subjects in the Examined Studies

English subjects were examined in 39 (76%) studies whereas non-English subjects such as arts, management, engineering, pharmacy, statistics, etc. were examined in 12 (24%) studies that utilized mobile applications to learn EFL vocabulary.

F. Treatment Period

Figure 3 overviews the treatment periods that were applied in using mobile applications in learning EFL vocabulary in the reviewed studies. As seen in the figure below, the treatment was split into two phases: 1-10 weeks and above 10 weeks.

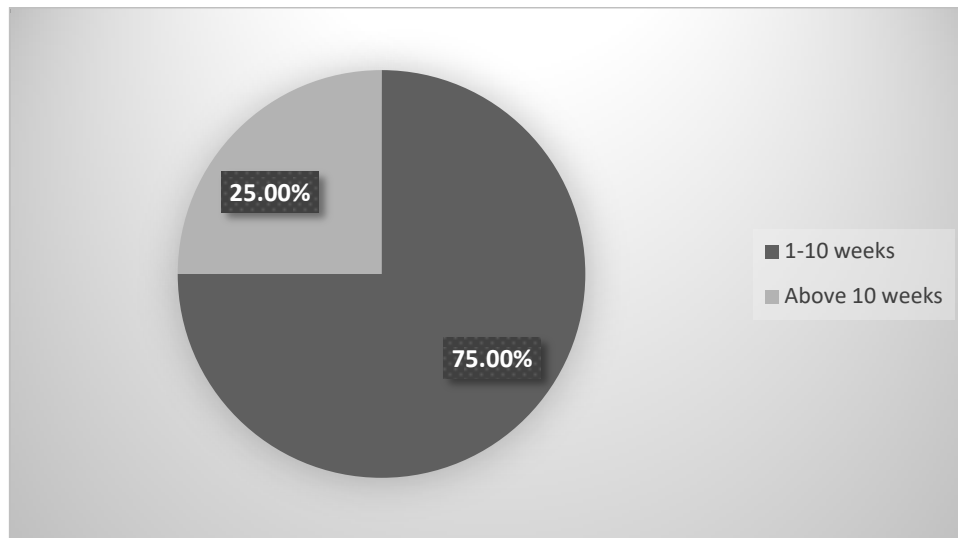


Figure 3 Treatment Period in the Examined Studies

The analysis revealed that 38 (75%) studies had a treatment period between one and ten weeks whereas 13 (25%) studies applied a treatment period longer than ten weeks. This result indicates that the short treatment periods may not reflect the real efficiency of mobile applications in the EFL vocabulary learning (EFLVL) process very well.

G. Mobile Applications

Table 6 presents the modes and names of the mobile applications designed for learning EFL vocabulary. The coding sheet revealed that there were two types of mobile applications tailored for EFL vocabulary learning (EFLVL): commercial applications (N = 12) and self-developed applications (N = 30). Also, it was revealed that the self-developed mobile applications offer a curriculum-based context, whereas the commercial applications are not part of the curriculum taught in schools or universities. The commercial applications outside the course context have raised issues related to students' boredom and decreased motivation due to the lack of the materials' relativity to the course and assessments, especially in treatments that last longer.

TABLE 6
APPS USED IN THE EXAMINED STUDIES

Mode	Application	Frequency	%
Flashcard-based mode	Quizlet, Memrise, Cram, AWL Builder Multilingual, ECTACO vocabulary system, AR Flashcards, Rememba, MyEVA Mobile	18	35%
Game-based mode	Mobile English Learning Application, Detective ABC, Role-play adventure video game (RPG), gamified word learning app Books vs Brains@PolyU, Mobile English Vocabulary Learning App designed with game-related functions (MELVA-GF), VocabGame, Game-based vocabulary learning APP, Mobile game-based English vocabulary practice system, English vocabulary learning app with a self-regulated learning mechanism (EVLAPP-SRLM)	10	19.6%
Others	Lexical Spreadsheet Application, The Spaced Repetition System, White smoke, VocabTutor, The mobile app, VocUp, MALL program, VocaStyle, Word Learning, Agnlictina	10	19.6%
Dictionary-based mode	Mobile dictionary (SPEARA), E-dictionaries, Online dictionary, Electronic dictionaries, BlueDict, Oxford Dictionary, Android Online Dictionary, CollocatApp	8	15.6%
Animated-based mode	(My English Idiom Learning Assistant (MEILA), Mobile vocabulary system, Mondly	3	5.9%
Augmentation-based mode	Augmented reality under visuospatial bootstrapping (AV-VSB), ARealSpeech Application	2	3.9%

The table above shows that six learning modes were reported in previous research on EFL vocabulary learning (EFLVL): flashcards, games, dictionaries, animations, virtual reality, and others. Eighteen (35%) studies implemented mobile applications that included flashcards, such as Quizlet, Cram, Memrise, and Rememba. Ten (19.6%) studies used game-based applications, such as Detective ABC, VocabGame, and Game-based vocabulary learning APP. Very few studies used animations (N = 3; 5.9%) and virtual reality (N = 2; 3.9%) in EFLVL.

RQ 2: In what ways do smartphone applications designed for vocabulary learning impact learners' vocabulary learning process in EFL contexts?

H. Learning Impact of Mobile Applications on EFLVL

Figure 4 depicts the EFLVL impact through the use of mobile applications.

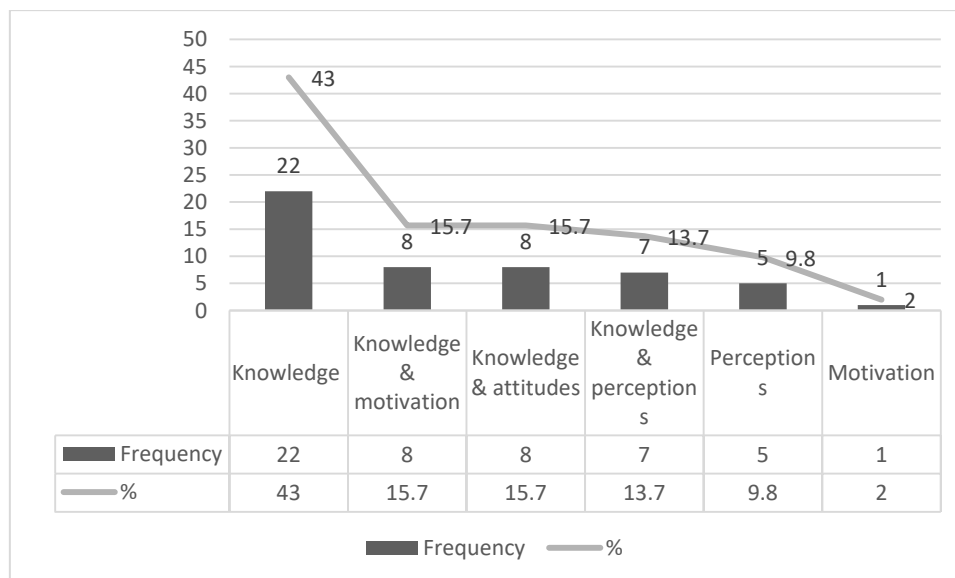


Figure 4 Learning Impact of Mobile Applications on EFLVL

It is revealed that 22 (43%) of the studies examined only the learners' knowledge gain of EFLVL through mobile applications. The knowledge aspect was investigated through the learners' performance and achievement in pre-post and delayed tests. Perceptions of EFLVL through mobile applications were explored in 12 studies whereas the motivational aspect of EFL vocabulary learning via mobile applications was examined in nine studies. Finally, learners' attitudes towards EFLVL via mobile applications were examined in eight studies.

The measurement of the reviewed studies' effect on learners' EFLVL progress can be seen in Figure 4 and is illustrated in four aspects: knowledge, motivation, attitudes, and perceptions. The majority of the reviewed studies agree on the learners' knowledge improvement levels in various aspects of the EFLVL process in spelling (Al-Malki, 2020; Hao et al., 2019), vocabulary retention (Alhuwaydi, 2020; Chen et al., 2019; Costuchen et al., 2020; Ma & Yodkamlue, 2019; Tai et al., 2020; Yüksel et al., 2020; Chen et al., 2020; Kohnke et al., 2020), learning idioms (Wu et al., 2021), pronunciation (Che Hashim et al., 2018; Hao et al., 2019), grammar and punctuation (Al-Wasy & Mahdi, 2016), learning collocations (Re Okumuş Dağdeler et al., 2020), meanings (Grami & Hashemian, 2017; Shen, 2013; Govindasamy et al., 2019; Çelik & Yavuz, 2017), and etymology of words (Fageeh, 2014). However, some reviewed studies reported no effects between the two modes of learning—traditional and mobile applications—in aspects of spelling and capitalization (Al-Wasy & Mahdi, 2016) or vocabulary retention (Chen & Chan, 2019).

Past research on the learners' use of mobile applications in the EFLVL process indicated that the learners were more motivated to learn vocabulary using mobile applications such as Mobile English Learning among Netherlands school students (Sandberg et al., 2014), mobile game-based English vocabulary practice systems among Taiwan students at university (Wu, 2018), VocabGame by Malaysian university students (Elaish et al., 2019), Quizlet among Indonesian school students (Setiawan & Wiedarti, 2020), game-based vocabulary learning APP by Chinese university learners (Li, 2021), VocaStyle by Turkish university students (Gürkan, 2018), Android Online Dictionary by Saudi university students (Fageeh, 2013), and Rememba by Turkish school students (Kose & Mede, 2018). Nevertheless, it was reported that the game-mode mobile applications did not motivate learners to spend more time learning EFL vocabulary, as revealed by Sandberg et al. (2014). Also, the Chinese university students' motivation did not predicate any improvement in their vocabulary knowledge perceived via a game-mode mobile application, as suggested by Li (2021).

Learners' attitudes towards using mobile applications to learn EFL vocabulary were examined in the reviewed studies. Findings revealed that the Taiwanese school learners felt relaxed and enjoyed the learning materials and the way of learning, considering the aspects of learning anytime and anywhere (Hao et al., 2019). Also, Chinese university learners enjoyed using a lexical spreadsheet application in vocabulary-learning activities (Wang et al., 2019). In addition, Online Dictionary was seen as being conducive to encouraging Saudi learners to learn word etymology (Fageeh, 2014).

Previous research has revealed positive perceptions of using mobile applications in the EFLVL process in association with the applications' usefulness and learners' intention to continue using Quizlet to learn vocabulary (Yükse et al., 2020), satisfaction with learning EFL vocabulary using game-based applications (Chen et al., 2019), provision of

information (Simanjutak, 2020), benefits of the practice, storage, and vocabulary teaching in and out of the class (Korlu & Mede, 2018), convenience and ease of use for vocabulary learning (Kose & Mede, 2018; Ma & Yodkamlue, 2019). However, the use of mobile applications for independent EFLVL learning may lack the human interaction needed for students' understanding and exchange of ideas (Simanjutak, 2020).

V. DISCUSSION

This review synthesized the impact of mobile applications designed for EFLVL between 2010 and 2021. The inclusion and exclusion criteria resulted in 51 studies chosen out of the original 146. The analysis targeted research features and the learning impact of mobile applications on the EFLVL process. Therefore, the study aimed to answer the following questions:

RQ 1. What are the research features of the reviewed studies on vocabulary learning-designed applications in EFL contexts?

The analysis has revealed that the level of university education was the researchers' main focus in examining the use of mobile applications in the EFLVL process. This may be an indication that using mobile applications to learn EFLVL requires learners to be mature enough to have some responsible and independent roles to enable them to learn on their own.

It was also found that quantitative research methods, such as tests and closed questionnaires, were widely used in past research on mobile applications in the EFLVL process. Tests were the most used instruments, as most past research explored learners' EFL vocabulary knowledge and retention through mobile applications. On the other hand, qualitative research methods were the least reported, appearing in only four studies.

In addition, the review found that only three continents have been very active in applying mobile applications in the EFLVL process. Asia stood first while Africa came last. Furthermore, it was revealed that 15 countries have been interested in EFL vocabulary learning via mobile applications. Turkey was reported as the most active country in terms of interest in researching the utilization of mobile applications to learn EFL vocabulary, followed by Taiwan and China in Asia. Oman and Thailand in Asia, the Netherlands and the Czech Republic in Europe, and South Africa in Africa are the least reported countries. These results may reflect the degree of interest these countries have in the importance of learning vocabulary mediated by mobile applications in EFL contexts as well as their keenness to employ cutting-edge technologies and keep pace with the times in developing EFLVL methods for the educational process.

As for the participants' gender in the reviewed studies, it was shown that male and female participants were mostly examined in the studies. However, a few studies conducted in countries such as Saudi Arabia and Iran, where their educational system is gender-segregated because of religious rules, had either exclusively male or female participants.

Moreover, the review showed that English subjects were mostly examined in past studies whereas non-English subjects such as arts, management, engineering, pharmacy, and statistics were the least explored in utilizing mobile applications for learning EFL vocabulary. Also, it was found that the majority of the examined research had a treatment period of between one and ten weeks, which may raise questions on the efficiency of mobile applications impacting the EFLVL process due to the short treatment period.

Finally, it was revealed that the mobile applications designed for EFLVL fall into two main categories: commercial applications (N = 12) and self-developed applications (N = 30). This classification leads to the efficient role of mobile applications. Also, it was revealed that self-developed mobile applications operate in a curriculum-based context whereas commercial applications were not part of the curriculum. The commercial applications outside the course context have raised issues related to students' boredom and decreased motivation due to the materials' lack of relativity to the course and assessments, especially in the treatments that last longer. Additionally, six learning modes were reported in previous research on EFL vocabulary learning (EFLVL): flashcards, games, dictionaries, animations, virtual reality, and others. Flashcard applications such as Quizlet were widely explored whereas animation and virtual reality were the least examined avenues in the EFLVL process.

RQ 2: In what ways do smartphone applications designed for vocabulary learning impact learners' vocabulary learning process in EFL contexts?

The analysis of past research on utilizing mobile applications in EFLVL showed that the process of vocabulary learning had been classified into four major areas: Knowledge, motivation, attitudes, and perceptions. The knowledge aspect was the most examined, whereas the attitude aspect was reported the least.

The learning impact of mobile applications in the EFLVL process was scrutinized, and the analysis revealed promising and positive effects of mobile applications if they are employed well. Learners witnessed tremendous improvements in EFL vocabulary knowledge such as spelling, retention, idioms, pronunciation, grammar, punctuation, learning collocations, meanings, and the etymology of words. Also, the learners were motivated to learn EFL vocabulary through mobile applications in various learning modes: flashcards, games, animations, and virtual reality. In addition, learners' attitudes toward using mobile applications in EFLVL were positive: Learners felt relaxed and enjoyed the learning materials and the way they learned, given the aspects of learning anytime and anywhere. Finally, the learners perceived mobile applications such as Quizlet in EFLVL as useful and interesting for learning vocabulary. Also, the learners were satisfied with vocabulary learning through game-based applications. Furthermore, mobile applications were appreciated for their provision of information, benefits of the practice, storage and vocabulary

teaching in and out of the class, convenience, and ease of use for vocabulary learning. The findings on the effectiveness of mobile technologies in supporting learners' vocabulary improvements in EFL contexts reported in this review are in line with Alzahrani (2015), who found positive impacts of employing mobile technology in EFL vocabulary development.

However, some aspects of the EFLVL process have seen no improvement, such as capitalization. Also, decreased motivation was reported in terms of spending more time using mobile applications to learn EFL vocabulary, and no correlation was shown between learners' vocabulary knowledge and motivation. The lack of the human interaction needed for understanding and exchange of ideas was perceived as one of the drawbacks of mobile applications for EFL vocabulary acquisition.

VI. CONCLUSION

This review has examined the role of mobile applications designed for learning vocabulary on various EFLV-associated aspects such as knowledge, motivation, attitudes, and perceptions. It has also reviewed major research features such as educational level, instruments, context, gender, course subject, treatment period, and the mode and type of mobile applications. This review suggests an increasing role for specifically designed mobile applications for EFL vocabulary learning, which has been proven by past research. This result encourages stakeholders to invest more in such learning technologies, to flow with the current latest educational methods. Also, the review has highlighted the issue of integrating authentic learning materials provided through mobile applications as part of the learners' curriculum to encourage them to learn and avoid boredom. Another important issue is that teachers should guide their students to use mobile applications effectively to achieve the maximum benefit of vocabulary learning.

More research on meta-analyzing the impact of experimental studies on integrating mobile applications in EFLVL is recommended. Also, further investigation on utilizing mobile applications in EFLVL is suggested in Africa and South America, due to the lack of studies there. In addition, future studies exploring animations and virtual reality applications are emphasized. Finally, more focus should be placed on improving the learners' independent vocabulary learning skills mediated by mobile applications.

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