

REVIEW

Open Access



A systematic review of Mobile-Assisted Vocabulary Learning research

Kübra Okumuş Dağdeler*

*Correspondence:
kokumus@cumhuriyet.edu.tr

English Language Teaching, Sivas
Cumhuriyet University, Faculty of
Education, Sivas, Türkiye

Abstract

With rapid development of mobile technology, the number of researches on its use in language education process has increased. This growing body of interest has led to a need for review studies that are expected to explain the literature and the trend in the field succinctly. Based on this ground, this study aimed to review the studies conducted on mobile-assisted vocabulary learning in two dimensions. Firstly, it tried to reveal a general map of the domain through bibliometric analysis. With this aim, Web of Science database was scanned and 687 publications were included in the analysis. Then, among these publications 19 articles were selected to identify the technological and pedagogical focus of research papers to determine the trend. The results of bibliometric analysis explained the most frequent keywords, the most productive countries, and the most influential authors and articles. Furthermore, it was discovered that achievement and perceptions were the most common topics in terms of language learning focus and it was gamification in the dimension of technological focus in empirical studies. Despite its preliminary character, the findings have provided insights for future studies.

Keywords: Mobile learning, Vocabulary, Review, Bibliometric

Introduction

Mobile-Assisted Language Learning (MALL) has become a popular topic for researchers after the intense utilization of mobile devices. As mobile devices have provided flexibility in all areas of life including education, mobile learning has become more of an issue both in practice and research. Burston (2021) states that there are approximately 3000 research studies related to Mobile-Assisted Language Learning. There are different reasons for this embracement of MALL. To start with, people prefer using mobile devices in their daily life for various purposes such as learning and exchanging information, making orders, banking, communicating with people, and entertaining. Thus, it can be beneficial to use this interest in mobile devices for language education since learning through mobile devices can provide motivation and entertainment for learners. Secondly, mobile learning is defined as “anytime and anywhere” (Kukulska-Hulme & Shield, 2008), so it provides flexibility in educational processes. Some characteristics of e-learning such as the portable size of mobile tools, and learning that is ubiquitous/spontaneous, blended, private, interactive and collaborative, and instant information (Özdamlı & Çavuş, 2011)

are another key point that keeps the MALL on the agenda. On the other hand, there are limitations such as small screen size, limited functions of mobile devices, cost of the devices, low battery life, and the problem of storing big data (Al-Said, 2015; Aygül, 2019; Fujimoto, 2012). However, new developments in technology have already minimized some of these problems. As a teacher, I observe that students no longer need any printed materials in the course. They use just their mobiles rather than books, dictionaries or any other printed materials. Moreover, devices such as smartphones have become more affordable. On the other hand, challenges such as differentiated access to devices and the internet, the problem of monitoring, and the ways of using the tools impact their effectiveness (McQuiggan et al, 2015) still present.

Review studies on MALL

Research on MALL generally concentrates on the effects of mobile technology use in English as a Foreign Language/ English as a Second Language (EFL/ESL) and Second Language Acquisition (SLA), teachers' and learners' perceptions/views on MALL and the effect of MALL on acquiring language skills (Yükselir, 2017). As there is a growing body of research, reviews that highlight the research trends and summarize the outcomes related to MALL systematically have gained importance. We can encounter MALL systematic review studies from 2010s to today in literature. The earlier review studies mainly tried to respond to the question of which areas and language skills were mostly studied in previous research. For instance; Duman et al. (2015) analyzed Social Science Citation Index (SSCI) indexed journals and found that the topics examined within the scope of MALL were vocabulary, grammar, listening, speaking, pronunciation, reading, writing, integrated skills, dictionary use, assessment/evaluation, multimedia use, instructional design, usability, potential drawbacks, collaboration, perception, and achievement. Burston (2015) found out that vocabulary, reading, listening, and speaking were the skills that were mostly studied. Similarly, Darmi and Albion (2014) and Li et al. (2022) indicated that the most popular language area in MALL studies was vocabulary. The researchers mostly preferred testing the effectiveness of mobile devices in the abovementioned areas. Liu et al. (2016) used text analysis on 24 articles in WoS database and the results supported that researchers were interested in testing the effectiveness and efficiency of mobile devices.

Later review studies tend to be more interested in affective behaviors such as motivation, attitude, and perception. Liu (2020) concluded that perception/motivation/attitude and comprehensive ability were the most popular topics among MALL researchers. On the other hand, this finding contradicts with the study of Che Mustafa and Sailin (2022) and Zain (2021) that emphasized that research regarding the effect of MALL on English performance was still trendy. However, the context was limited to Malaysia and 11 articles (Che Mustafa & Sailin, 2022) and 25 empirical studies (Zain, 2021) which directly sought the effect of interventions. Shadiev et al. (2020) reviewed the articles published between 2009 and 2018 to examine the research on MALL in familiar environments. They found that task-based learning and communicative language teaching, questionnaires, pretest and posttests, and interviews were the most frequent items. Penelope and Panagiotis (2021) examined the MALL trends between 2010 and 2020 by using text

analysis. The analysis of 340 publications showed that the most frequent words in the texts were learning, mobile, language, assisted, English, students, and MALL.

Although there are some meta-analyses (Taj et al, 2016; Peng et al., 2020; Burston & Gianakou, 2022) or synthesis studies (e.g. Yükselir, 2017) of MALL in literature, there is little emphasis on the bibliometric analysis of the field. However, bibliometrics is suitable for summarizing and highlighting the research trends, which is important since there are many studies on MALL (Khodabandelou et al., 2022). Moreover, many review studies are confined to a limited number of studies while bibliometrics requires analysis with big data. Bibliometric analysis is also helpful for finding research areas through key word and abstract analysis, and the most influential papers, journals and authors. This type of information reveals the foci and trends of the related field and the contribution of the countries, authors and journals to such field (Andres, 2009). Moreover, it helps researchers find new research topics, journals, and authors that they may encounter during their literature review processes. Despite its contributions to the field there is little bibliometric research on MALL. Khodabandelou et al. (2022) examined English Mobile Learning and highlighted the most cited papers and authors, and research areas. Feng and Chen (2022) also conducted a bibliometric analysis on Mobile-Assisted Second Language Learning and found out that the most popular research areas were vocabulary, personalized learning, learning environment, and learner attitudes.

Being one of the most important parts of learning a language, vocabulary is considered one of the areas that attract much attention in MALL research. As Wilkins (1972) stated; “without grammar very little can be conveyed, without vocabulary nothing can be conveyed (p. 11–112). Hence, this dense interest in vocabulary is understandable. Moreover, mobiles save us from carrying heavy dictionaries. The aforementioned review studies also support the interest in Mobile-Assisted Vocabulary Learning (MAVL, hereafter). The role of utilizing m-learning for vocabulary learning has made the review of topic inevitable (Afzali et al., 2017). In their meta-analysis study, Lin and Lin (2019) discovered a large effect size, which meant that MAVL affected the language learning process positively. For these reasons, the nature and trends of MAVL research were examined in this study through bibliometric and thematic analysis. A thematic/content analysis of MAVL studies would be beneficial for understanding the field in detail and it would provide information on some features of the study such as sampling, methodology and aim. However, there is a scarcity of qualitative analysis on MAVL. Moreover, an existing study in the literature (Pang & Aziz, 2021) was based on the aspects such as sampling, technological tools, country, and data sources. In this study, sampling and technological focus were also analyzed since the previous articles were different due to the differentiated inclusion and exclusion criteria (e.g. this study used only WoS database and empirical studies while the mentioned study had a variety of databases and no exclusion criteria in terms of the nature of the study). Besides, the tools and the technological focus imply different meanings as this study went beyond giving the name of mobile applications but also the specific feature of applications as well. Furthermore, this study included the aspect of language learning to see which learning domains were studied. This information will enable researchers to see the gap in language learning areas regarding mobile learning. Based on these rationales and since there is no bibliometric research on MAVL (to my knowledge), this study aimed at firstly showing a general map of MAVL research

and an in-depth analysis of empirical studies which are mostly studied in MAVL. The research questions were as follows:

- (1) What are the bibliometric features such as the most frequent keywords, the most productive countries, and the most influential authors and articles regarding MAVL research?
- (2) What are the technological and language learning foci and sampling of MAVL research?

Method

The methodology of the research was explained within the context of two research questions which were tried to be responded in two dimensions.

Bibliometric mapping

Web of Science core collection was used as a source of data as it includes more qualified research. The query of (Mobile AND language AND learn* AND vocabulary or Word or lexeme or lexicology) was set to the topic section of WoS on 18th April 2022, which resulted in 687 publications. Any exclusion/inclusion criteria were not applied in this phase since it was targeted to show a general map of MAVL research. The distribution of the research over the years was shown in Fig. 1:

The figure shows that the first MAVL research in WoS was published in 2002, while the most productive year was 2019. It should be also noted that more and more studies have been conducted over the years. The other features of publications such as document types and languages of publications can be seen in Table 1:

It is seen that most of the publications were in English as it is all known that English is the lingua franca. Moreover, researchers mostly prefer articles rather than other types of publications (see Table 1).

Thematic analysis

For the second dimension of the study, some inclusion criteria were applied. Firstly, articles written in English were chosen and it resulted in 360 publications. Then, the

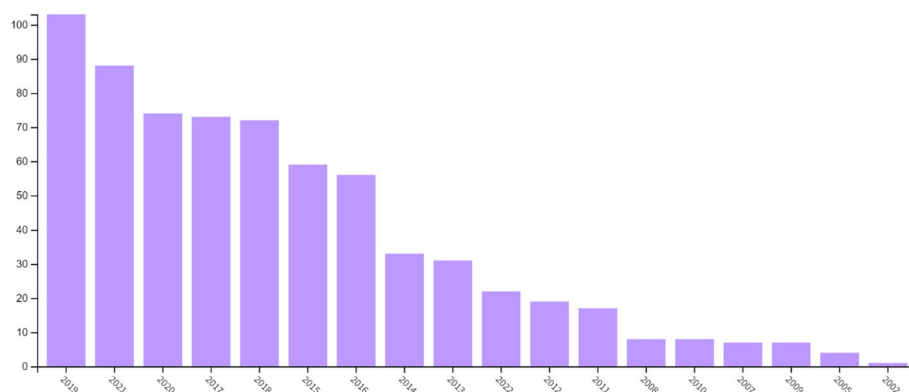


Fig. 1 Years of publication

Table 1 Profile of data set

Document types	F	Languages	F
Articles	365	English	670
Proceedings papers	286	Portuguese	5
Early access	36	Russian	2
Review articles	30	Ukraine	2
Book chapters	5	German	1
Editorials materials	2	Spanish	1
Data papers	1	Turkish	1
New items	1		
Total	687	Total	687

Table 2 The most productive journals

Journal	F
Computer—Assisted Language Learning	26
ReCALL	17
Language Learning Technology	11
Computers & Education	10
Educational Technology & Society	10
Total	74

most productive five journals which were indexed in Social Science Citation Index were selected as there were more studies on the topic and these journals had higher impacts. Moreover, it would not be appropriate and practical to include hundreds of papers in a qualitative analysis, so a narrowing in terms of number of publications was applied and 74 articles were determined. The journals and number of MALL articles listed in WoS scanning were shown in Table 2: 74 articles were read in detail and some inclusion criteria were applied. Such inclusion criteria and reasons were given below:

- Focus on foreign/second language learning: acquiring first language and a second/foreign language is different.
- Related to only MALL: there were some articles on general technology usage (e.g. perceptions and meta-analyses on technology usage including all devices)
- Directly focus on vocabulary: as vocabulary is an integral part of communicative skills, research studies including also these skills existed in the WoS search results. However, the focus of this study was vocabulary learning/teaching.
- The empirical studies: only empirical studies were included since they were more popular in MAVL research and contributed much to the observed and measured experience or experiment with research questions, sampling, data collection and analysis, and findings that are studied (Goodwin, 2005) meticulously.

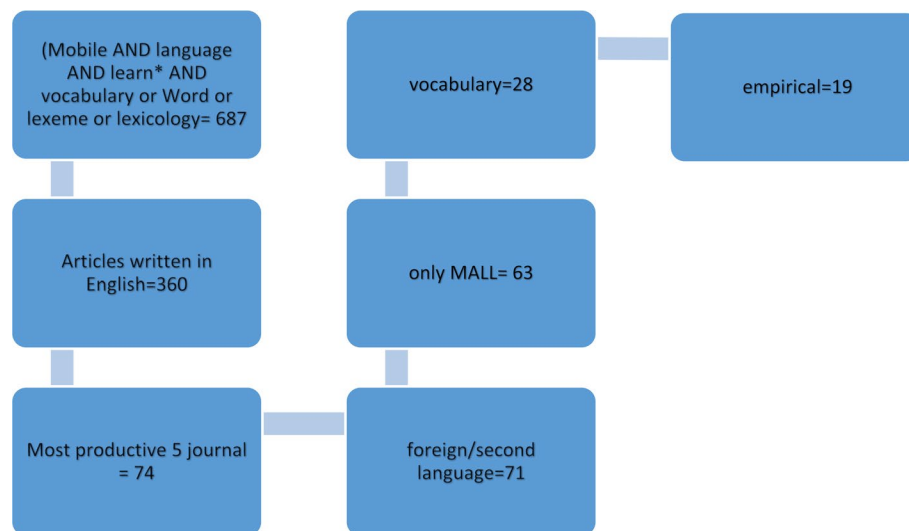


Fig. 2 Process

Based on these criteria, 19 articles were finally included in the analysis (see Fig. 2).

Data analysis

In the first phase, the bibliometric mapping approach was adopted since it “applies quantitative methods to a body of literature to arrive at an understanding of the communication patterns, trends and networks occurring in the literature” (Haddow, 2013; p. 219). To analyze data, the VOSviewer, a social network analysis program, was used. VOSviewer is “developed specifically for analyzing and visualizing bibliometric networks” (van Eck & Waltman, 2014; p.292). The most frequent keywords, the most productive countries, and the most cited authors and articles were analyzed through VOSviewer. To respond to the second research question which was “what are the technological and language learning foci and sampling of MAVL research?”, 19 articles (see Appendix) were read and analyzed through thematic analysis.

Findings

The findings were presented regarding the research questions.

What are the bibliometric features such as the most frequent keywords, the most productive countries, and the most influential authors and articles regarding MAVL research?

As a result of WoS scanning, 687 articles were analyzed and results were presented below.

The most frequent key words

In order to determine the keywords that authors mostly prefer, co-occurrences of author keywords were analyzed. As there were 1901 keywords that the authors used, the minimum number of occurrences of a keyword was adjusted to 10. As a result, there existed five clusters with 29 keywords (see Table 3).

Table 3 The most frequent key-words

Clusters	Items
Cluster 1	CALL (f = 15), computer-assisted language learning (f = 13), EFL (f = 16), foreign language learning (f = 11), MALL (f = 35), mobile apps (f = 10), mobile-assisted language learning (f = 32), mobile assisted language learning (f = 15), technology (f = 17), vocabulary (f = 30), vocabulary acquisition (f = 10)
Cluster 2	Augmented reality (f = 10), English learning (f = 10), game-based learning (f = 14), gamification (f = 16), language learning (f = 57), motivation (f = 12)
Cluster 3	Deep learning (f = 14), machine learning (f = 17), mobile application (f = 20), mobile technology (f = 14), natural language processing (f = 20)
Cluster 4	Mobile assisted language learning (MALL) (f = 11), mobile devices (f = 15), mobile learning (f = 119), vocabulary learning (f = 43)
Cluster 5	E-learning (f = 20), m-learning (f = 17), mobile applications (f = 16)

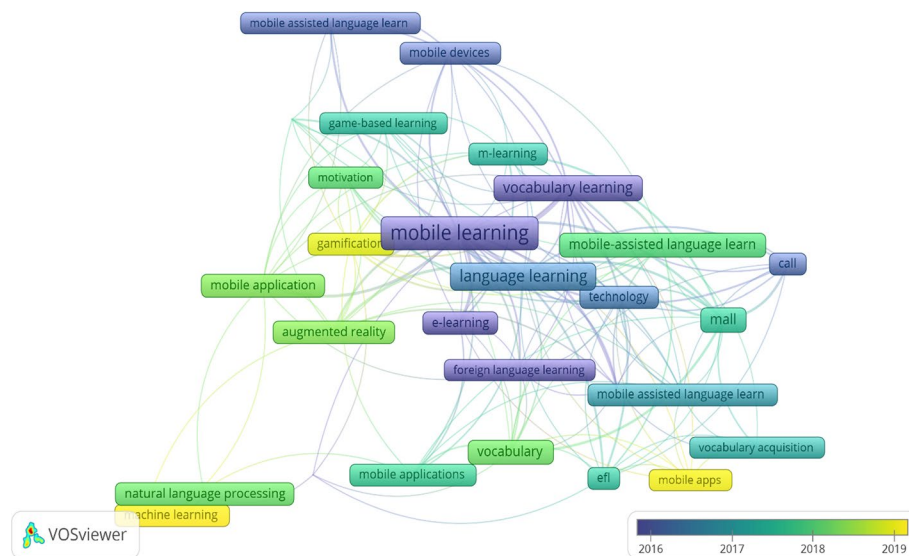
**Fig. 3** The most frequent keywords

Table 3 points out that the most frequent keywords were mobile learning ($f = 119$), language learning ($f = 57$), and vocabulary learning ($f = 43$). It was observed that different names such as MALL, Mobile-Assisted Language Learning, and Mobile Assisted Language Learning (MALL) were used for the same concept. The same finding can be noted also in the dimensions of vocabulary (e.g. vocabulary, vocabulary learning and vocabulary acquisition), and language learning (e.g. EFL, foreign language learning, English learning, language learning).

The network and distribution of keywords over the years can be seen in Fig. 3.

Figure 3 indicates some changes over years. Although there is no rigid discrimination among years, some differences can be observed. The terms such as foreign language learning, vocabulary learning and mobile assisted language learning were preferred in 2016. On the other hand, the terms such as augmented reality, m-learning, mobile application, and game-based learning were more popular in 2017–2018. Finally, the most recent keywords were determined as gamification, machine learning, and mobile apps.

The most productive countries

While examining the most productive countries, the minimum number of documents of an author was determined as 5, while the minimum number of citations was adjusted to 2. The results were presented in Fig. 4.

As it can be seen from Fig. 4, the most productive countries were the USA ($f=104$), China ($f=92$), Taiwan ($f=72$), Turkey ($f=34$), and Japan and Malaysia ($f=31$) in terms of number of publications. As for the collaboration among the researchers, again the USA was the leading country as it had collaboration with 17 countries. England ($f=12$) was the second country and China ($f=10$) was the third country that works in international research studies.

The most influential authors

The minimum number of citations of an author were set to 50 to determine the most co-cited authors. The results can be seen in Fig. 5.

It was observed that the most influential authors were Agnes Kukulska-Hulme (f=226), Chih-Ming Chen (f=124), Patricia Thornton (f=116), Glenn Stockwell (f=106), and Robert Goodwin Jones (f=100). The networks indicated that there were three clusters which were blue, green and red. There were researchers that study on mobile learning in blue cluster, while the red cluster included both researchers such as Batia Laufer, Paul Nation, Norbert Schmitt studying vocabulary, and Michael Levy, Glenn Stockwell, Nadire Çavuş, and Patricia Thornton studying technology. The green cluster included researchers interested in utilizing mobile devices for language learning.

The most influential articles

The co-citation analysis was conducted and the most cited ten articles were found. The information regarding the articles and citation numbers in the reviewed articles were presented below.

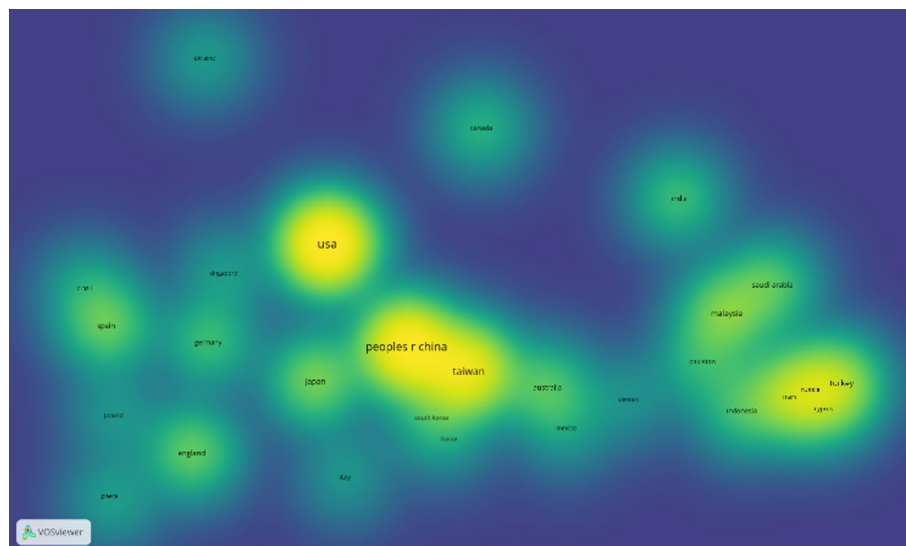


Fig. 4 The most productive countries

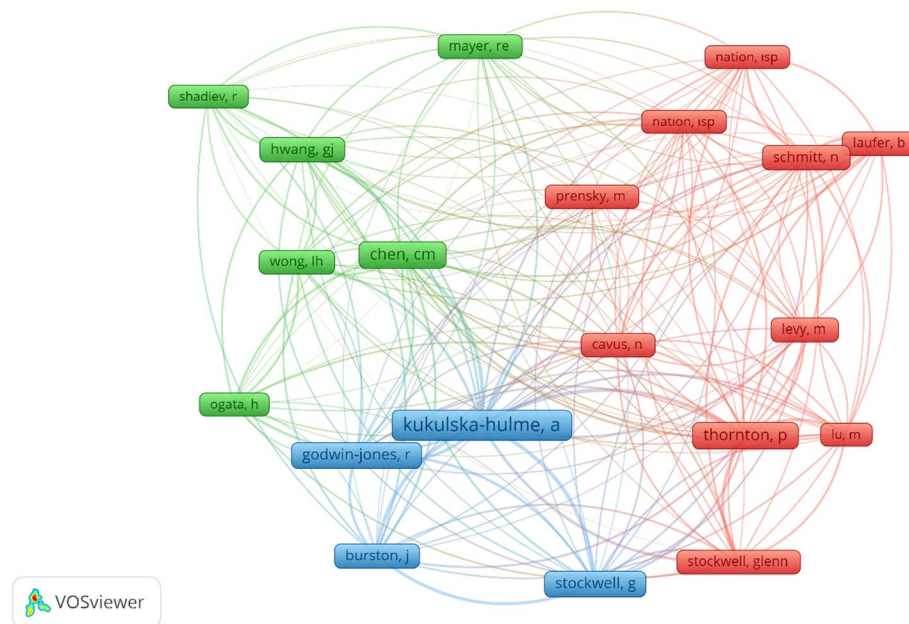


Fig. 5 Co-cited authors

Table 4 Influential articles

Authors	Name of Article	Year	Publisher	Citations
P. Thornton, P., & C. Houser	Using mobile phones in English education in Japan	2005	Journal of Computer-Assisted Learning	76
A. Kukulska-Hulme & L. Shield,	An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction	2008	ReCALL	66
M. Lu	Effectiveness of vocabulary learning via mobile phone	2008	Journal of Computer Assisted Learning	54
G. Stockwell	Using mobile phones for vocabulary activities: Examining the effect of the platform	2010	Language Learning & Technology	52
A.Kukulska-Hulme	Will mobile learning change language learning?	2009	ReCALL	49
G. M. Chinnery	Going to the MALL: Mobile Assisted Language Learning	2006	Language Learning & Technology	47
I.S.P.Nation	Learning vocabulary in another language	2001	Cambridge University Press	47
C-M.Chen & Chung, C-J	Personalized mobile English vocabulary learning system based on item response theory and learning memory cycle	2008	Computers & Education	41
R. Goodwin Jones	Mobile Apps for Language Learning	2011	Language Learning & Technology	40

According to Table 4, the most influential article belonged to Thornton and Houser (2005) with 76 citations followed by Kukulska- Hulme and Shield (2008) (n = 66), and Lu (2008) (n = 54).

What are the technological and language learning foci and sampling of MAVL research?

To answer this research question, 19 articles were examined and the findings were presented below.

Technological focus: According to the results, the types of mobile systems and features showed variety. While 9 (A3, A6, A7, A8, A11, A14, A15, A17, A19) articles included systems developed by the researchers, the rest of researchers used existing applications such as Duolingo (A18), Pokemon Go (A13) and Mondly (A10). Furthermore, researchers focused on different aspects of systems such as games, texting, augmented reality, concept mapping, mind-mapping, mobile-based cards, HMD, situational learning, self-regulation, image-to-text, artificial intelligence, and concept mapping. Gamification was the most preferred feature. (A4, A7 A17, A18) (see Table 5).

Language Learning focus: The findings showed that nearly all of the articles were concerned with vocabulary achievement (see Table 5). Only one article (A7) chose self-assessment of vocabulary abilities as the basis. Learners' attitudes, perceptions and satisfaction on/with the systems were the second behaviors on which the researchers concentrated mostly. Some studies examined other affective components such as motivation (A8, A11, A14), satisfaction (A13), and self-efficacy (A16, A18).

Sampling: It is possible to see participants from elementary level (A11, A14, A15, A17, A18, A19), secondary education (A10), high school (A2), and higher education (A1, A3, A4, A5, A6, A7, A8, A9, A12, A13, A16). However, it is noteworthy that higher education had the highest frequency, followed by elementary school. As for the countries where interventions were conducted, five countries which were Taiwan, China, Canada, the USA, and Netherlands came prominent (see Table 5).

Discussion

The focus of this research was twofold; the first objective was to identify the bibliometric mapping of MAVL and the second was to find the nature and trend in empirical studies. Both of these dimensions shed some light on the area of interest. The results were discussed in line with the previous research on MALL as MAVL review studies are scarce.

Mobile learning, language learning, and vocabulary learning were the most frequent keywords according to the VOSviewer analysis. This indicates some similarity with the study of Penelope and Panagiotis (2021) that examined the MALL trends between 2010 and 2020 by using text analysis. Their analysis of 340 publications showed that the most frequent keywords in the corpus were learning, mobile, language, assisted, English, students, and MALL. This study also explained that there was a shift in keywords over the years. Regarding the use of educational technologies, terms like augmented reality, machine learning and gamification have acquired more place in research. This finding can be supported with the results of the second dimension of this study which presented that gamification was the most common feature in the reviewed articles. This finding suggests that the number of topics in MAVL research are increasing. This increase may be associated with the development of technology and pedagogy. For instance, the technology of augmented reality and its use for educational purposes is more current. At the beginning of MAVL research, features such as Short Message Service (SMS) and Multimedia Message Service (MMS)

Table 5 Themes of reviewed articles

Number	Article	Technological focus		Pedagogical focus	Sampling	
		Application	Feature (if specified)		Level	Country
A1	Li & Hafner (2022)	Zhimi	Mobile-based word cards	Achievement and attitudes	Higher education	China
A2	Shi & Tsai (2022)	Simple Mind	Mind-mapping	Achievement and learners perspectives	High school	Taiwan
A3	Wu (2015)	Word Learning-CET6 (developed by the researcher)		Achievement	Higher education	China
A4	Chen, Liu & Huang (2019)	Phone words	Gamification	Achievement and perceptions	Higher education	Taiwan
A5	Li & Cummins (2019)	Word Matters	Texting (direct and transfer effect)	Achievement	Higher education	Canada
A6	Chen & Chung (2008)	System developed by researchers	Personalization through Item response Theory	Self-assessment of vocabulary abilities and learners' satisfaction	Higher education	Taiwan
A7	Wu & Huang (2017)	System developed by the researchers	Gamification	Achievement and learners' behaviors	Higher education	Taiwan
A8	Wang et al. (2020)	System developed by the researchers	Contribution-oriented self-directed mobile learning Ecology model	Achievement, motivation, learner perceptions and satisfaction	Higher education	China
A9	Liu (2016)	Instant messaging	Concept mapping and text only	Achievement	Higher education	Taiwan
A10	Tai, Chen & Todd (2022)	Mondly VR	Mobile-rendered HMD	Achievement and perception	Secondary school	Taiwan
A11	Huang et al. (2016)	System developed by the researchers	Situational	Achievement and motivation	Elementary school	Taiwan
A12	Li, Ji, & Deng (2021)	Text messages		Achievement	Higher education	Canada
A13	Wu (2021)	Pokemon Go	Augmented reality	Attitudes, satisfaction, achievements	Higher education	Taiwan
A14	Chen, Chen & Yang (2019)	English vocabulary learning app with a self-regulated learning mechanism (EVLAPP-SRLM)-developed by the researchers	Self-regulation	Achievement and motivation	Elementary school	Taiwan
A15	Shadiev, Wu & Huang (2020)	System developed by the researchers	Image-to-text recognition	Achievement, perceptions, affordances	Elementary school	Not specified

Table 5 (continued)

Number	Article	Technological focus		Pedagogical focus	Sampling	
		Application	Feature (if specified)		Level	Country
A16	Hanson & Brown (2020)	Anki	Spaced repetition	Achievement, self-efficacy, motivation, quick learning belief, study strategy	Higher education	USA
A17	Sandberg, Maris & Hoogendoorn (2014)	Mobile English Learning (developed by the researcher)	Artificial intelligence and gamification	Achievement	Elementary school	Netherlands
A18	Rachels & Rockinson-Szapkiw (2018)	Duolingo	Gamification	Achievement and self-efficacy	Elementary school	USA
A19	Sandberg, Maris & Geus (2011)	Mobile English Learning (developed by the researcher)-		Achievement	Elementary school	Netherlands

were benefited in understanding mobile language learning and general terms such as mobile learning and MALL were preferred. However, some new features such as gamification and augmented reality have found place in mobile learning research after the mobile devices have been updated. Hence, there is a real variety of features that will be examined within the scope of MALL. For instance, machine learning has been popular in different fields recently and this popularity has reflected on also MAVL research. This finding also highlights the emerging areas and potential subjects for researchers.

The most productive countries were determined as the USA, China and Taiwan in bibliometric analysis. Similarly, the review of sampling in the empirical studies indicated that the interventions were conducted in mainly Taiwan, China, the USA, Canada, and Netherlands. Although there are some minor differences in the countries and their order, the findings of bibliometric and thematic analysis had parallel findings. This finding is also parallel with the previous research. For instance, Khodabandelou et al (2022) also found that the most productive countries in MALL research were China, the USA and Taiwan. The USA is the leading country in terms of contributing mobile technology publications (Kumar & Kaliyaperumal, 2015). The statistics show that smartphone usage is highest in China, followed by India and the USA (Statista, Wikipedia). This high rate of use may be one of the reasons explaining the number of research in these countries as research is affected by the situations and policies in the countries. Furthermore, it is important that the learners have mobile technologies for conducting MALL research especially for experimental studies. Secondly, both the USA and China have necessary infrastructure and lots of resources for research. Lastly, international collaborations are essential for research as it provides more global and general data.

The results on the most influential authors and articles did not differ from what the researchers had already known intuitively. It is possible to say each researcher

who steps into the world of m-learning and MALL has encountered the names of professors Agnes Kukulska-Hulme while this name is Paul Nation, Norbert Schmit and Batia Laufer in vocabulary. The findings of this study supported this intuitive knowledge. The field owes to these scholars as they contributed much to the fields of vocabulary and mobile learning. The definition of mobile learning which is “anytime anywhere” learning (Kukulska-Hulme & Shield, 2008) has provided great assistance in the conceptualization of mobile learning. It was found that Agnes-Kukulska Hulme was the most cited researcher while the most cited article belonged to Patricia Thornton in this study. This finding contradicts with Khodanadelau et al. (2022) that concluded that the most influential papers belonged to Wu et al. (2013), Gikas and Grant (2013) and Wang et al. (2009). The main reason of this difference may be the dimension of vocabulary added in this study. Khadabandelou et al. (2022) examined publication on general English Mobile Learning while the center of this study was vocabulary learning.

Most of the empirical studies examined within the scope of this study went beyond focusing on the applications as a whole and took one or two features as basis in their interventions. Moreover, researchers preferred designing their own systems of vocabulary teaching and tested their effectiveness and then searched learners’ perspectives and satisfaction on these systems. Pang and Aziz (2021) highlighted that researchers benefited from mostly existing commercial applications while it was found that researchers generally developed their own applications in this study. This finding can be a result of using different databases. Only WoS was included in this study and it is assumed that WoS could have more comprehensive articles. Secondly, Short Message Services (SMS), Multimedia Message Services (MMS), and mobile applications were the popular aspects in the review study of Lin and Lin (2019). They investigated the studies conducted between 2005 and 2018. However, this study did not apply any inclusion criteria related to date, which resulted in the inclusion of the most recent articles (e.g. 2022). The finding of this study that foresees different applications and different features such as gamification and augmented reality did not totally contradict with the previous findings as there were a few studies that examined messaging.

Although mobile devices are used by people from different age groups, teenagers are more keen on them. Based on this interest, the digital literacy of teenagers and policies, it is possible to say MALL is more utilized in higher education. In addition, mobile learning requires more autonomous learning compared to the traditional learning approaches as it is independent from place and time. Young learners need more scaffolding of teachers than university students and may have more difficulty in learning English autonomously. Thus, it is possible for researchers to think that mobile learning work better in higher education. Another reason might be the fact that researchers work generally in higher education so it is easier to conduct research in the place where they work. Moreover, using smartphones is forbidden in some K12 schools and these schools have stricter curricula which may limit mobile integration. 11 of the studies investigated in this study were about MAVL in higher education. Higher education is the most common educational level in MALL research (CheMustaffa & Sailin, 2022).

Recent studies of MALL are more related to the affective behaviors and attitudes/perception scales (Shadiev et al., 2019; Liu, 2020). This study both contradicts with and

supports the previous research. It contradicts as nearly all of the studies examined in this study focused on learners' vocabulary achievement. On the other hand, most of the studies were also interested in learners' opinions and satisfaction on/with the applications. In many countries, the educational policies attribute more importance to achievement than any other behaviors. Thus, it is understandable that research that is both affected and affects the practice is parallel with it. More, many studies are experimental. It is known that testing the achievement is easier and more objective than testing affective behaviors as measurement of dimensions such as perception, attitude, and motivation relies mainly on self-evaluation of learners. This practicality of achievement tests can be one of the reasons of focusing on cognitive process. Besides, changing affective behaviors of individuals needs more time, which requires longer treatment.

Conclusions

Despite its preliminary character, this study concluded with some important findings, which can show a path of what to study within the context of MAVL to the researchers. Furthermore, it shows that MAVL is an area that involves a large area to explore. Based on the keyword and thematic analysis, it can be concluded that there is limited variety in the topics studied in MAVL. Besides, there is a lack of international collaborations among researchers, which may yield a limitation for the development of research. Based on these findings, researchers are suggested to seek more collaboration and find untouched areas of MAVL. The findings do not have implications for just researchers but also for practitioners. The analysis illustrates which applications and aspects to be used in vocabulary learning. Both teachers and learners may have an insight for the technological and pedagogical features used in language learning process. For instance, teachers may prefer utilizing gamification both in classroom and out of classroom and make learners play vocabulary games with their mobile devices during or after the course. This will help increase their motivation and learn with fun. Moreover, learners may feel in an authentic context of an English speaking country thanks to virtual reality. The learners can obtain the highest efficiency in their vocabulary learning process by using appropriate technical feature and pedagogical approach. Although this study contributed to the review of MAVL, which has been little discussed in literature, it is not free from weaknesses. Firstly, the bibliometric analysis was restricted to the just WoS database. Inclusion of other databases will result in much more studies, leading to an in-depth analysis of the field. Secondly, 19 studies were chosen based on the inclusion criteria such as articles and empirical studies in the second dimension. On the other hand, other publication types such as book chapters and conference proceedings may provide various views of points. Finally, the inclusion criteria and themes were subject to the researchers' own preferences.

Within the light of these limitations of this research and the gaps in the literature, it is suggested that more review research to be conducted on vocabulary learning through mobile learning. The previous MALL review studies reveal that vocabulary has generated wide interest in MALL research studies. However, this interest was not observed in the review studies. Thus, more MAVL review studies using different methods of analysis and datasets may be produced.

Appendix (List of the articles, n = 19)

Chen, C. M., & Chung, C. J. (2008). Personalized mobile English vocabulary learning system based on item response theory and learning memory cycle. *Computers & Education*, 51, 624–645. <http://dx.doi.org/10.1016/j.compedu.2007.06.011>.

Chen, C-M. Chen, L-C. & Yang, S-M. (2019) An English vocabulary learning app with self-regulated learning mechanism to improve learning performance and motivation, *Computer Assisted Language Learning*, 32 (3), 237–260, <https://doi.org/10.1080/09588221.2018.1485708>

Chen, C., Liu, H., & Huang, H. (2019). Effects of a mobile game-based English vocabulary learning app on learners' perceptions and learning performance: A case study of Taiwanese EFL learners. *ReCALL*, 31(2), 170–188. <https://doi.org/10.1017/S0958344018000228>

Hanson, A. E. S. & Brown C. M. (2020). Enhancing L2 learning through a mobile assisted spaced-repetition tool: an effective but bitter pill?, *Computer Assisted Language Learning*, 33, (1)2, 133–155, <https://doi.org/10.1080/09588221.2018.1552975>

Huang, C. S. J., Yang, S. J. H., Chiang, T. H. C., & Su, A. Y. S. (2016). Effects of situated mobile learning approach on learning motivation and performance of EFL Students. *Educational Technology & Society*, 19 (1), 263–276.

Li, J. & Cummins, J. (2019). Effect of using texting on vocabulary instruction for English learners. *Language & Learning Technology*, 23 (2), 43–64.

Li, Y., & Hafner, C. (2022). Mobile-assisted vocabulary learning: Investigating receptive and productive vocabulary knowledge of Chinese EFL learners. *ReCALL*, 34(1), 66–80. <https://doi.org/10.1017/S0958344021000161>

Li, J., Ji, L. & Deng, Q. (2021). The heterogeneous and transfer effects of a texting-based intervention on enhancing university English learners' vocabulary knowledge. *Computer Assisted Language Learning*, <https://doi.org/10.1080/09588221.2021.1900264>

Liu, P-Lin. (2016). Mobile English vocabulary learning based on concept-mapping strategy. *Language Learning & Technology*, 20(3), 128–141. <http://dx.doi.org/10125/44485>

Rachels, J. R. & Rockinson-Szapkiw, A. J. (2018). The effects of a mobile gamification app on elementary students' Spanish achievement and self-efficacy, *Computer Assisted Language Learning*, 31 (1)2, 72–89, <https://doi.org/10.1080/09588221.2017.1382536>

Sandberg, J., Maris, M. & Hoogendoorn, P. (2014). The added value of a gaming context and intelligent adaptation for a mobile learning application for vocabulary learning. *Computers & Education*, 76, 119–130. <https://doi.org/10.1016/j.compedu.2014.03.006>.

Sandberg, J., Maris, M. & de Geus, K. (2011). Mobile English learning: An evidence-based study with fifth graders. *Computers & Education*, 57 (1), 1334–1347, <https://doi.org/10.1016/j.compedu.2011.01.015>.

Shadiev, R., Wu, T., & Huang, Y. (2020). Using image-to-text recognition technology to facilitate vocabulary acquisition in authentic contexts. *ReCALL*, 32(2), 195–212. <https://doi.org/10.1017/S0958344020000038>

Tai, T-Y., Chen, H. H-J. & Todd, G. (2022) The impact of a virtual reality app on adolescent EFL learners' vocabulary learning. *Computer Assisted Language Learning*, 35(4), 892–917, <https://doi.org/10.1080/09588221.2020.1752735>

Wang, Z., Hwang, G.-J., Yin, Z., & Ma, Y. (2020). A Contribution-Oriented Self-Directed Mobile Learning Approach to Improving EFL Students' Vocabulary Retention and Second Language Motivation. *Educational Technology & Society*, 23 (1), 16–29.

Wu, M.-H. (2021). The applications and effects of learning English through augmented reality: a case study of *Pokémon Go*. *Computer Assisted Language Learning*, 34:5–6, 778–812, <https://doi.org/10.1080/09588221.2019.1642211>

Wu, Q. (2015). Designing a smartphone app to teach English (L2) vocabulary. *Computers & Education*, 85, 170–179, <https://doi.org/10.1016/j.compedu.2015.02.013>.

Wu, T. T. & Huang, Y. M. (2017). A Mobile Game-Based English Vocabulary Practice System Based on Portfolio Analysis. *Educational Technology & Society*, 20 (2), 265–277.

Shi, Y.-S. & Tsai, C.-Y. (2022). Fostering vocabulary learning: mind mapping app enhances performances of EFL learners, *Computer Assisted Language Learning*, <https://doi.org/10.1080/09588221.2022.2052905>

Abbreviations

WoS	Web of science
MALL	Mobile-assisted language learning
MAVL	Mobile-assisted vocabulary learning
EFL	English as foreign language
ESL	English as second language
SLA	Second language acquisition
SSCI	Social science citation index

Author contribution

The author is responsible for the whole process including literature review, scanning the data set, data analysis and reporting on the data. The author read and approved the final manuscript.

Funding

The author did not receive support from any organization for the submitted work.

Availability data and materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The author declares that she has no competing interest.

Received: 23 August 2022 Accepted: 13 February 2023

Published online: 28 February 2023

References

- Afzali, P., Shabani, S., Basir, Z., & Ramazani, M. (2017). Mobile-assisted vocabulary learning: A review study. *Advances in Language and Literary Studies*, 8(2), 190–195. <https://doi.org/10.7575/aial.v8n.2p.190>
- Al-Said, K. M. (2015). Students' perceptions of Edmodo and mobile learning and their real barriers towards them. *The Turkish Online Journal of Educational Technology*, 14(2), 167–180.
- Andres, A. (2009). *Measuring academic research: How to undertake a bibliometric study*. Chandos Publishing.
- Aygül, S. Ö. (2019). *Pre-service EFL teachers' current practices and perceptions of mobile-assisted language learning*. (Unpublished master's thesis). Middle East Technical University, Ankara.
- Burston, J. (2015). Twenty years of MALL project implementation: A meta-analysis of learning outcomes. *ReCALL*, 27, 4–20.
- Burston, J. (2021). Unreported MALL studies: What difference do they make to published experimental MALL research results? In V. Morgana & A. Kukulska-Hulme (Eds.), *Mobile assisted language learning across educational contexts (Chapter 2)*. Routledge.
- Burston, J., & Giannakou, K. (2022). MALL language learning outcomes: A comprehensive meta-analysis 1994–2019. *ReCALL*, 34(2), 147–168. <https://doi.org/10.1017/S0958344021000240>
- CheMustaffa, N. U., & Sallin, S. N. (2022). A systematic review of mobile-assisted language learning research trends and practices in Malaysia. *International Journal of Interactive Mobile Technologies (IJIM)*, 16(05), 169–198. <https://doi.org/10.3991/ijim.v16i05.28129>

- Darmi, R. & Albion, P. (2014). A review of integrating mobile phones for language learning. In Paper presented at 10th International Conference Mobile Learning, Madrid.
- Duman, G., Orhon, G., & Gedik, N. (2015). Research trends in mobile assisted language learning from 2000 to 2012. *ReCALL*, 27(2), 197–216.
- Feng, J., & Chen, Y. (2022). A bibliometric analysis of mobile assisted second language learning. *International Journal of Interactive Mobile Technologies (IJIM)*, 16(09), 175–190. <https://doi.org/10.3991/ijim.v16i09.30351>
- Fujimoto, C. (2012). Perceptions of mobile language learning in Australia: How ready are learners to study on the move? *The JALT CALL Journal*, 8(3), 165–195. <https://doi.org/10.29140/jaltcall.v8n3.140>
- Haddow, G. (2013). Bibliometric research. In K. Williamson & G. Johanson (Eds.), *Research methods: Information, systems and contexts* (pp. 219–244). Tilde University Press.
- Khodabandelou, R., Fathi, M., Amerian, M., & Fakhraie, M. R. (2022). A comprehensive analysis of the 21st century's research trends in English mobile learning: a bibliographic review of the literature. *International Journal of Information and Learning Technology*. <https://doi.org/10.1108/IJILT-07-2021-0099>
- Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile-assisted language learning: From content delivery to supported collaboration and interaction. *ReCALL*, 20(3), 271–289. <https://doi.org/10.1017/S0958344008000335>
- Kumar, S. R., & Kaliyaperumal, K. A. (2015). Scientometric analysis of mobile technology publications. *Scientometrics*, 105, 921–939. <https://doi.org/10.1007/s11192-015-1710-7>
- Liu, K.-X. (2020). The trend of mobile-assisted language learning from 2014 to 2018. In Paper presented in International Conference on Education, Culture, Economic Management and Information Service, Changsha, China
- Li, F., Fan, S., & Wang, Y. (2022). Mobile-assisted language learning in Chinese higher education context: A systematic review from the perspective of the situated learning theory. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11025-4>
- Lin, J. J., & Lin, H. F. (2019). Mobile-assisted ESL/EFL vocabulary learning: A systematic review and meta-analysis. *Computer Assisted Language Learning*, 32(8), 878–919.
- Liu, G.-Z., Lu, H.-C., & Lai, C.-T. (2016). Towards the construction of a field: The developments and implications of mobile assisted language learning (MALL). *Digital Scholarship in the Humanities*, 31(1), 164–180. <https://doi.org/10.1093/llc/fqu070>
- McQuiggan, S., Kosturko, L., McQuiggan, J., & Sabourin, J. (2015). *Mobile learning: A handbook for developers, educators, and learners*. John Wiley & Sons Inc.
- Özdamli, F., & Çavus, N. (2011). Basic elements and characteristics of mobile learning. *Procedia-Social and Behavioral Sciences*, 28, 937–942. <https://doi.org/10.1016/j.sbspro.2011.11.173>
- Pang, W. J., & Aziz, A. A. (2021). A systematic review of vocabulary learning with mobile assisted learning platforms. *International Journal of Academic Research in Business and Social Sciences*, 11(11), 1503–1521. <https://doi.org/10.6007/IJARBS/v11-i11/11383>
- Penelope, K., & Panagiotis, A. (2021). Mobile assisted language learning (MALL): Trends from 2010 to 2020 using text analysis techniques. *European Journal of Education*, 4(1), 13–22. <https://doi.org/10.26417/461iaw87u>
- Peng, H., Jager, S., & Lowie, W. (2020). Narrative review and meta-analysis of MALL research on L2 skills. *ReCALL Advance Online Publication*. <https://doi.org/10.1017/S0958344020000221>
- Shadiev, R., Liu, T., & Hwang, W.-Y. (2020). Review of research on mobile-assisted language learning in familiar, authentic environments. *British Journal of Educational Technology*, 51(3), 709–720. <https://doi.org/10.1111/bjet.12839>
- Smartphone penetration. https://en.wikipedia.org/wiki/List_of_countries_by_smartphone_penetration
- Smartphone users. <https://www.statista.com/statistics/748053/worldwide-top-countries-smartphone-users/>
- Taj, I. H., Sulan, N. B., Sipra, M. A., & Ahmad, W. (2016). Impact of mobile assisted language learning (MALL) on EFL: A meta-analysis. *Advances in Language and Literary Studies*, 7(2), 76–83. <https://doi.org/10.7575/aiac.all.v.7n.2p.76>
- van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact*. Cham: Springer.
- Wilkins, D. A. (1972). *Linguistics in language teaching*. MIT Press.
- Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers and Education*, 62, 41–49.
- Yükselir, C. (2017). A meta-synthesis of qualitative research about mobile assisted language learning (MALL) in foreign language teaching. *Arab World English Journal*, 8(3), 302–318. <https://doi.org/10.24093/awej/vol8no3.20>
- Zain, D. S. M. (2021). Mobile-assisted language learning (MALL) for higher education instructional practices in EFL/ESL contexts: A recent review of literature. *Computer Assisted Language Learning Electronic Journal*, 22(1), 290–317.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.