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Review

Effects of Mobile Learning in English Language Learning: A Meta-Analysis and Research Synthesis

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Abstract: English has become the most important language for communication worldwide, but learning it as a second language presents multiple challenges. Given its multimedia nature, mobile learning is an ally in learning this language. However, although the use of mobile devices in English education has been broadly documented, there is little evidence of its effect on students' learning. This article presents a meta-analysis of 62 studies to assess the effects of mobile learning on students' learning. Moreover, the study considered the moderating effect of education level, pedagogical approach, learning environment, mobile device, and control treatment. The results show that mobile learning has a large effect ($g = 0.89$) on students' learning. Regarding education level, the best results were found at the Bachelor's level. Similarly, collaborative learning provided the best results among the pedagogical approaches. As for the learning environment, semi-formal settings, such as field trips and outdoor activities, performed better than formal settings within classrooms or laboratories. Furthermore, smartphones yielded better results than any other mobile device. Finally, the results indicated that mobile learning produces better results than traditional lectures, traditional pedagogical tools, or other multimedia resources. Therefore, it should be promoted as a pedagogical alternative to foster quality education for all.

Keywords: English as a second language; meta-analysis; mobile device; mobile learning

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Citation: Garzón, J.; Lampropoulos, G.; Burgos, D. Effects of Mobile Learning in English Language Learning: A Meta-Analysis and Research Synthesis. *Electronics* **2023**, *12*, 1595. https://doi.org/10.3390/electronics12071595

Academic Editor: Christos J. Bouras

Received: 16 February 2023
Revised: 17 March 2023
Accepted: 27 March 2023
Published: 29 March 2023

1. Introduction

The use of mobile devices for educational purposes has been coined under the term "mobile learning" (m-learning). This is an emergent approach to learning, which has experienced a steady growth since 2013, perhaps due to UNESCO'S publication of the policy guidelines for mobile learning [1]. According to this organization [2], m-learning has the potential to expand and enrich education for all types of learners. Therefore, different organizations, such as UNESCO [3], OCDE [4], the European Union [5], and the African Union [6], have encouraged stakeholders to embrace research on this topic as a strategy to overcome space and time barriers in education.

1.1. M-Learning in English Education

Language learning involves four primary skills: reading, writing, listening, and speaking [7]. Therefore, different strategies must be included to help students acquire these skills. In this sense, previous studies have noted that using active learning techniques, in which students construct knowledge, is an efficient way to promote multiple abilities when learning a second language [8,9].

English is the language that has gained the most notoriety in recent decades [10,11]. This language plays a key role in global communication, access to information, career opportunities, cultural exchange, and personal and intellectual development [12]. English is widely used as the language of international communication and is the dominant language in many fields, including business, technology, and research. As a result, knowledge of English is essential for effective communication with people from around the world. As the world becomes increasingly interconnected, fluency in English will become an increasingly valuable skill. Hence, researchers and teachers are urged to do their best to provide students with the right pedagogical tools to help them succeed in English language learning.

On the other hand, mobile devices have shown to help present information in multiple formats [13], helping learners acquire the four basic skills when learning English as a second language. That is, mobile devices allow students to actively construct knowledge using multiple means in ways hardly possible with other pedagogical alternatives. However, although mobile devices provide multiple possibilities, it is not the technical tools that guarantee academic success, but rather, the pedagogical strategies underpinning educational interventions [14]. We, therefore, pose that using mobile devices as part of a well-structured academic intervention enhances students' chances of mastering English as a second language.

1.2. Related Work

The meta-analysis technique has been extensively implemented by several researchers to estimate m-learning's effect on education. A meta-analysis establishes the general characteristics of an experimental treatment by analyzing the results of individual studies that have investigated it [15]. The principal purpose of a meta-analysis is to estimate the magnitude of the effect of an experimental treatment transformed into a standardized mean difference [16]. Effect sizes are usually measured using Cohen's d [17] or Hedges' g [18] estimates. Both estimates divide the difference between sample means of a continuous response by the pooled standard deviation. Cohen's d estimate is more commonly used, but it is subject to bias for small sample sizes. On the other hand, Hedges' g eliminates this bias with a correction factor, whereby this has recently gained popularity in educational research [15].

Some comprehensive meta-analyses have measured the impact of m-learning on students' learning outcomes [19,20]. Other meta-analytical studies have focused on education levels [21], mobile devices [22], or pedagogical approaches [23]. Additionally, other studies have analyzed the effects of m-learning on language learning [24,25] or have focused on specific English skills, such as vocabulary acquisition [26].

To the best of our knowledge, two meta-analyses have estimated the impact of m-learning on English learning. First, the study by Chen [27] analyzed 29 studies published in the gray literature and peer-reviewed journals between 2008 and 2019 and found an effect of $g = 0.89$ on student learning. Furthermore, the study found moderating effects from the education level and the mobile device, but not from the learning environment or the intervention duration. Second, the meta-analysis by Garzón et al. [28] analyzed 54 studies published in peer-reviewed journals and conference proceedings between 2013 and 2022. The study found an effect of $g = 0.94$ on student English learning. Additionally, the study found moderator effects by the pedagogical approach, the education level, and the control treatment.

These studies have made significant contributions to understanding m-learning in English education. However, some research gaps remain, raising the need for new and enhanced studies. Concerning the study conducted by Chen [27], the inclusion of non-peer-reviewed articles did not allow the author to guarantee the quality of the conclusions of the meta-analysis [29]. Second, the author did not estimate the effect size of m-learning in the subgroups within the moderator variables. Third, the reduced number of analyzed studies risked biasing the conclusions of the meta-analysis [30]. Fourth, the study did not analyze the educational theory underpinning each intervention, ignoring the importance of the pedagogical approach in guaranteeing academic success [31]. Fifth, the study failed to analyze the pedagogical strategies included in the control treatment to determine the amount of knowledge that could be explicitly attributed to m-learning [23].

On the other hand, the study carried out by Garzón et al. [28] aptly addressed the abovementioned research gaps. However, the authors did not establish the implications of their results for theory and practice, nor did they discuss the results from the perspective of previous studies. In the present study, we extended the research of Garzón et al. [28] by adding significant changes. First, we broadened the time span to studies published by 2023. Second, we expanded the search for empirical studies in different databases, which allowed us to identify eight additional empirical studies to answer the research questions. Third, we employed specialized meta-analysis software to calculate the overall effect more precisely. Fourth, based on the analysis of the results, we established the implications for theory and practice and discussed the results from the perspective of previous studies and learning theories. Fifth, we established some suggestions to guide future research regarding the effects of m-learning in English language learning.

1.3. Purpose of the Study

This meta-analysis assesses the effects of m-learning on students' English language learning. We considered the elements of the population, intervention, comparison, and outcomes (PICO) framework [32] to guide the study. Using the PICO framework can help researchers create clear and focused research questions specific to the population and intervention of interest. It is commonly used in evidence-based research to help guide the search for relevant research articles and to ensure that the research question is well defined and answerable with the available evidence. In the present meta-analysis, the population is composed of learners at all levels of education. The intervention encompasses the use of mobile devices to learn English in educational settings. The comparison was made with traditional lectures (traditional teaching methods), traditional pedagogical tools (not technology-based), and other multimedia resources (non-mobile). Finally, the outcomes were measured regarding students' English language acquisition. Moreover, the study identifies the moderating effect of the education level, the pedagogical approach, the learning environment, the mobile device, and the control treatment. Within this context, this study aims to answer the following research questions:

(1) What is the effect of mobile learning on students' learning of the English language?

(2) What factors moderate the effect of mobile learning on students' learning of the English language?

The remainder of this article is structured as follows: Section 2 describes the process of conducting the meta-analysis, including the study selection, the coding process, the effect size calculation, and the moderating effect. Section 3 presents the main results of the meta-analysis, including descriptive and quantitative analysis. Finally, Section 4 discusses the implications of the results and shows the study's limitations and some indications for future research.

2. Methods

We conducted a meta-analysis to measure the effect of m-learning on students' English language learning. To identify the effect size of m-learning on student learning, we followed the four-step procedure recommended in previous studies [15]: selection of the studies, data coding, calculation of the effect size, and moderating effect analysis.

2.1. Selection of the Studies

This meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [33] to guarantee transparency, accuracy, and completeness. The search for the studies was conducted on IEEE Xplore, Science Direct, Scopus, Taylor and Francis Online, and the Web of Science. These databases were selected, as they encompass high-quality journals and conference proceedings related to educational technology. The search terms included "English", "mobile", and "education". In addition, we used alternative search terms to produce a more comprehensive collection of studies. Alternative search terms for "English" were "EFL" and "ESL", alternative search terms for "mobile" were "ubiquitous" and "handheld", and alternative search terms for "education" were "learning" and "teaching".

We limited the search to studies published from 2013 to align with the UNESCO policy guidelines for mobile learning [1]. Moreover, we considered only studies from peer-reviewed journals or conference proceedings to secure the quality and strength of the analysis [29]. Studies included in the meta-analysis fulfilled the following criteria: (a) empirical research, (b) include a mobile device, (c) relate to English language learning, (d) evaluated students' learning gains, (e) included a control condition, and (f) written in the English language. On the other hand, studies were excluded if any of the following reasons were met: (a) work in progress, (b) secondary data analysis, (c) book or thesis, (d) data obtained through a self-assessment process, or (e) does not provide sufficient statistical information to calculate the effect size.

The last search was conducted on 20 January 2023, and this allowed us to identify 461 studies. After removing duplicates, we identified 252 potential studies. Two authors conducted the initial screening based on the title, abstract, and keywords. This process allowed them to reduce the number of studies to 184. They then reviewed the methods section of each study based on the inclusion/exclusion criteria. Missing information in the studies was requested from the corresponding authors via email, and the study was discarded if the information was not received in the following week. The study selection process yielded 62 studies relevant to the research questions (see Figure 1). At all stages of the process, occasional disagreements were resolved through consensus.

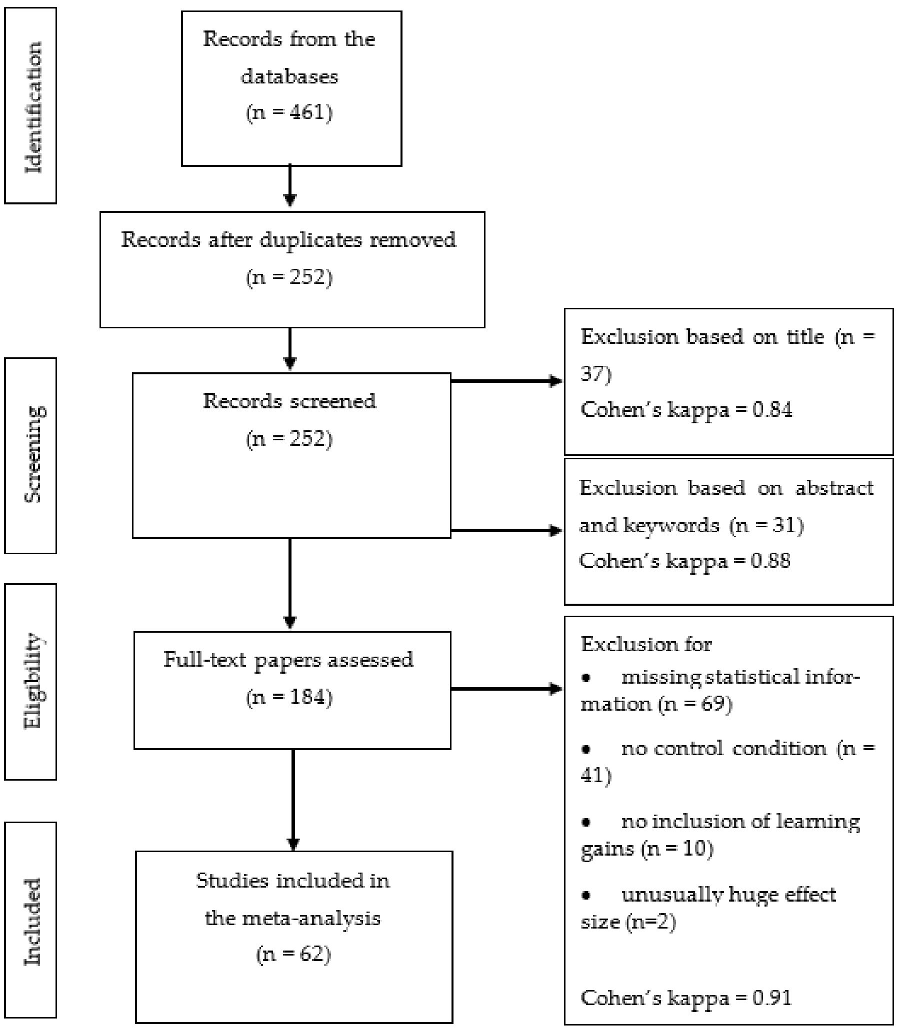

Figure 1. PRISMA flowchart of the study selection process.

2.2. Data Coding

We designed a data extraction form with the following elements: study name, year of publication, journal of publication, country of the study, type of research design, education level, pedagogical approach, learning environment, mobile device, control treatment, sample size, mean values, and standard deviations. The first and third authors individually extracted the information from each study [34]. Cohen's kappa statistic was used to measure inter-coder reliability. This value was 0.87, which indicates a high degree of agreement [35]. Disagreements were resolved through consensus between the three authors. The data extraction form with the statistical information of each study can be requested by email to the corresponding author.

2.3. Calculation of the Effect Size

We used the Comprehensive Meta Analysis 4.0 software to conduct the meta-analysis. We estimated the effect size based on Hedges' g [18], as this statistic offers more accuracy compared to the more conventional Cohen's d value. The effects were analyzed based on the random-effects model [11] because the study samples were drawn from populations with varying effect sizes [18]. As recommended, each study contributed a single effect size [15]. Therefore, an average effect size was calculated if a study provided multiple case studies or different experimental or control conditions.

We only consider studies that included a control condition to prevent Hawthorne effects [36]. Consequently, we considered pretest–posttest with control (PPC) and posttest only with control (POWC) research design studies [36]. Some PPC studies used the pretest as the covariate and did not report the scores for the pretest. In those cases, we computed a POWC effect size [37]. The guidelines to infer the effect sizes were as follows: $-0.15 < g < 0.15$ negligible; $0.15 \leq g < 0.40$ small; $0.40 \leq g < 0.75$ medium; $0.75 \leq g < 1.10$ large, $1.10 \leq g < 1.45$ very large; and $1.45 \leq g$ huge [38].

2.4. Moderating Effect Analysis

We used the homogeneity analysis to evaluate if the effect sizes were homogeneous across studies [39]. The set of effect sizes was evaluated for homogeneity with the Q, I^2, and p statistics [18]. The analysis of the three values led us to reject the null hypothesis of homogeneity, suggesting that it is appropriate to test for moderators. We conducted a preplanned analysis to identify whether the education level, the pedagogical approach, the learning environment, the mobile device, or the control treatment, moderated the overall effect size. As previous studies recommended [40], we evaluated the moderating effects by classifying the studies according to the moderator categories, and then, we evaluated homogeneity between and within categories.

2.4.1. Education Level

This analysis revealed which levels of education benefit the most from m-learning, allowing us to establish under what conditions it is advantageous or not to use mobile devices in English education. We coded the education level in each study according to the UNESCO classification [41]: preschool education (early childhood education), primary education, secondary education (including lower secondary education and upper secondary education), vocational education (including post-secondary non-tertiary education and short-cycle tertiary education), Bachelor's level, Master's level, and doctoral level.

2.4.2. Pedagogical Approach

This analysis helped identify which learning theories best support each specific situation. This data can be used to inform researchers about what strategies to implement in m-learning interventions. We classified the studies according to categories proposed in previous research [31,42]: situated learning (includes context-aware learning), game-based learning, collaborative learning (includes cooperative learning), cognitive theory of multimedia learning (multimedia learning), project-based learning (includes problem-based learning), and inquiry-based learning (includes discovery learning). If a study included elements of different approaches, we coded it according to the more influential approach in the intervention [31]. Similarly, if a study did not explicitly mention a specific pedagogical approach, we identified the underlying approach by analyzing the characteristics of the intervention [43].

2.4.3. Learning Environment

This analysis played an important role identifying which contexts favor students' achievement and enable them to make the most of the advantages of using mobile devices. We classified the learning environment in each study, following suggestions in previous research [43]: formal settings (classrooms and laboratories), semi-formal settings (field trips, outdoor activities, museums, and homes), informal settings (means of transportation, parks, and recreational places), and multiple settings (more than two settings simultaneously).

2.4.4. Mobile Device

This analysis helped identify which mobile devices should or should not be used according to students' characteristics. Additionally, it provided an idea of what type of device investments should be directed towards. We classified the mobile devices used in each study according to the different devices used in education in the last decade: personal digital assistants, smartphones, tablets, game consoles, smartglasses, and smartwatches.

2.4.5. Control Treatment

This analysis was crucial, as it allowed us to identify the learning that can be explicitly attributed to m-learning. We coded the control treatment in each study following the categories recommended in previous research [44]: multimedia (other multimedia non-mobile resources), traditional pedagogical tools (non-technological educational resources), and traditional lectures (lectures and curriculum-based teaching methods).

3. Results

Below, we present the results of the study according to our research questions. In that sense, we first present some descriptive data of the studies included in the meta-analysis, then we identify the effects of m-learning on student learning, and finally, we describe the results of the moderator analysis.

3.1. Descriptive Data of the Studies

Sixty-two studies published between 2013 and 2023 were included in the meta-analysis. The participants ($N = 4898$) were randomly assigned to the m-learning condition ($N = 2489$) or to the control condition ($N = 2409$). Two studies were published in 2013, one in 2014, seven in 2015, five in 2016, six in 2017, four in 2018, ten in 2019, six in 2020, eight in 2021, eleven in 2022, and two in 2023. The studies were conducted in 19 different countries on all inhabited continents, which supports the idea that m-learning has attracted interest worldwide. They were published in 38 peer-reviewed journals and conference proceedings. As it is common in English education, Computer Assisted Language Learning published the largest number of studies ($N = 12$).

3.2. Effects of m-Learning on Student Learning

All the effect sizes were found to be positive. According to the guidelines, there were four negligible effects, four small effects, twenty-six medium effects, nine large effects, eight very large effects, and eleven huge effects. The overall weighted effect size was $g = 0.89$, with a 95% confidence interval [0.75–1.03] and $p < 0.001$, indicating that m-learning positively impacts student learning in English education. In other words, using mobile devices in English education can improve knowledge scores by 0.89 standard deviations, which can be classified as a large effect according to the proposed guidelines [38]. Furthermore, the standard score indicated significant statistical differences in achievement between the experimental and control groups ($z = 12.54$, $p < 0.001$). Figure 2 summarizes the statistical values for each study included in the meta-analysis.

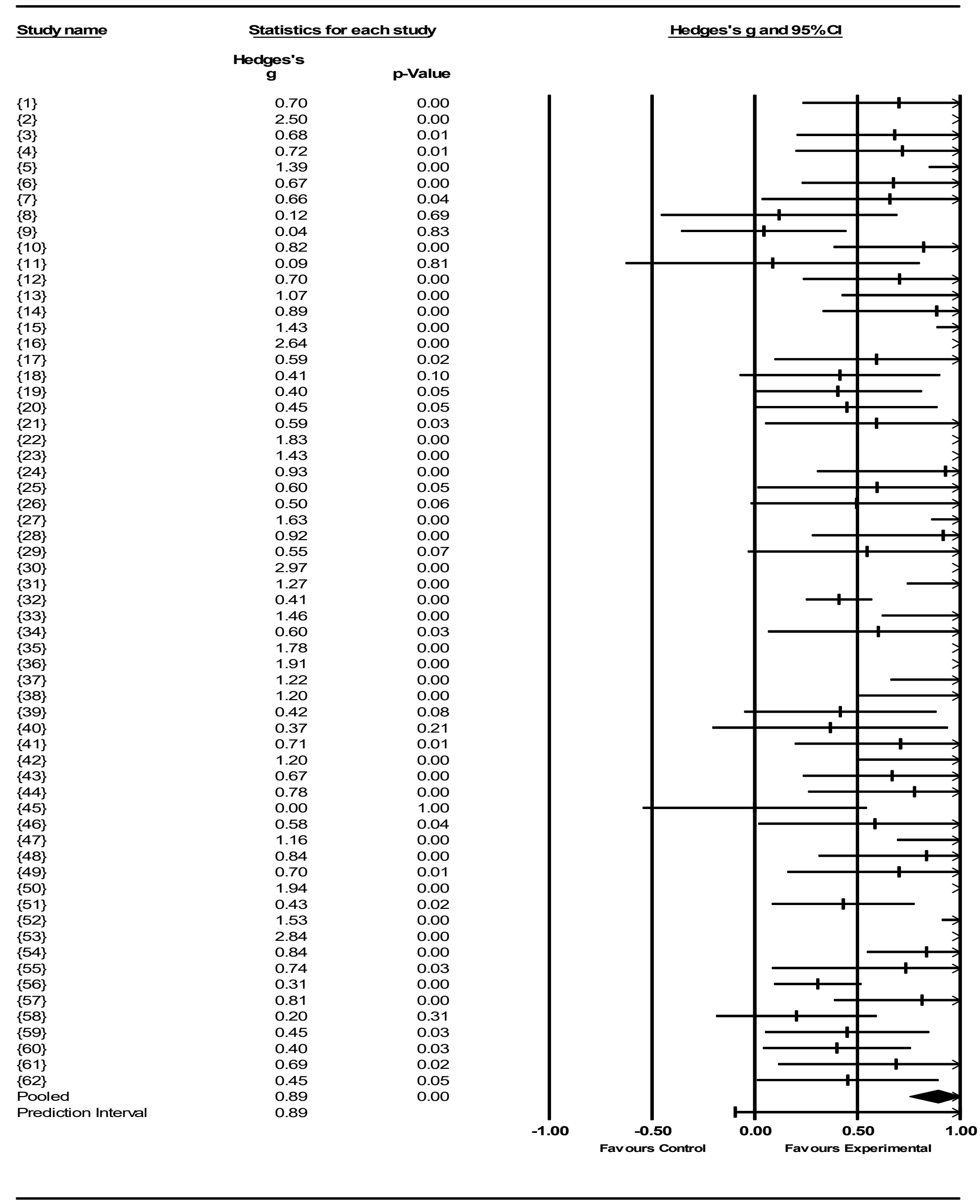

Figure 2. Summary of the studies' statistics.

3.2.1. Heterogeneity Test

Results indicated that the studies included in the meta-analysis had heterogeneous effects on the evaluated population, suggesting that the variance among the studies was unlikely to be due to sampling errors [15]. The Q value was higher than the critical value $(Q = 317.24 > 81.38,\ df = 61)$ at a 95% significance level from the chi-square distribution table. Similarly, the I^2 index was measured to identify the level of true heterogeneity. This value indicated that 80.77% of the total variance reflected real differences in effect sizes [45]. Finally, the p-value, which was lower than 0.05, also indicated heterogeneity. These three values support the assumption of the random effects model and imply the possibility of moderating variables.

3.2.2. Publication Bias

We evaluated potential publication bias through three methods, namely, a trim-and-fill plot [46], Egger's regression test [47], and the classic fail-safe N [48]. As depicted in Figure 3, the studies are symmetrically plotted according to their combined effect size.

Most of the studies appear in the upper part of the graph, suggesting the absence of publication bias [46]. This visual inspection was confirmed through Egger's regression ($t[61] = 5.02$, $p < 0.001$). Additionally, the classic fail-safe N for this meta-analysis was found to be 998. This value indicates that it would be necessary to include 998 "null" studies to nullify the effect. This analysis indicates that the meta-analysis results are reliable and unlikely to suffer publication bias.

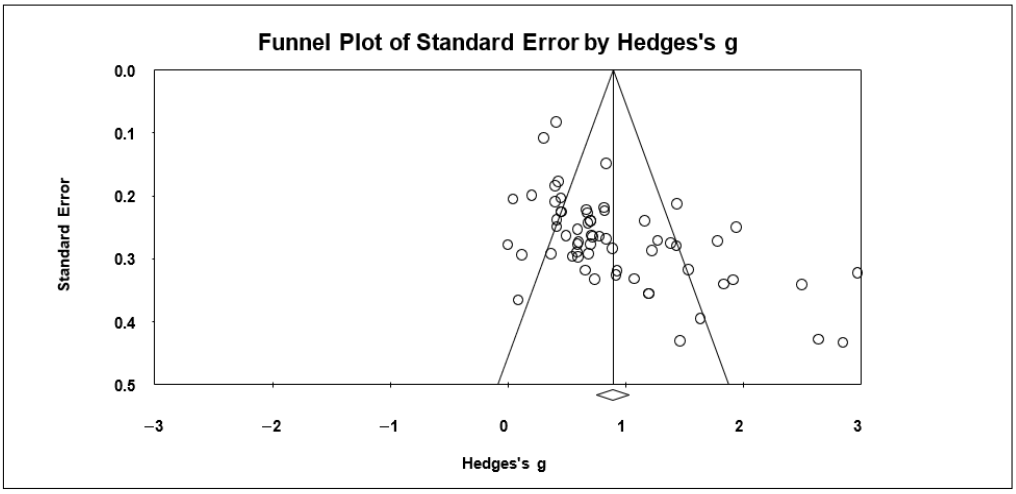

Figure 3. Funnel Plot of Standard Error by Hedges' g.

3.3. Moderator Analysis

Table 1 summarizes the moderator analysis. We evaluated the between-group homogeneity (Q_B) using the mixed method approach to identify group differences. This value allowed us to determine whether a variable moderates the impact of m-learning on student achievement.

Table 1. Summary of the moderating analysis.

Moderator	N	g	p	*Description*	Q_B
Education level					7.90
Preschool education	2	0.51	0.66	Medium	
Primary education	10	0.90	<0.001	Large	
Secondary education	21	0.80	<0.001	Large	
Vocational education	6	0.64	0.03	Medium	
Bachelor's level	22	1.11	<0.001	Very large	
Pedagogical approach					8.37
Situated learning	8	0.95	<0.001	Large	
Game-based learning	11	0.78	<0.001	Large	
Collaborative learning	7	1.45	<0.001	Very large	
Multimedia learning	6	0.65	0.88	Medium	
Learning environment					7.96 *
Formal settings	39	0.73	<0.001	Medium	
Semi-formal settings	17	1.08	<0.001	Large	
Multiple settings	6	1.38	<0.001	Very large	
Mobile device					12.06 *
Personal digital assistant	2	1.58	<0.001	Huge	
Smartphone	47	0.97	<0.001	Large	
Tablet	13	0.56	0.07	Medium	
Control treatment					23.85 *
Traditional lectures	32	1.04	<0.001	Large	
Traditional pedagogical tool	21	0.88	<0.001	Large	
Multimedia resource	9	0.43	0.56	Medium	

Note: * $p < 0.05$.

The between-groups analysis indicated that the education level does not moderate m-learning's effect on student learning ($Q_B = 7.90$, $p = 0.09$). The effect was very large at the Bachelor's level ($g = 1.11$, $p < 0.001$) and large at the primary education level ($g = 0.90$, $p < 0.001$) and secondary education level ($g = 0.80$, $p < 0.001$). The effect was found to be medium on vocational education ($g = 0.64$, $p = 0.03$) and preschool ($g = 0.51$, $p = 0.66$). However, the small sample size does not allow us to establish reliable conclusions about these last two education levels.

The between-groups analysis indicated that the effect of m-learning on student learning does not differ significantly according to the pedagogical approach ($Q_B = 8.37$, $p < 0.08$). The effect was found to be huge on collaborative learning ($g = 1.45$, $p < 0.001$), large on situated learning ($g = 0.95$, $p < 0.001$) and game-based learning ($g = 0.78$, $p < 0.001$), and medium on multimedia learning ($g = 0.65$, $p < 0.88$). No studies included project-based learning or inquiry-based learning, perhaps because these approaches are more common in engineering or science-related fields, respectively [19].

The between-groups analysis indicated that the learning environment moderates m-learning's effect on student learning ($Q_B = 7.96$, $p < 0.05$). The effect was found to be very large on multiple settings ($g = 1.38$, $p < 0.001$) and on semi-formal settings ($g = 1.08$, $p < 0.001$) and large on formal settings ($g = 0.81$, $p < 0.001$). No study was conducted in informal settings.

The between-groups analysis indicated that the mobile device also moderates the effect of m-learning on student learning ($Q_B = 12.06$, $p < 0.05$). The effect was found to be large when using smartphones ($g = 0.97$, $p < 0.001$) and medium when using tablets ($g = 0.56$, $p < 0.001$). The effect when using personal digital assistants was found to be huge ($g = 1.58$, $p < 0.001$); however, the small sample size does not allow us to establish reliable conclusions. No studies used game consoles, smartglasses, or smartwatches.

The between-groups analysis indicated differences in the effect of m-learning on student learning according to the control treatment ($Q_B = 23.85$, $p < 0.001$). The effect was found to be very large when m-learning is compared with traditional lectures ($g = 1.04$, $p < 0.001$), large when compared with traditional pedagogical tools ($g = 0.43$, $p < 0.56$), and medium when it is compared with other multimedia resources ($g = 0.47$, $p < 0.001$).

4. Discussion

This study answers UNESCO's call to investigate the potential benefits of using mobile devices in educational settings. Specifically, we provide information on the affordances of m-learning for English language learning, considering various contexts, such as different educational levels, pedagogical approaches, learning environments, mobile devices, and other pedagogical alternatives. The results of this study can be helpful for researchers and teachers, providing insights to help them design and develop compelling learning experiences, materials, and activities. It can be confirmed that m-learning is a flexible and versatile approach to learning that can be integrated into all education levels, enriching and supporting existing educational practices, and it can be implemented in diverse contexts while providing high-quality education for everyone.

4.1. Effects of M-Learning on Student Learning in English Education

The results of the present meta-analysis indicate that m-learning has a large effect on students' learning of the English language. These results are similar to those found in the studies by Chen [27] and Garzón et al. [28]; therefore, the present meta-analysis confirms that using mobile devices for learning English is a valid pedagogical alternative that can be promoted to assist teachers and students in the teaching/learning process.

These positive results could be explained by the multimedia nature of mobile devices, which allows multiple senses to be stimulated to develop skills, such as reading, writing, listening, and speaking [7]. In addition, mobile devices work as pedagogical tools that students can use to construct learning actively [9]. These tools can extend learning environments to outdoor spaces, thus eliminating space and time constraints. Finally, mobile devices' usability allows students to feel more confident in the learning process [9], which translates into better academic achievement [25].

4.2. Moderator Analysis

The heterogeneity analysis indicated significant variability in the effect sizes. This suggests that while m-learning has a large effect on student learning, the effect may vary depending on the specific characteristics of each intervention. Below, we discuss the moderating effect of the education level, the pedagogical approach, the learning environment, the mobile device, and the control treatment.

4.2.1. Education Level

The results of our meta-analysis present some differences compared with the studies conducted by Chen [27] and Garzón et al. [28]. First, in contrast to those studies, we did not find moderating effects by the education level. Moreover, Chen's [27] study found negative effects on secondary education students, and our meta-analysis found positive effects in all education levels, as did the study by Garzón et al. [28]. The study by Chen [27] did not evaluate m-learning's effect on each educational level. In this regard, we found the most favorable results at the Bachelor's level, which is in line with the findings in the study by Garzón et al. [28]. It is likely that a combination of variables, such as age, maturity, autonomy, access to resources, and technological familiarity, all explain why students at this level perform better than other students [12,13]. These characteristics facilitate Bachelor education to take place in outdoor spaces, which have proven to be the most effective learning environments.

4.2.2. Pedagogical Approach

Our results do not indicate a moderating effect of the pedagogical approach, contrary to the results of the study by Garzón et al. [28]. However, the results in both studies are similar in identifying collaborative learning as the most beneficial approach in English education. The most positive results from interventions adopting the collaborative learning approach can be attributed to its ability to increase students' confidence [25] and reduce their cognitive load and anxiety [24]. Additionally, the results of interventions adopting situated learning or game-based learning approaches were significantly positive. The situated learning approach helps immerse students in real English learning contexts [14], while the game-based learning approach increases students' motivation, which is vital for students to succeed in any learning process [31].

4.2.3. Learning Environment

The results of the study showed significant differences regarding the learning environment, contrary to what was found in the studies by Chen [27] and Garzón et al. [28]. However, the results of the three studies are similar in identifying the best results in educational interventions carried out outdoors. As for the between-group categories, multiple settings and semi-formal settings conducted in outer spaces, such as field trips, museums, or homes, presented the best results in learning English. Learning in outer spaces provides opportunities for contextual learning, where learners can experience real-life situations and contexts that can help to reinforce and contextualize their language learning. This can be particularly useful for English language learners, as it allows them to practice their language skills in more authentic settings [49]. Additionally, learning in outer spaces can be motivating and stimulating, as learners are exposed to new environments, people, and experiences [50]. This can help to maintain learners' interest and engagement in language learning, which is crucial for effective language acquisition.

4.2.4. Mobile Device

The results of this meta-analysis indicate significant differences depending on the mobile device used; however, each evaluated device's effect was found to be positive. Our findings contradict the study by Chen [27], as that study found a negative impact when PDA or smartphone applications were used. It is important to note that the mentioned study included gray study articles; therefore, the results may have been confounding. In fact, our results, similar to the study by Garzón et al. [28], found the most positive results in interventions carried out using smartphones. The efficiency of a mobile device for learning English depends on the learner's preferences, learning style, and needs [51]. In that sense, smartphones may have an advantage over other devices due to their portability and convenience. Smartphones are relatively cost-effective, which makes them accessible to a wide range of learners, including those from disadvantaged backgrounds or with limited financial resources. This has helped make smartphones ubiquitous and widely used worldwide, significantly enhancing their familiarity in modern contexts. Smartphones are often seen as more personal devices than other devices, and learners may have a stronger emotional attachment to them [52]. This can create a sense of ownership and motivation that may enhance the learning experience.

4.2.5. Control Treatment

Results indicate significant differences according to the control treatment. Hence, similar to the results in the study by Garzón et al. [28], the effect was found to be large when compared with traditional lectures and traditional pedagogical tools and medium when compared with other multimedia resources. These results were expected, as previous research established that English language learning is more effective when active learning techniques are employed [8,9]. Consequently, the effects of m-learning are more evident when compared with traditional passive lectures, which do not motivate the students to learn the academic content. In the same line, the positive effects of m-learning are less evident when compared with those of other multimedia resources, as those strategies also represent active learning techniques.

4.3. Implications for Theory and Practice

The positive results at all educational levels indicate that using mobile devices is an effective strategy to help all students learn English, regardless of their age. At most education levels, institutions tend to exploit the bring your own device (BYOD) concept to lower the costs related to purchasing devices [53]. This fact positively affects students' confidence, yielding better academic results because the usability of the pedagogical tool (i.e., the mobile device) is intrinsically improved. Additionally, recent research has shown a strong correlation between students' attitudes toward using technology and language learning outcomes [54]. As younger learners grow up surrounded by technology, they are more accustomed to handling mobile devices from an early age. This fact improves usability and justifies the positive effect of integrating m-learning in English education at all levels of education.

Our results confirm that the pedagogical approaches play a crucial role in English language learning, as they determine the success of an educational intervention. Specifically, pedagogical approaches derived from the constructivist theory (i.e., situated learning, collaborative learning, game-based learning, multimedia learning) help create a supportive and engaging learning environment, encourage student participation, and promote language acquisition [9]. The right approach can also address students' diverse needs and learning styles, increase motivation and self-confidence, and foster critical thinking skills [8]. Therefore, this may imply that a well-designed pedagogical approach can lead to improved language proficiency and enhanced communicative competence in English.

Our results show that the learning environment significantly impacts the success and effectiveness of the learning process. Each student has their own learning style and preferences. Therefore, a proper learning environment should accommodate different learning styles, such as visual, auditory, and kinesthetic, to ensure that all students have equal opportunities to learn and succeed. The flexibility of m-learning flexibility allows these styles to be taken out of the classroom, thus satisfying each student's needs and preferences. Consequently, a positive and supportive learning environment motivates students, develops their language skills, helps them interact with others, helps them receive valuable feedback, and helps them gain cultural exposure.

The use of mobile devices offers a variety of benefits for English language learners; however, mobile devices provide two specific advantages, which are difficult to find when using other pedagogical alternatives. First, learning English is enhanced by authentic educational contexts [55], which is validated by the success of interventions using collaborative learning and situated learning approaches. In this regard, mobile devices provide timely access to online communities where students can interact with native English speakers and other English language learners. This helps students practice their speaking, listening, reading, and writing skills, as well as gain new insights into the culture and customs of English-speaking countries. Second, mobile devices provide multimedia options, such as audio, video, and text capabilities, making them ideal for delivering various language learning materials, including videos, audio recordings, and interactive quizzes. Additionally, the portability of mobile devices allows students to access multimedia learning materials and practice their skills whenever and wherever.

Finally, the g value found in this meta-analysis indicates that m-learning has a large effect on students' learning of the English language. Nonetheless, it was important to verify that this effect is due to the use of mobile devices and not the educational intervention per se. Consequently, we compared the effects of m-learning treatments against those in the control groups. Our results indicated that m-learning yields better results when compared either with traditional lectures, traditional pedagogical tools, or other multimedia resources. Therefore, it can be concluded that the positive effect size is due to the use of mobile devices.

5. Limitations of the Study

There are three significant limitations that must be considered when interpreting the results of this meta-analysis. First, as depicted in Figure 1, 69 empirical studies were discarded because they did not provide sufficient statistical information to calculate the effect size. Therefore, those studies could have provided valuable information to understand the whole picture of the effects of m-learning on English language learning. Second, the study selection protocol included five databases to search for journal and conference articles. However, the inclusion of additional databases and different types of research, such as doctoral theses or book chapters, could have enriched the study's conclusions. Third, Figure 3 shows that publication bias is not a threat in this meta-analysis. Nonetheless, adding unpublished studies (usually rejected because some journals tend to publish only positive results) could modify the overall results presented in this study.

6. Future Research

This meta-analysis provides valuable information for understanding m-learning's effect on student learning. However, limitations in its scope and the results of our analysis allowed us to identify some gaps that could be addressed in future research. First, we analyzed the moderating effect of the education level, the pedagogical approach, the learning environment, the mobile device, and the control treatment. However, future research could evaluate the moderating effects of variables, such as intervention duration, sample size, or student personality traits. Such analysis could provide a broader understanding of m-learning's effectiveness in English education. Second, m-learning has been described as an effective approach for all types of students. However, neither this nor previous studies have analyzed the effects of m-learning on people with special needs (whether cognitive or physical). Therefore, future research should analyze the effect of using mobile devices in special needs education. Such research could validate m-learning as an essential approach to learning that improves quality education for all. Third, this study analyzes English learning as a general variable. However, learning English requires different skills, such as reading, writing, listening, and speaking. Hence, we propose that future studies analyze the effect of mobile learning on each specific skill. This information is valuable as it informs about which specific context best supports each component of learning English.

Author Contributions: Conceptualization, J.G.; methodology, J.G. and G.L.; software, J.G.; validation, J.G. and D.B.; formal analysis, J.G. and D.B.; investigation, J.G. and G.L.; resources, D.B.; data curation, J.G. and G.L.; writing—original draft preparation, J.G.; writing—review and editing, G.L. and D.B.; visualization, J.G. and D.B.; funding acquisition, D.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research has been partially funded by the Research Institute for Innovation and Technology in Education (UNIR iTED) at Universidad Internacional de La Rioja (UNIR).

Data Availability Statement: All data related to the investigation process are stored personally by the authors; however, they can be shared with interested parties. All data can be formally requested from the corresponding author of the study.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

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