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# Educational Games in Arabic Language Learning: A Meta-Analysis of Outcomes and Moderating Factors

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**ENGLISH ABSTRACT**
This study examined the effectiveness of educational games in Arabic language learning through a meta-analysis of 38 independent effect sizes from empirical studies conducted in various educational contexts. A random-effects model was used to estimate the overall effect and analyze moderator variables, including school level, country, language skill, game type, and sample size. The results showed a statistically significant and large overall effect of educational games on Arabic language learning outcomes (SMD = 1.649, 95% CI = 1.303–1.996, $p < .001$). However, substantial heterogeneity was found among the studies ($I^2$ = 93.02%), indicating variation across educational contexts. Subgroup analyses revealed positive effects across all moderator categories. The largest effects were identified among primary school students, studies conducted in Saudi Arabia, and interventions targeting speaking, listening, and writing skills. Traditional educational games produced slightly larger effects than digital games. Sensitivity analysis confirmed

the robustness of the findings, although PET-PEESE analysis indicated the presence of publication bias and small-study effects. Overall, the findings suggest that educational games are a promising instructional approach for improving Arabic language learning outcomes across different educational settings. This study also contributes to Arabic language education research by identifying contextual factors associated with variations in learning outcomes.

**Keywords:** Educational Games, Arabic Language Learning, Meta-Analysis, Learning Outcomes, Moderating Factors

**INDONESIAN ABSTRACT**

*Penelitian ini mengkaji efektivitas permainan edukatif dalam pembelajaran bahasa Arab melalui meta-analisis terhadap 38 effect size independen dari berbagai penelitian empiris pada konteks pendidikan yang berbeda. Model random-effects digunakan untuk mengestimasi efek keseluruhan dan menganalisis variabel moderator, meliputi jenjang pendidikan, negara, keterampilan bahasa, jenis permainan, dan ukuran sampel. Hasil penelitian menunjukkan bahwa permainan edukatif memiliki efek keseluruhan yang besar dan signifikan terhadap hasil pembelajaran bahasa Arab (SMD = 1,649; 95% CI = 1,303–1,996; p < .001). Namun, ditemukan heterogenitas yang tinggi antarpenelitian ($I^2$ = 93,02%), yang menunjukkan adanya variasi konteks pendidikan. Analisis subgroup menunjukkan efek positif pada seluruh kategori moderator. Efek terbesar ditemukan pada siswa sekolah dasar, penelitian di Arab Saudi, serta intervensi yang berfokus pada keterampilan berbicara, menyimak, dan menulis. Permainan edukatif tradisional menghasilkan efek yang sedikit lebih besar dibandingkan permainan digital. Analisis sensitivitas menunjukkan bahwa hasil penelitian cukup robust, meskipun analisis PET-PEESE mengindikasikan adanya publication bias dan small-study effects. Secara keseluruhan, hasil penelitian menunjukkan bahwa permainan edukatif merupakan pendekatan pembelajaran yang potensial untuk meningkatkan hasil pembelajaran bahasa Arab di berbagai konteks pendidikan. Penelitian ini juga berkontribusi pada kajian pendidikan bahasa Arab dengan mengidentifikasi faktor-faktor kontekstual yang berkaitan dengan variasi hasil pembelajaran.*

***Kata Kunci**: Permainan Edukatif, Pembelajaran Bahasa Arab, Meta-Analisis, Hasil Pembelajaran, Faktor Moderator*

## Introduction

Educational games have emerged as an important innovation in contemporary education, particularly in language learning contexts. In Arabic language learning, educational games provide an engaging and effective instructional approach that can improve students' motivation, participation, and learning outcomes (Almelhes, 2024; Ismath et al., 2022; Jaafar & Yusoff, 2022; Mazer & Al-Ajlouni, 2023; Putria et al., 2021). As part of the broader development of educational technology, the integration of game elements into learning activities enables students to engage more actively and meaningfully in the learning process. Similar findings have also been reported in the

learning of other foreign languages, including English (John, 2024; Taşkara & Ekmekçi, 2024), Korean (Maldonado, 2024), Malay (Teo et al., 2024), Indonesian (Yuriananta et al., 2023), and Spanish (Rodríguez & Argüello, 2023). These studies indicate that educational games can create interactive learning environments that support both cognitive and emotional engagement in language learning.

In Arabic language education, educational games have been reported to positively influence various language skills, including vocabulary acquisition (Azimah, 2024; Azizah et al., 2024; Bukhori & Sulton, 2022), grammar comprehension (Eltahir et al., 2021; Siregar et al., 2024; T. Alshammari, 2020), writing skills (Bakry & Alsamadani, 2015; Hejaili & Newbury, 2023), speaking skills (Ezzat, 2019; Ghani & Daud, 2023a), listening skills (Mohammed et al., 2020; Ubaidillah et al., 2024), and reading skills (ALRababah, 2019). In addition, educational games facilitate more adaptive, enjoyable, and student-centered learning experiences that correspond to students' learning needs and preferences. Through elements such as rewards, missions, competition, and interactive challenges, educational games encourage students to participate more actively in classroom activities and sustain their learning motivation.

The implementation of educational games in education is closely related to the broader development of educational technology and learner-centered pedagogy. Educational games integrate various game mechanics, such as points, badges, leaderboards, missions, and challenges, into educational activities to enhance motivation, engagement, and academic achievement (Mitchell & Co, 2024; Saleem et al., 2022). Beyond mechanical aspects, educational games also emphasize emotional engagement, positive reinforcement, collaboration, and communication among learners (Castillo-Parra et al., 2022; Feng et al., 2024). Previous studies have shown that educational games can contribute not only to academic achievement but also to the development of cognitive, social, and procedural skills (Jaramillo-Mediavilla et al., 2024). Consequently, educational games have become a promising instructional strategy for creating more engaging and supportive learning environments across different educational contexts (Montenegro-Rueda et al., 2023).

Research in language education has also increasingly employed meta-analysis to evaluate the effectiveness of various instructional approaches. Previous meta-analytical studies have demonstrated the effectiveness of bilingual education (Reljić et al., 2015;

Rolstad et al., 2005), Mobile-Assisted Language Learning and Virtual Reality technologies (Chang & Hung, 2019; Li, 2024; Yi et al., 2024), Self-Regulated Learning interventions (J. Chen, 2022), and written corrective feedback strategies (Brown et al., 2023). Furthermore, educational technology and educational games in English language learning have been shown to positively influence students' engagement and learning outcomes (Chan & Lo, 2024; Fan et al., 2016; Rahmati et al., 2021). These findings highlight the importance of technology-driven and well-structured instructional approaches in improving language learning effectiveness.

Despite the growing number of empirical studies on educational games in Arabic language learning, a comprehensive meta-analysis synthesizing the effectiveness of educational games and examining moderating factors influencing learning outcomes remains limited. Existing studies generally focus on specific learning contexts, language skills, or educational levels without providing an overall synthesis of findings across studies. In contrast, meta-analyses on educational games and technology-based learning have been conducted more extensively in other foreign language learning contexts. This gap indicates the need for a comprehensive meta-analysis to evaluate the overall effectiveness of educational games in Arabic language learning and identify contextual factors contributing to variations in learning outcomes.

Therefore, this study aims to examine the effectiveness of educational games in Arabic language learning through a meta-analysis of empirical studies conducted in various educational settings. In addition, this study investigates several moderator variables, including educational level, game type, sample size, country, and targeted language skills, to identify factors associated with variations in educational games effectiveness. The findings of this study are expected to contribute to the development of Arabic language education research and provide practical implications for educators in designing more effective, engaging, and contextually appropriate game-based Arabic language learning strategies.

In addition to its practical implications, this study also contributes theoretically to the growing discussion on technology-enhanced language learning and game-based pedagogy in non-Western educational contexts. Arabic language learning possesses distinctive linguistic and cultural characteristics that may influence how educational games function in classroom settings. Therefore, examining educational games within

Arabic language education provides a broader understanding of how game-based learning strategies operate across different languages, educational systems, and sociocultural environments. The results of this study may also serve as a reference for future researchers interested in developing innovative and evidence-based instructional approaches in Arabic language education.

## Methods

This study employs a quantitative research design using a meta-analysis group contrast approach. The research utilizes the Scopus and Google Scholar databases to identify relevant articles as data sources. To enhance the robustness and reliability of this meta-analysis, the researcher implements inclusion and exclusion criteria in selecting relevant studies. These criteria are established to minimize bias in the data selection process. Table 1 provides an overview of the inclusion and exclusion criteria applied in this study.

**Table 1.** Inclusion and Exclusion Criteria

| Criteria | Included | Excluded |
|---|---|---|
| Open Access | All open access | Gold, hybrid gold, bronze, green |
| Years | 2014 - 2024 | Others |
| Document Type | Article | Book Chapter, book, review, conference paper, conference reviews |
| Language | English and Arabic | Others |
| Research Design | Experimental Groups (Containing Control and Experimental Groups) in educational games research topics | Others |
| Data Provided | N, M, SD, or a way of extracting equivalent Study conducted in formal school, e.g., primary school, junior high school, senior high school and university | Others |
| Quality | All | Ø |

On November 25, 2024, data were retrieved from the Google Scholar database using the keyword "game Arabic language" (66 documents); on December 17, 2024, using the keyword "game Arabic language experiment" (390 documents); on November 28, 2024, from the Scopus database using the keywords "game AND Arabic-language"

(67 documents) and "educational games AND Arabic-language" (10 documents); and on December 8, 2024, from Scopus using the keywords "game AND Arabic-language AND Experiment" (4 documents) and "educational games AND Arabic-language AND Experiment" (1 document). A total of 538 documents were extracted and subsequently filtered based on publication year (2014–2024), publication type (journal articles), language (English/Arabic), research design (experimental group with N, Mean, and Standard Deviation), and educational level. Ultimately, 33 relevant documents were selected for this study. For more details it can be seen in figure 1.

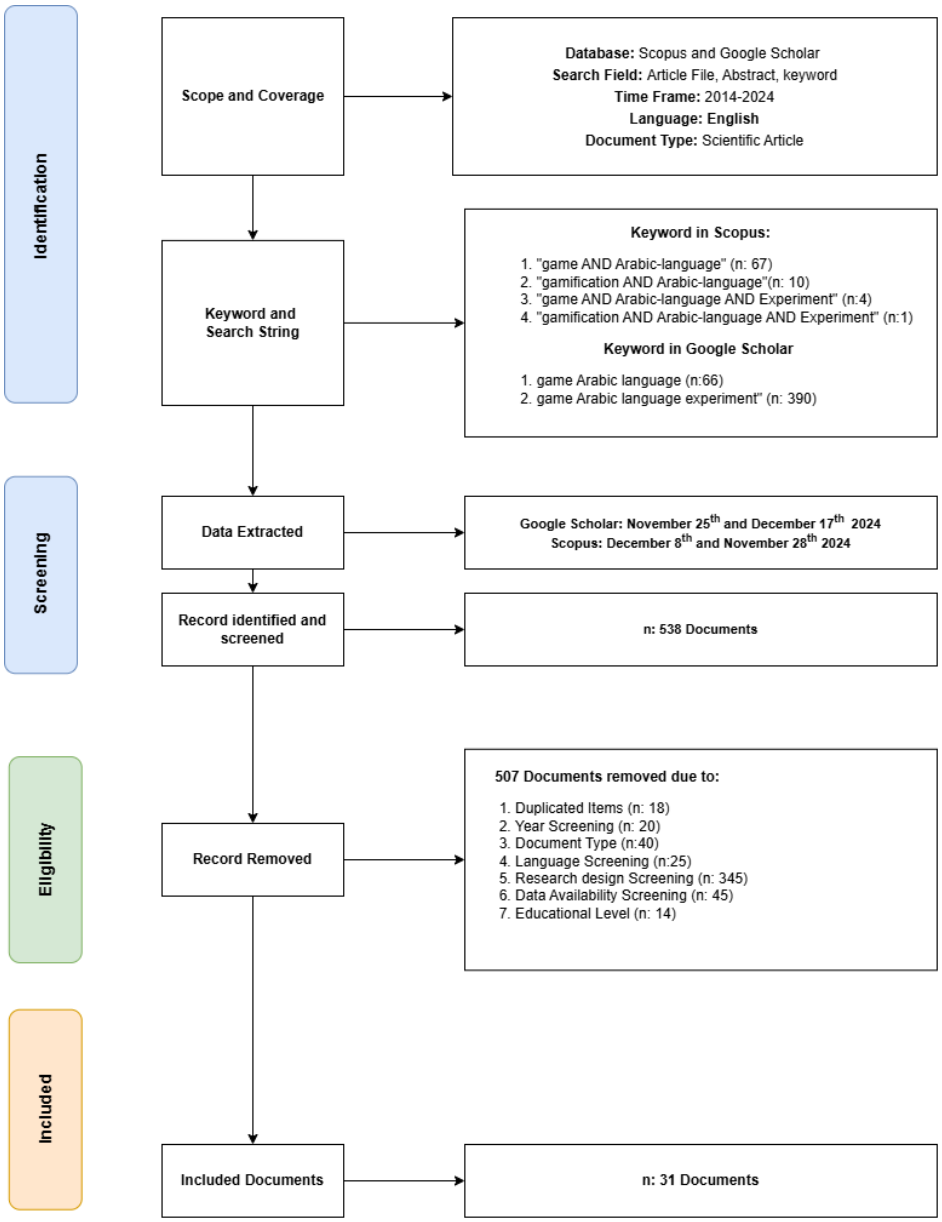


**Figure 1.** Prisma Flow adapted from (Page et al., 2021)

From the 31 selected studies, the researcher identified 38 independent samples for analysis, as presented in Table 3 and Figure 1. This occurred because four studies reported more than one language skill outcome (Al-Nawaisah, 2022; Mohammed et al., 2020; T. Alshammari, 2020; حولتا, ٢٠٢١), while the remaining studies focused on a single language skill.

The data were analyzed using OpenMEE software (Wallace et al., 2017). Continuous outcome data from treatment and control groups were compiled into CSV format and analyzed using Hedges' g within a random-effects model to calculate standardized mean differences (SMD). Hedges' g was selected because it reduces bias in small sample sizes (Galkanda-Arachchige et al., 2020; Higgins et al., 2003). A 95% confidence interval (CI) was applied, and positive effect sizes ($p < 0.05$) indicated better outcomes in the treatment group.

To examine potential heterogeneity, subgroup analyses were conducted using moderator variables such as school level, country, game type, and language skill (Choi & Kang, 2025; Ruppar, 2020). Subgroups with fewer than two studies were interpreted descriptively (Ogbuewu & Mbajiorgu, 2023). A leave-one-out sensitivity analysis was also performed to evaluate the robustness of the pooled effect size and determine whether individual studies disproportionately influenced the findings (Migliavaca et al., 2022; Prady et al., 2014).

Heterogeneity was assessed using Cochran's Q and $I^2$ statistics under the DerSimonian and Laird random-effects model. Following Higgins et al. (2003), heterogeneity was categorized as low (≤25%), moderate (26%–50%), substantial (51%–75%), and considerable (>75%). Because educational intervention studies commonly show high heterogeneity, subgroup and sensitivity analyses were used to identify possible sources of variation.

Publication bias was assessed using PET–PEESE analysis in JASP. This method was selected because it is considered less biased and more stable than several alternative methods, particularly when handling unequal variances across studies (Almalik, 2025). PET–PEESE was used to detect and adjust publication bias based on the relationship between effect size and study precision, resulting in more robust effect size estimates.

## Result and Discussion

### *Summary of Included Studies*

This study collected 33 studies that met the eligibility criteria, resulting in 42 independent samples for meta-analysis. Table 2 presents key information regarding the publication year, effect size (g), standard error (SE), as well as the population size of the experimental (Ne) and control (Nc) groups. Table 3 includes the results of the moderation variable analysis, covering the number of students, educational level, research location, language skills, and the type of game utilized.

**Table 2.** Summary of Meta-Analysis Studies

| No | Study | G | SE | Ne | Nc |
|---|---|---|---|---|---|
| 1 | Mahizer Hamzah et.al (Hamzah et al., 2019) | 2.072 | 0,295859359 | 35 | 35 |
| 2 | Ahmed Ezzat et.al (Ezzat, 2019) | 9.168 | 0,680595785 | 50 | 50 |
| 3 | Ghani MTA et.al (Ghani & Daud, 2023b) | 0.416 | 0,083637983 | 371 | 240 |
| 4 | Eltahir et.al (Eltahir et al., 2021) | 2.008 | 0,236830742 | 54 | 53 |
| 5 | Mohd Nazmi et.al (Jaafar & Yusoff, 2022) | 1.666 | 0,298726977 | 30 | 30 |
| 6 | al-Hejaili (Hejaili & Newbury, 2023) | 0.700 | 0,289352141 | 25 | 25 |
| 7 | M. T. Alshammari (1) (T. Alshammari, 2020) | 1.451 | 0,294131488 | 28 | 30 |
| 8 | M. T. Alshammari (2) (T. Alshammari, 2020) | 1.303 | 0,288028378 | 28 | 30 |
| 9 | M. T. Alshammari (3) (T. Alshammari, 2020) | 1.555 | 0,298754248 | 28 | 30 |
| 10 | M. T. Alshammari (4) (T. Alshammari, 2020) | 2.002 | 0,321156475 | 28 | 30 |
| 11 | Azizah et.al (Azizah et al., 2024) | 0.441 | 0,259692114 | 30 | 30 |
| 12 | Evi Muzaiyidah (Bukhori & Sulton, 2022) | 0.227 | 0,40309462 | 12 | 12 |
| 13 | Fathimah Muthmainnah et.al (Muthmainnah et al., 2024) | 2.638 | 0,498988063 | 15 | 15 |
| 14 | Hanifa Azimah (Azimah, 2024) | 0.393 | 0,320240974 | 19 | 20 |
| 15 | Ana Taqwa Wati et.al (Wati & Wahyuni, 2023) | 0.612 | 0,243340373 | 35 | 35 |
| 16 | Annas Nur Aziz et.al (Aziz et al., 2018) | -0.756 | 0,242847142 | 36 | 36 |
| 17 | Mamluatul Hasanah et.al (Hasanah et al., 2024) | 0.564 | 0,264208601 | 31 | 28 |
| 18 | Mohamed Saad Bakry et.al (Bakry & Alsamadani, 2015) | 5.363 | 0,884038088 | 12 | 12 |

| | | | | | |
|---|---|---|---|---|---|
| 19 | Muhammad Kamal (Hakim, 2019) | 4.272 | 0,548180631 | 22 | 22 |
| 20 | Nurlatipah (Latipah, 2024) | 2.197 | 0,372651599 | 23 | 23 |
| 21 | Najiba Abdullah Meyad et.al (Meyad et al., 2014) | 0.765 | 0,206505647 | 50 | 50 |
| 22 | Zulkifli Dali et.al (Dali et al., 2023) | 3.777 | 0,504381481 | 22 | 22 |
| 23 | Malek Abdulhadi Al Zamel Kasasbeh (Kasasbeh & Malek, 2016) | 0.734 | 0,134626283 | 115 | 120 |
| 24 | Nursiyah F. Kadullah et.al (Kadullah et al., 2023) | 1.092 | 0,295641433 | 26 | 26 |
| 25 | Fahd K. A. Ismail et.al (Ismail, 2018) | 1.895 | 0,310012605 | 30 | 30 |
| 26 | Ibnu Rawandhy N. Hula et.al (Hula et al., 2024) | 1.427 | 0,352113024 | 20 | 20 |
| 27 | Fatima Khaled Al-Nawaisah (1) (Al-Nawaisah, 2022) | 0.088 | 0,317236277 | 19 | 20 |
| 28 | Fatima Khaled Al-Nawaisah (2) (Al-Nawaisah, 2022) | 0.528 | 0,318702013 | 20 | 20 |
| 29 | Amy Fitriani Siregar et.al (Siregar et al., 2024) | 2.391 | 0,477131188 | 15 | 15 |
| 30 | Ifa Rodifah Nur et.al (Nur et al., 2024) | 0.779 | 0,387124191 | 14 | 14 |
| 31 | Ubaidillah et.al (Ubaidillah et al., 2024) | 3.262 | 0,415905179 | 27 | 27 |
| 32 | Tawffeek A. S. Mohammed et.al (1) (Mohammed et al., 2020) | 1.074 | 0,386643727 | 15 | 15 |
| 33 | Tawffeek A. S. Mohammed et.al (2) (Mohammed et al., 2020) | 1.249 | 0,395517151 | 15 | 15 |
| 34 | Tawffeek A. S. Mohammed et.al (3) (Mohammed et al., 2020) | 1.329 | 0,399980668 | 15 | 15 |
| 35 | Tawffeek A. S. Mohammed et.al (4) (Mohammed et al., 2020) | 1.831 | 0,432600065 | 15 | 15 |
| 36 | Tawffeek A. S. Mohammed et.al (5) (Mohammed et al., 2020) | 0.843 | 0,376716371 | 15 | 15 |
| 37 | Rajaa Yousef Hawalta (1) ( حولتا, ٢٠٢١) | 2.096 | 0,392493845 | 20 | 20 |
| 38 | Rajaa Yousef Hawalta (2) ( حولتا, ٢٠٢١) | 3.947 | 0,584628239 | 20 | 15 |

**Table 3.** Descriptive Statistics of Included Studies

| Moderator Variables | Identified Categories | Counts (%) |
|---|---|---|
| Sample Size | Small ($N \leq 30$) | 30 (78,95) |
| | Big ($N \geq 30$) | 8 (21,05) |
| Grade Level of Participants | Primary School | 13 (34,21) |
| | Junior High School | 11 (28,95) |

| | | |
|---|---|---|
| | Senior High School | 2 (5,26) |
| | University | 12 (31,58) |
| Country | Indonesia | 15 (39,47) |
| | Malaysia | 5 (13,16) |
| | Saudi Arabia | 6 (15,79) |
| | Egypt | 1 (2,63) |
| | Jordan | 5 (13,16) |
| | Africa | 5 (13,16) |
| Skill Under Measurement | General | 10 (26,32) |
| | Speaking Skill | 3 (7,89) |
| | Writing Skill | 5 (13,16) |
| | Reading Skill | 1 (2,63) |
| | Listening Skill | 2 (5,26) |
| | Vocabulary | 8 (21,05) |
| | Grammar | 4 (10,53) |
| | Language Style | 3 (7,89) |
| Type of Game | Non-Digital Game | 16 (42,11) |
| | Digital Game | 22 (57,89) |

***Heterogenity Test***

**Table 4.** Results of Heterogeneity Test

| tau^2 | Q(df=37) | Het. p-Value | I^2 |
|---|---|---|---|
| **1.046** | 530.279 | < 0.001 | 93.023 |

The heterogeneity test results in Table 4 show substantial variability among the included studies. The between-study variance ($\tau^2$) was 1.046, while Cochran's Q value reached 530.279 with 37 degrees of freedom ($p < 0.001$), indicating significant heterogeneity across studies. In addition, the $I^2$ value of 93.023% shows that most of the variability in effect sizes was caused by real differences among studies rather than sampling error (Higgins et al., 2003).

The high heterogeneity may be related to differences in educational level, country, game type, language skill, intervention characteristics, and study design. Therefore, a random-effects model was used because it accounts for between-study variability. Subgroup analyses based on school level, country, game type, and language skill were also conducted to explore possible sources of heterogeneity. In addition, leave-one-out sensitivity analysis showed that the pooled effect size remained stable after excluding individual studies, indicating that the overall findings were robust and not dominated by any single study.

### *Meta-Analysis of Overall Included Studies*

**Table 5.** Meta-Analysis Result of Overall Included Study

| Estimate | Lower Bound | Upper Bound | Std. Error | P-Value |
|---|---|---|---|---|
| **1,649** | 1,303 | 1.996 | 0.177 | < 0.001 |

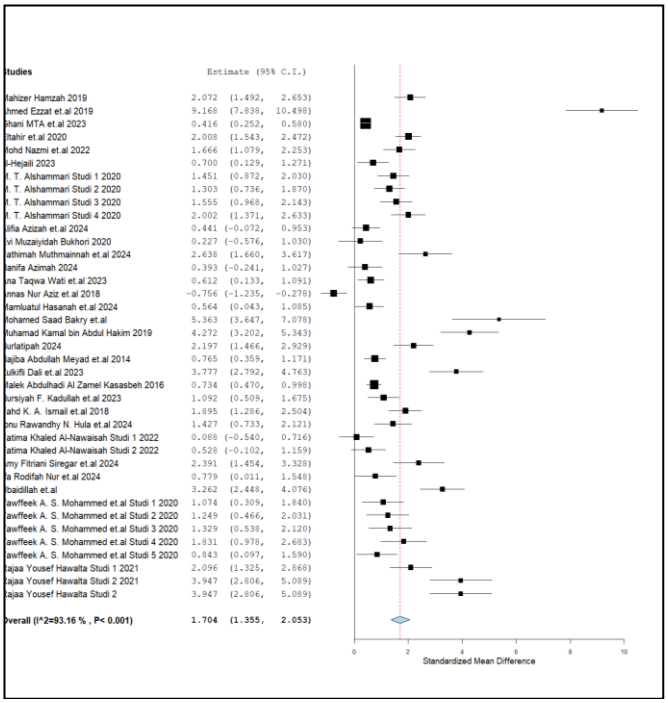


**Figure 2.** Meta-Analysis Result of Overall Included Study

The overall meta-analysis was conducted using a Continuous Random-Effects Model to examine the effectiveness of game-based learning interventions on Arabic language learning outcomes. As shown in Table 5, the pooled effect size was 1.649 (SMD) with a 95% confidence interval of 1.303–1.996 and a standard error of 0.177. Since the confidence interval did not include zero and the p-value was less than 0.001, the overall effect was statistically significant. Based on Cohen's interpretation, this effect size is categorized as large, indicating that game-based learning produced better learning outcomes than conventional instruction.

Figure 2 presents the forest plot of all included studies. Most studies showed positive effect sizes, although the magnitude varied considerably, ranging from -0.756 to 9.168. Only one study reported a negative effect (Aziz et al., 2018), while most studies demonstrated positive and large effects. Overall, the pooled estimate supports the effectiveness of game-based learning across different educational contexts.

However, substantial heterogeneity was identified among the studies ($I^2$ = 93.02%, $p < 0.001$), indicating large variations in effect sizes beyond sampling error. This variation may be related to differences in educational levels, countries, class size, game types, and language skills. Therefore, subgroup and sensitivity analyses were conducted to explore potential sources of heterogeneity and examine the robustness of the findings.

**The Leave-One-Out Analysis**

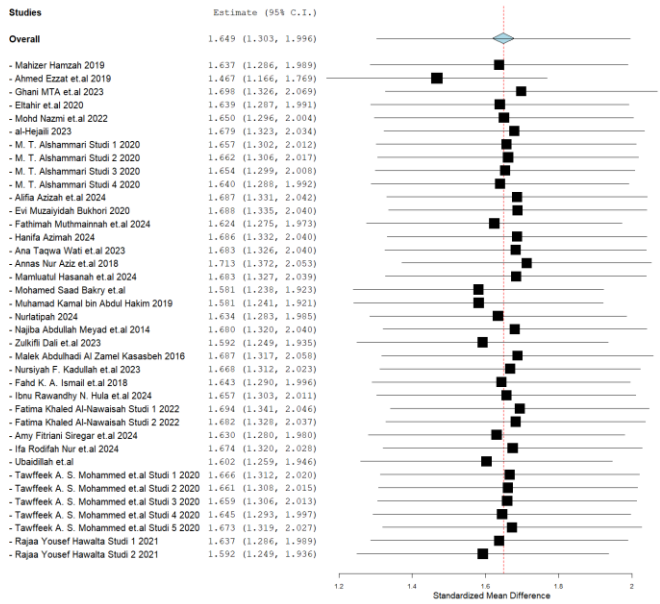


**Figure 3.** *Result of Leave-One-Out Analysis*

Leave-one-out sensitivity analysis in Figure 3 was conducted to examine the robustness of the pooled effect size and identify whether any single study strongly influenced the overall results. The pooled effect size remained relatively stable after each study was excluded, ranging from 1.467 to 1.713. The lowest estimate appeared after excluding (Ezzat, 2019), while the highest occurred when (Aziz et al., 2018) was removed. All pooled estimates remained statistically significant, and the direction of the effect did not change.

These findings indicate that no individual study disproportionately affected the overall meta-analysis results, supporting the robustness and reliability of the positive effect of game-based learning on Arabic language learning outcomes. In addition, the

persistent heterogeneity suggests that the variability was likely caused by multiple study characteristics rather than by a single study.

### *The Analysis of Moderation Variables Based on School Levels*

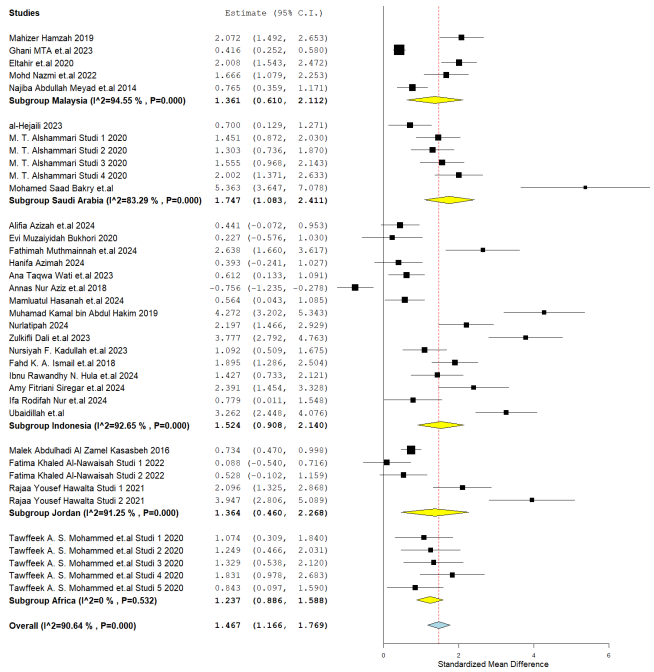


**Figure 4.** *Schools Levels Subgroup Summary*

Figure 4 presents the subgroup analysis based on school level, showing that educational games positively affected Arabic language learning outcomes across all educational levels. The largest effect size was found in primary schools (SMD = 2.103), followed by universities (SMD = 1.629), junior high schools (SMD = 1.309), and senior high schools (SMD = 1.125). These findings indicate that educational games can improve Arabic language learning outcomes at different educational levels.

However, substantial heterogeneity remained in the university, primary school, and junior high school subgroups, indicating considerable variation among studies. In contrast, the senior high school subgroup showed lower heterogeneity, suggesting more consistent findings across studies. Overall, these results suggest that school level alone could not fully explain the variation in effect sizes, and that other factors may also influence the effectiveness of educational games in Arabic language learning.

### *The Analysis of Moderation Variables Based on Countries*

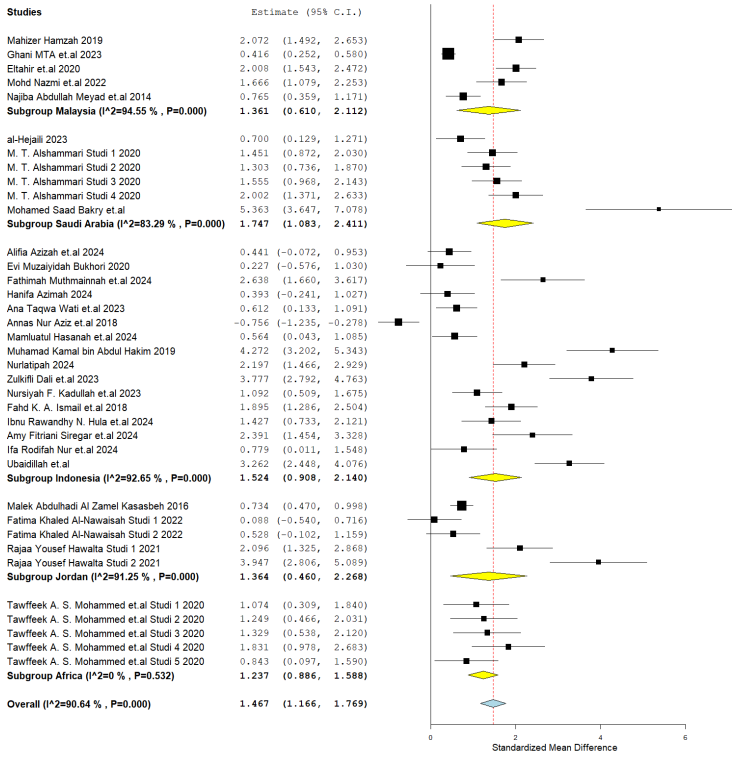


**Figure 5.** Country Subgroup Summary

Figure 5 presents the subgroup analysis based on country, showing that educational games positively affected Arabic language learning outcomes across different countries. The highest pooled effect size was found in Saudi Arabia (SMD = 1.747), followed by Indonesia (SMD = 1.524), Jordan (SMD = 1.364), Malaysia (SMD = 1.361), and Africa (SMD = 1.237). These findings indicate that educational games are effective in improving Arabic language learning outcomes in various geographical contexts.

However, substantial heterogeneity was identified in most country subgroups, especially in Malaysia, Indonesia, Jordan, and Saudi Arabia, indicating considerable variation among studies. In contrast, the Africa subgroup showed no significant heterogeneity, suggesting more consistent findings across studies. Overall, these results suggest that geographical context alone could not fully explain the variability in effect sizes, and that other study-related factors may also influence the effectiveness of educational games in Arabic language learning.

### *The Analysis of Moderation Variables Based on Language Skills*

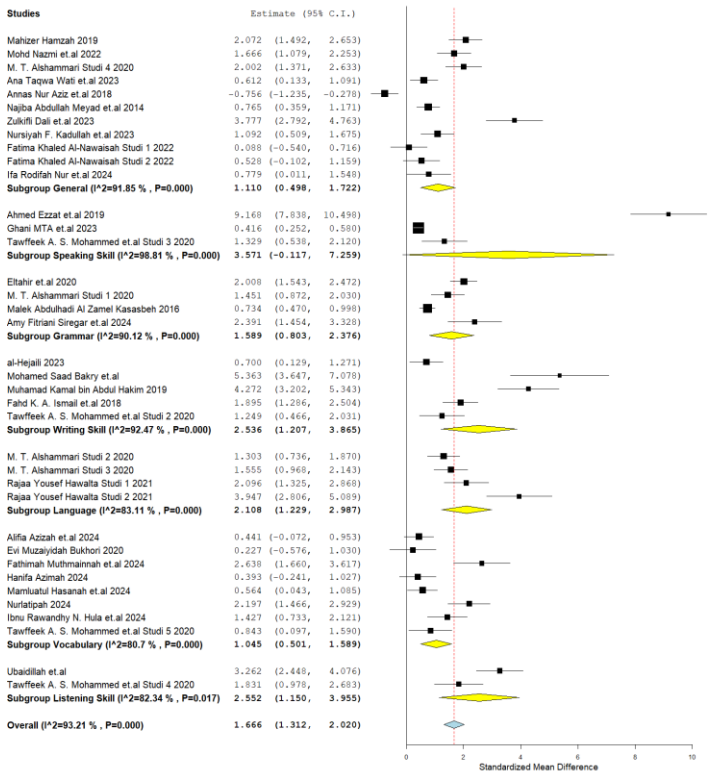


**Figure 6.** Language Skills Subgroups Summary

Figure 6 presents the subgroup analysis based on language skills, showing that educational games positively affected all domains of Arabic language learning. The largest effect size was found in speaking skills (SMD = 3.571), followed by listening (SMD = 2.552), writing (SMD = 2.536), language-related skills (SMD = 2.108), grammar (SMD = 1.589), general Arabic achievement (SMD = 1.110), and vocabulary (SMD = 1.045). These findings suggest that educational games tend to produce stronger effects on productive and communicative skills, especially speaking, listening, and writing.

However, substantial heterogeneity was observed across most subgroups, with $I^2$ values ranging from 80.70% to 98.81%, indicating considerable variation among studies. The speaking subgroup showed the highest heterogeneity and a confidence interval crossing zero, suggesting that the findings should be interpreted cautiously. Overall, these results indicate that language skill type alone could not fully explain the variability in effect sizes, and that other study characteristics may also influence the effectiveness of educational games in Arabic language learning.

## The Analysis of Moderation Variables Based on Type of Games

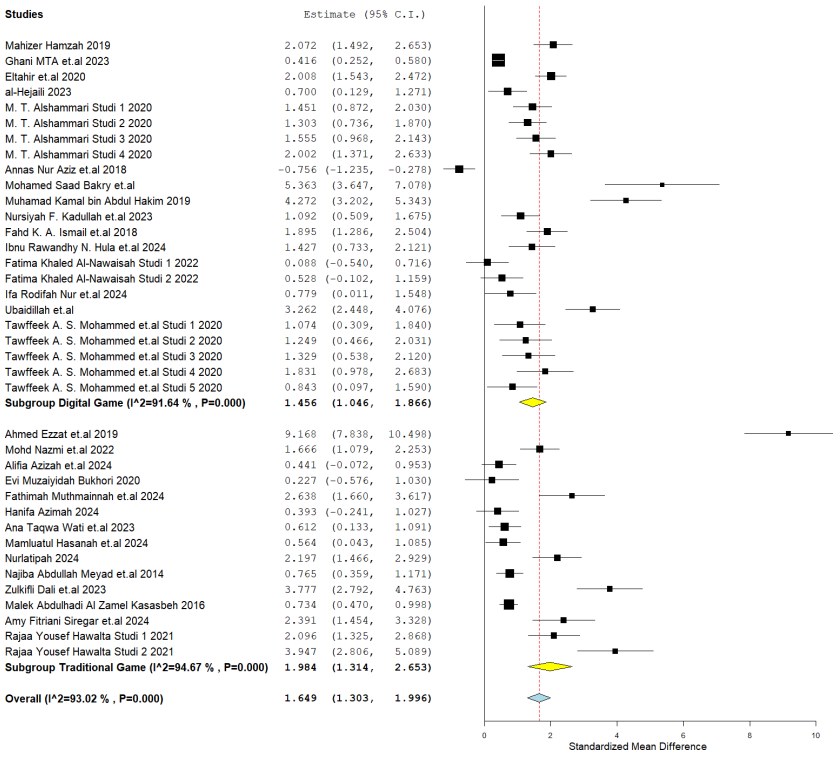


**Figure 7.** Type of Games Subgroups Summary

Figure 7 presents the subgroup analysis based on the type of educational games in Arabic language learning. The results indicate that both digital games and traditional games significantly enhance learning outcomes, with overall standardized mean differences (SMD) of 1.456 (95% CI: 1.046–1.866) for digital games and 1.984 (95% CI: 1.314–2.653) for traditional games, respectively. Heterogeneity within the subgroups remains high, as reflected by $I^2$ values of 91.64% for digital games and 94.67% for traditional games, suggesting substantial variability across individual studies. These findings demonstrate that while both types of educational games are effective, traditional games appear to yield slightly higher effect sizes, highlighting their potential in enhancing Arabic language acquisition across diverse learning contexts.

## The Analysis of Moderation Variables Based on Sample Size

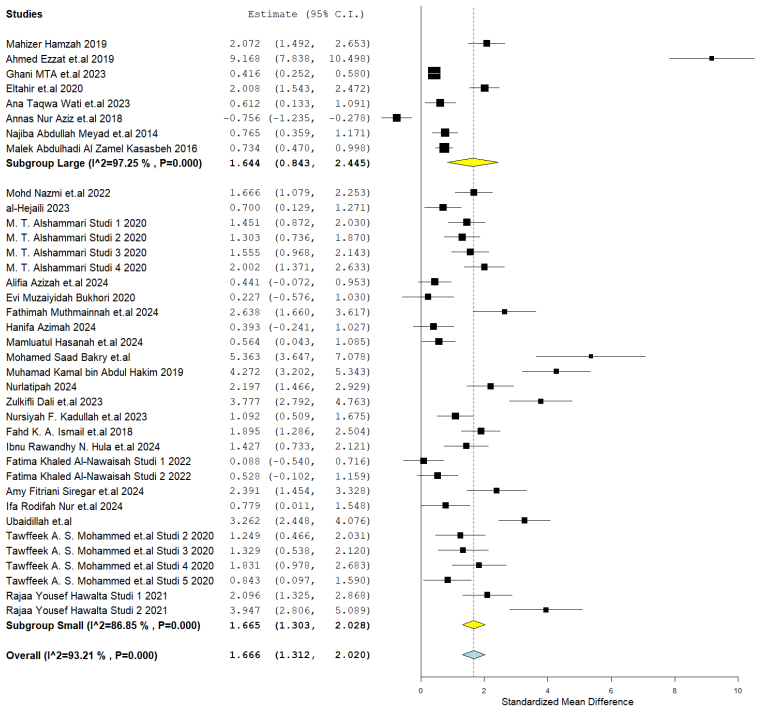


**Figure 8.** Sample Size Subgroups Summary

Figure 8 presents the subgroup analysis based on sample size, dividing studies into large and small sample groups. The results show that educational games positively affected Arabic language learning outcomes in both groups. The small-size subgroup produced an effect size of 1.665, while the large-size subgroup showed a similar effect size of 1.644. These findings indicate that the effectiveness of educational games was relatively consistent across different sample sizes.

However, substantial heterogeneity remained in both subgroups, with $I^2$ values of 86.85% for the small-size group and 97.25% for the large-size group, indicating considerable variation among studies. Overall, the findings suggest that sample size alone could not fully explain the observed heterogeneity, as educational games consistently showed positive effects across both categories.

## The Evaluation of Publication Bias

**Table 5.** Test of Effect

| | t | df | p |
|---|---|---|---|
| **PET** | **-0.858** | **36** | **0.397** |

**Table 6.** Test of Publication Bias

| | t | df | p |
|---|---|---|---|
| **PET** | **5.297** | **36** | **<.001** |

**Table 7.** Mean Estimates (μ)

| | Estimate | Standard Error | t | df | p | 95% Confidence Level | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| **PET** | -0.224 | 0.261 | -0.858 | 36 | 0.397 | -0.736 | 0.288 |
| **PEESE** | 0.290 | 0.155 | 1.872 | 36 | 0.069 | -0.014 | 0.594 |

The PET-PEESE analysis was conducted to examine the potential influence of publication bias on the pooled effect size. The PET test showed a non-significant corrected effect estimate (t = -0.858, p = 0.397), indicating that the adjusted effect did not significantly differ from zero. Therefore, the PET estimate was retained as the final bias-adjusted effect size, with a mean effect of -0.224 (95% CI = -0.736 to 0.288).

However, the publication bias test was significant (t = 5.297, p < 0.001), suggesting the presence of publication bias or small-study effects among the included studies. Although the PEESE estimate showed a positive effect size (μ = 0.290), it was not used for final interpretation because the PET criterion was not fulfilled. Overall, these findings indicate that publication bias may have increased the pooled effect size reported in the main meta-analysis.

## Discussion

Educational games have emerged as an innovative approach in Arabic language learning. The findings of this meta-analysis indicate that educational games have a significantly positive effect on Arabic language learning outcomes. Elements such as rewards, challenges, and leaderboards were found to increase students' motivation and engagement (Almelhes, 2024; Arribathi et al., 2024; Hejaili & Newbury, 2023). These findings are consistent with previous studies showing that educational games can create more interactive and enjoyable learning environments that improve students'

achievement across various language skills (Al-Razgan & Alshaarri, 2020; Mohammed et al., 2021; T. Alshammari, 2020).

However, the effectiveness of educational games is influenced by several factors, including students' age, educational level, and the type of games used. This study found that primary school students tended to respond more positively to educational games than older students. In addition, traditional games produced slightly higher effect sizes than digital games, although both types were effective. Previous studies suggest that technology-based games provide flexibility and attractive visual features that support learning engagement (C.-Y. Chen et al., 2024; Reynaldo et al., 2021; Zahari et al., 2024).

This study also showed that educational games positively affected both small and large classes. However, successful implementation in large classrooms depends on teachers' ability to manage game-based activities effectively (Kallookaran & Robra-Bissantz, 2016; Memar et al., 2021). Furthermore, educational games demonstrated stronger effects on productive and communicative language skills, especially listening and writing. The interactive nature of educational games supports activities such as quizzes, collaboration, and communication exercises, which contribute to improving these skills (Andreeva, 2024; Casanova-Mata, 2023; Mohamad et al., 2024).

The COVID-19 pandemic also accelerated the use of educational games in online Arabic language learning environments (Mustapa et al., 2022). Nevertheless, technological limitations remain a challenge in implementing educational games effectively (Stateri, 2024). Overall, this study supports the view that educational games are an effective approach in Arabic language learning. However, their implementation requires careful planning, adaptation to students' needs, and appropriate technological support to create meaningful and engaging learning experiences.

## Conclusion

This meta-analysis synthesized findings from 31 studies reporting 38 independent effect sizes to examine the effectiveness of educational games in Arabic language learning. The overall random-effects model showed a statistically significant and large positive effect (SMD = 1.649, 95% CI = 1.303–1.996), indicating that educational games generally improve Arabic language learning outcomes compared with conventional instruction. Sensitivity analysis confirmed the robustness of the findings,

while subgroup analyses showed positive effects across different educational levels, countries, language skills, game types, and sample sizes. The strongest effects were found among primary school students, studies conducted in Saudi Arabia, and interventions targeting speaking, listening, and writing skills. Traditional games produced slightly larger effects than digital games, while similar results appeared across different sample-size categories. Overall, these findings suggest that educational games are a promising instructional approach for improving Arabic language learning outcomes in various educational contexts.

However, substantial heterogeneity remained across most subgroups, indicating that the effectiveness of educational games was influenced by various contextual and instructional factors. PET-PEESE analysis also identified publication bias and small-study effects, suggesting that the pooled effect size may have been overestimated. In addition, this study was limited by the small geographical coverage and the absence of several moderating variables, such as intervention duration, game design, teacher competency, and technological infrastructure. Despite these limitations, this study contributes to Arabic language education research by providing a comprehensive overview of the effectiveness of educational games. Future studies should involve broader geographical contexts, additional moderators, and larger samples to produce more accurate findings.

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