



Does Class Size Matter? A Reassessment of the Moderating Role of Class Size on the Effectiveness of E-Learning in Arabic Language Acquisition

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Abstract

This study investigates the effect of e-learning on Arabic language learning outcomes, with a particular focus on how class size moderates this relationship. Despite the growing use of e-learning in education, the impact of class size on its effectiveness remains unclear. The objective of this study is to assess the effect size of e-learning on Arabic language learning across different class sizes and to explore the moderating role of class size in this relationship. Using a meta-analysis approach, data from 21 studies were analyzed with OpenMee Software. The results show that e-learning has a significant positive effect on Arabic language learning, with a larger effect observed in larger classes compared to smaller ones. Specifically, larger classes are found to provide more opportunities for interaction, which enhances student engagement and learning outcomes. These findings challenge the traditional belief that smaller classes are inherently more effective. The study highlights the importance of class size as a moderating variable in the effectiveness of e-learning and provides valuable insights into how e-learning strategies can be optimized for different class sizes. However, the study is limited by the focus on Arabic language learning and the small number of studies analyzed. Future research should explore the impact of e-learning in other subject areas and conduct longitudinal studies to assess the long-term effects of e-learning on language learning outcomes.

Keywords:

Meta-Analysis, E-Learning, Arabic Language Teaching, Size Class

A. INTRODUCTION

E-learning has become an integral part of modern education, particularly since the COVID-19 pandemic, which accelerated the widespread adoption of educational technology. In the context of language learning, especially Arabic, e-learning offers significant flexibility, enabling students to access learning materials anytime and anywhere (Kern, 2024). Arabic, as a language

with a complex grammar structure and unique vocabulary, presents particular challenges in the learning process, especially in countries where Arabic is not actively used in daily life. The issue of e-learning effectiveness in Arabic language learning has become increasingly important, given these challenges and the growing global demand for proficiency in this language (Aosh, 2001). However, while technology has proven to offer significant opportunities in language learning (Fajaruddin et al., 2024).

According to existing literature, several studies have shown that e-learning has had a positive impact on foreign language teaching, including Arabic. For instance, studies discussing the learning of English or other foreign languages have shown that e-learning can increase student engagement and improve learning outcomes (Burston & Giannakou, 2022; Dixon et al., 2022). However, research on the influence of class size in e-learning, specifically for Arabic, remains limited. Other studies have shown that big class size in e-learning settings, can negatively impact the quality of interaction between students and instructors (Monks & Schmidt, n.d.). Larger class sizes may reduce students' opportunities to interact directly with the instructor, which can affect their understanding of the material and mastery of the language (Russell & Curtis, 2013). Additionally, smaller classes allow for more intensive interactions (Deutsch, 2003), but in the context of e-learning, factors such as platform design and the type of materials provided can also moderate these effects (Kizi, 2024; R. Lee & Faulkner, 2011).

The main argument in this research is that class size can influence the effectiveness of Arabic language learning through e-learning. In educational theory, larger class sizes are generally associated with limitations in student-teacher interaction, which can impact the level of student engagement in the learning process (De Matos-Ala & Hornsby, 2015). On the other hand, smaller classes allow for more individualized attention from instructors (Exeter et al., 2010), which can enhance understanding of the material and language mastery, especially in Arabic, which has unique structural and vocabulary characteristics. However, in e-learning platforms, student engagement is not only influenced by class size but also by the quality of the platform and how the materials are delivered. Therefore, the hypothesis posited is that class size moderates the impact of e-learning on Arabic language learning outcomes, with smaller classes potentially being more effective, although other factors, such as the platform used, can also play an important role.

The aim of this study is to measure the effect size of e-learning on Arabic language learning across different class sizes and to assess the moderating effect of class size on the relationship between e-learning and Arabic language learning outcomes. This study uses a meta-analytic approach to synthesize findings from existing research to provide a clearer understanding of the relationship between class size and the effectiveness of Arabic language learning through e-learning. It is expected that this research will offer valuable insights for educators in designing more effective and contextually relevant e-learning strategies, particularly for Arabic language instruction. By considering factors such as class size in e-learning platforms, this research is also expected to assist policymakers in formulating educational policies that support the optimization of e-learning, thereby improving Arabic language proficiency among students.

B. METHODS

1. Data Selection Process

This study collected 21 studies that met the eligibility criteria, resulting in 28 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 (N_e) and control (N_c) groups. Table 3 includes the results of the moderation variable analysis, covering the number of students.

Table 1. Inclusion and Exclusion Criteria

Criteria	Included	Excluded
Open Access	All open access	Gold, hybrid gold, bronze, green
Years	2015 - 2025	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)	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

Data collection was carried out across multiple databases between September 25 and 26, 2025. On September 25, data were obtained from Google Scholar using the keyword “*Arabic Language Learning E-Learning*” (680 documents) and from Scopus using the query *TITLE-ABS-KEY (Arabic-language-learning OR Arabic-language-teaching OR Arabic-language-education OR teaching-Arabic AND E-Learning)* (24 documents). On September 26, an additional Scopus search with *TITLE-ABS-KEY (Arabic-language-learning OR Arabic-language-teaching OR Arabic-language-education OR teaching-Arabic AND Online-Learning) AND PUBYEAR > 2015 AND PUBYEAR < 2025* retrieved 54 documents. From the Web of Science (WoS) database, two searches were conducted: the first on September 25 using *Arabic-language-learning OR Arabic-language-teaching OR Arabic-language-education OR teaching-Arabic AND Online-Learning* (207 documents), and the second on September 26 using *Arabic-language-learning OR Arabic-language-teaching OR Arabic-language-education OR teaching-Arabic AND E-Learning* (204 documents).

A total of 1,169 records were initially retrieved and subsequently screened based on the inclusion and exclusion criteria summarized in Table 2. After the screening process, 21 studies met all eligibility requirements. However, as shown in Table 3, these 21 studies yielded 28 independent samples for meta-analysis because two of them (al-Kināni, 2018; I. N. Hassan et al., 2021; Muflihah et al., 2025) reported multiple experimental groups.

2. Data Analysis Procedure

This study aims to assess the impact of class size on the effectiveness of online learning in Arabic language acquisition. Data will be analyzed using OpenMEE software (<http://www.cebm.brown.edu/openmee/index.html>), designed for meta-analysis in biological and ecological research. Continuous outcome data, representing the mean values of experimental groups (control vs. treatment), will be compiled into a comma - separated value (CSV) file and uploaded. The effect size for each outcome will be calculated using Hedges’ g within a random-effects model, often employed to present standardized mean differences (SMD) between treatment and control groups.

Hedges’ g is selected to mitigate potential bias due to small sample sizes, calculated as: $g \approx d \times (1 - 3 / (4(n_1 + n_2) - 9))$ where n_1 and n_2 are the sample sizes of the treatment and control groups, respectively (Hedges & Olkin, 1985). A random-effects model with a 95% confidence interval (CI) will be used for robust statistical analysis. The use of Hedges’ g is particularly beneficial in small sample contexts (Wu et al., 2006). A positive Hedges’ g value ($P < 0.05$) will indicate a greater effect in the treatment group compared to the control group.

The study will also examine moderator variables such as school level, country, game type, language skills, and sample size through subgroup meta-analysis in OpenMEE, using a Continuous Random Effects Model with SMD. This approach will evaluate how factors like class size influence online learning effectiveness in Arabic language acquisition (Goldstein et al., 2000). Subgroups

with fewer than two comparisons will be excluded from the meta-analysis, following Orwin's procedure (Orwin, 1983).

Heterogeneity will be assessed using the DerSimonian and Laird Q test, and the heterogeneity index (I^2) will be calculated, with significance set at $P < 0.05$ (Biggerstaff & Jackson, 2008). Heterogeneity will be categorized as: none ($0 < I^2 \leq 25\%$), low ($25\% < I^2 \leq 50\%$), moderate ($50\% < I^2 \leq 75\%$), and high ($I^2 > 75\%$) (White et al., 2024). To assess publication bias, OpenMEE will use the fail-safe N method (Rothstein, 2008). The fail-safe N method will estimate how many unpublished studies with non-significant results are required to make the mean effect size statistically insignificant (Gleser & Olkin, 1996).

C. RESULT & DISCUSSION

1. Summary of Included Studies

Table 1. Summary of Meta-Analysis Studies

No	Study	Ne	Nc	g	SE	Class Size
1.	(T. Alshammari, 2020)	28	30	0,233641	0,261908	Small Class
2.	(E. A. Hassan et al., 2021)	30	30	2,669926	0,354946	Small Class
3.	(Al-Ghifari et al., 2025)	36	36	1,056479	0,250586	Big Class
4.	(I. N. Hassan et al., 2021)1	16	18	-0,08166	0,339658	Small Class
5.	(I. N. Hassan et al., 2021)2	8	10	-1,0899	0,498931	Small Class
6.	(Alqatawneh & Alsahhi, 2025)	37	38	1,144029	0,248212	Big Class
7.	(Al-bordeini, 2020)	25	25	-4,4481	0,52892	Small Class
8.	(Abdul-Hameed, 2023)	39	42	6,424986	0,553396	Big Class
9.	(Ali et al., 2021)	30	30	5,961983	0,604904	Small Class
10.	(Muflihah et al., 2025)1	42	41	1,781906	0,258958	Big Class
11.	(Muflihah et al., 2025)2	43	43	-1,78122	0,254378	Big Class
12.	(Muflihah et al., 2025)3	42	24	0,425063	0,257082	Big Class
13.	(Aldhafiri, 2020)	30	30	0,612874	0,262626	Small Class
14.	(Yuspa & Bahsin, 2025)	17	17	1,296615	0,374419	Small Class
15.	(al-Kināni, 2018) 1	15	15	1,071226	0,386505	Small Class
16.	(al-Kināni, 2018) 2	15	15	1,246144	0,395386	Small Class
17.	(al-Kināni, 2018) 3	15	15	1,328516	0,399953	Small Class
18.	(al-Kināni, 2018) 4	15	15	1,83076	0,4326	Small Class
19.	(al-Kināni, 2018) 5	15	15	0,843427	0,376716	Small Class
20.	(Ismail et al., 2023)	40	40	2,590254	0,303084	Big Class
21.	(AL-Rashidi & Alghattami, 2019)	35	34	0,212914	0,240133	Big Class
22.	(Rahimi et al., 2021)	23	23	0,27725	0,293796	Big Class
23.	(Nurlaila et al., 2025)	32	32	0,20103	0,249119	Big Class
24.	(M. A. Hassan & Fook, 2014)	85	85	0,052076	0,153076	Big Class
25.	(Putri et al., 2025)	15	15	1,346925	0,401007	Small Class
26.	(Hawamdeh et al., 2025)	20	20	0,495631	0,318035	Small Class
27.	(Nurlaila et al., 2025)	14	13	0,397963	0,38325	Small Class
28.	(Wahyudi et al., 2022)	14	14	-0,72678	0,385242	Small Class

Table 1 provides a summary of various meta-analysis studies focusing on the moderating effect of class size on the effectiveness of e-learning. The table presents various key statistics, including the number of participants in the experimental group (Ne) and control group (Nc), effect size (g), standard error (SE), and class size classification (small class with fewer than 30 students, and big class with more than 30 students). For example, the study by (T. Alshammari, 2020), with 28 participants in the experimental group and 30 in the control group, shows a small effect size of 0.23 in a small class setting. In contrast, the study by (Abdul-Hameed, 2023), with 39 participants in the experimental group and 42 in the control group, demonstrates a significantly higher positive effect size of 6.42 in a big class setting.

The table also highlights a range of effect sizes across studies, illustrating how class size can influence learning outcomes in e-learning contexts. Several studies report negative effect sizes, such as those by (I. N. Hassan et al., 2021) and (Al-bordeini, 2020), indicating that smaller class sizes do not always yield better results. On the other hand, studies conducted in larger classes, such as those by (Abdul-Hameed, 2023) and (Muflihah et al., 2025), show larger positive effect sizes, suggesting that big classes may be more effective for certain learning strategies or in specific contexts. The variation in effect sizes highlights the complex nature of class size as a moderator in e-learning effectiveness, with implications for the design and implementation of online learning programs. However, to determine whether e-learning is overall effective for Arabic language learning, this will be explained in Table 3 and Figure 1. Furthermore, to identify which class size is most effective, a subgroup analysis will be conducted, and the details can be found in Table 4 below.

2. Heterogeneity Test

Table 2. Heterogeneity Test

τ^2	$Q(df=41)$	Het. p-Value	I^2
1.926	553.542	<0.001	95.122

Table 2 presents the results of the heterogeneity test conducted in the meta-analysis. The tau-squared (τ^2) value is 1.926, indicating a significant amount of variability between the studies included in the analysis. The Q-statistic with 41 degrees of freedom is 553.542, which is highly significant with a p-value of less than 0.001. This suggests that there is substantial heterogeneity across the studies, meaning that the effect sizes differ considerably from one study to another. The I^2 value of 95.122% further confirms the high degree of heterogeneity, indicating that approximately 95% of the variability in effect sizes is attributable to differences between the studies rather than sampling error. These results emphasize the importance of considering study-specific factors when interpreting the overall effect in this meta-analysis.

3. Meta Analysis of Overall Included Studies

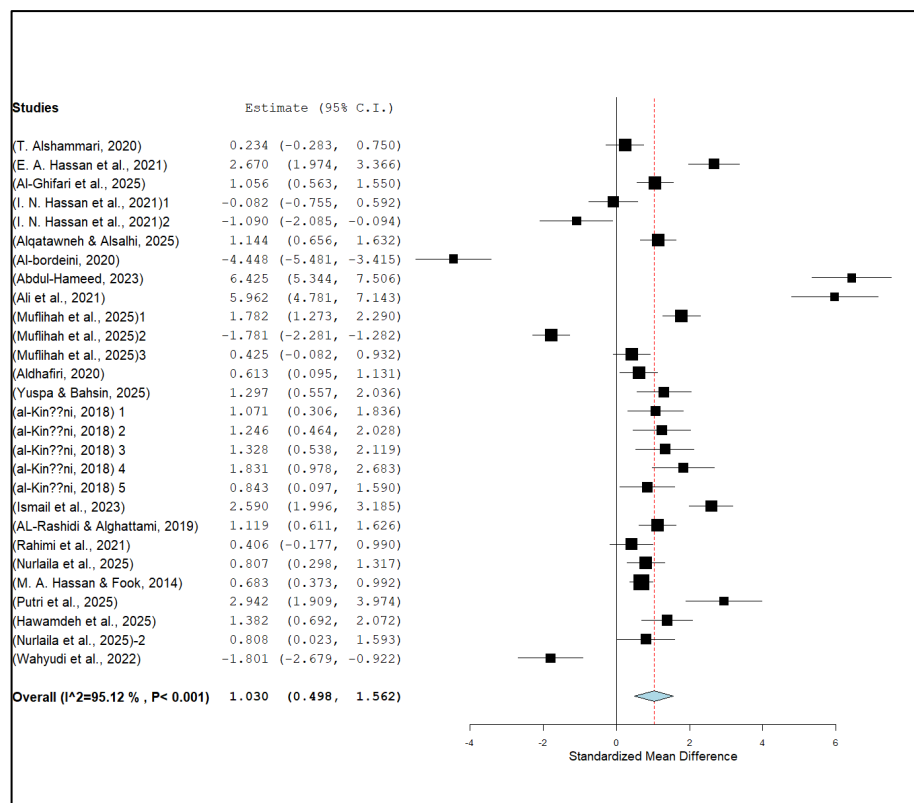


Figure 1. Forest Plot of Overall Included Studies

Table 3. Meta-Analysis Result of Overall Included Study

Estimate	Lower Bound	Upper Bound	Std. Error	P-Value
1.030	0.498	1.562	0.272	< 0.001

The forest plot in the figure 3 displays the results of individual studies included in the meta-analysis, along with their estimated standardized mean differences (SMD) and corresponding 95% confidence intervals (C.I.). Each study is represented by a square, where the size of the square indicates the weight of the study in the analysis, and the horizontal line through each square represents the confidence interval. The vertical dashed line at 0 indicates no effect, and studies to the right of this line suggest a positive effect, while those to the left suggest a negative effect. Most studies show a wide range of effects, with several studies ((e.g., Abdul-Hameed, 2023) reporting large positive effects, while others (e.g., Al-bordeini, 2020) show negative effects. The overall estimate at the bottom shows a pooled standardized mean difference of 1.030 with a 95% confidence interval of (-1.562, -0.498), suggesting a small but statistically significant effect of the intervention. The I^2 value of 95.12% indicates a high level of heterogeneity among the studies, reinforcing the need to consider individual study differences when interpreting the overall result.

Furthermore, table 3 presents the meta-analysis results of the overall included studies. The estimate value is 1.030, indicating a positive effect size of the intervention. The 95% confidence interval ranges from 0.498 to 1.562, suggesting that the true effect size is likely to fall within this range. The standard error is 0.272, which reflects the precision of the estimate. The p-value is less than 0.001, indicating that the result is statistically significant. This table supports the findings shown in the forest plot, confirming that, despite variability across individual studies, the overall effect of the intervention is positive and significant.

4. The Analysis of Moderation Variables Based on Size Class

Table 4. The Analysis of Moderation Variables Based on Size Class

Studies	Estimate	Lower Bound	Upper Bound	Std. Error	p-Value
Small Class	0.863	0.081	1.645	0.399	0.031
Big Class	1.274	0.491	2.056	0.001	0.001
Overall	1.030	0.498	1.562	0.272	< 0.001

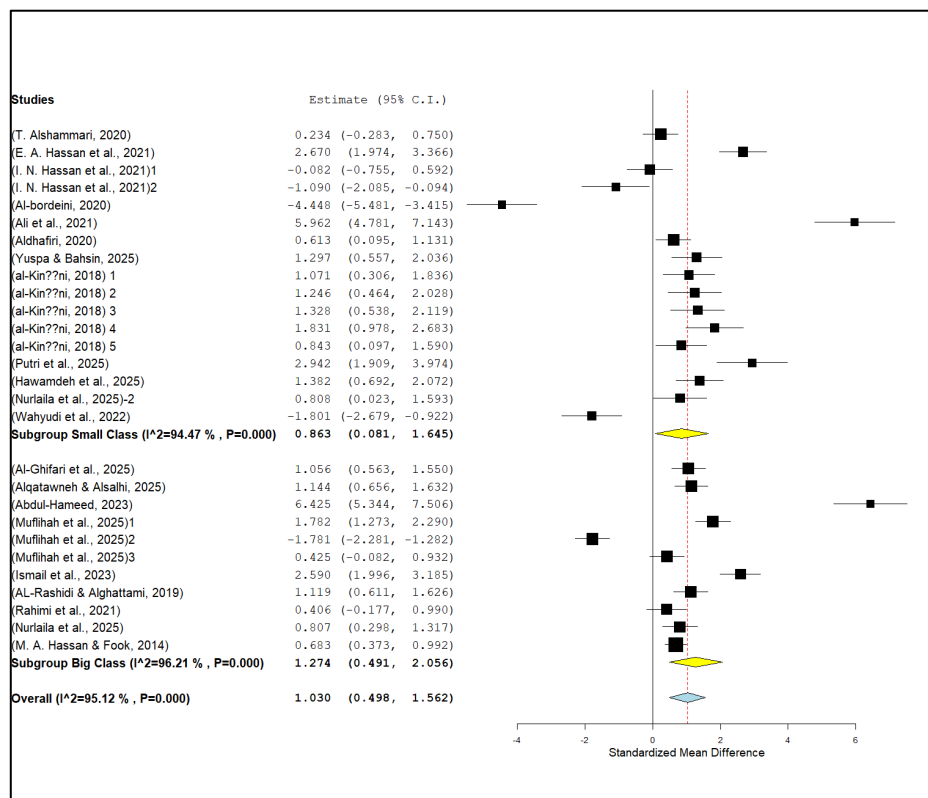


Figure 2. forest plot of the subgroup analysis based on class size

Table 4 and figure 2 presents the analysis of moderation variables based on class size, comparing the effect of the intervention in small and big classes. For small classes, the estimate is 0.863, with a 95% confidence interval ranging from 0.081 to 1.645. The standard error is 0.399, and the p-value is 0.031, indicating a statistically significant effect for small classes. This suggests that, in smaller class settings, the intervention has a positive impact, although the effect size is smaller compared to larger classes.

In contrast, for big classes, the estimate is 1.274, with a 95% confidence interval ranging from 0.491 to 2.056. The standard error is minimal at 0.001, and the p-value is 0.001, also indicating a statistically significant effect. This suggests that the intervention has a stronger and more significant effect in larger class sizes. The overall analysis, combining both small and big classes, shows an estimate of 1.030, with a confidence interval of 0.498 to 1.562 and a p-value of less than 0.001, confirming the overall positive and significant impact of the intervention across all studies. Based on these results, it is evident that class size as a moderating variable affects the effectiveness of e-learning in Arabic language learning. Both variables show significant influence, but the big class has a larger estimate value than the small class, indicating that larger classes are more effective for e-learning in Arabic language learning.

5. The Evaluation of Publication Bias

Table 5. The Evaluation of Publication Bias

Parameter	Value
Observed Significance Level	<.0001
Target Significance Level	0.05
Fail-Safe N	2335

Table 5 presents the evaluation of publication bias for the studies included in the meta-analysis. The observed significance level is reported as <0.0001, which is much smaller than the target significance level of 0.05, indicating a strong statistical significance and suggesting that publication bias is unlikely to have a substantial effect on the results. Additionally, the Fail-Safe N

is 2335, which represents the number of missing studies that would be required to nullify the overall effect. This large value further supports the robustness of the findings, implying that the results are not significantly affected by potential publication bias.

The results of the study above show a large and statistically significant overall effect of e-learning in Arabic language acquisition, as evidenced by the pooled standardized mean difference (SMD) of 1.030. These findings are in line with several previous meta-analytic studies, such as those conducted by (S. Lee et al., 2022; Xu et al., 2019) which utilized learning application media, (Sharifi et al., 2018) which employed computer media, (H. Lee & Lee, 2024) which applied Artificial Intelligence in e-learning-based language learning. All of these meta-analytic studies reported large positive effects of e-learning interventions. However, these findings also need to consider various factors that contribute to the success of e-learning, such as elaborated feedback compared to feedback regarding the correctness of the answer (Van der Kleij et al., 2015) and accessibility to technology (Alam et al., 2023).

Furthermore, while some of the aforementioned meta-analytic studies found e-learning to be effective in language learning, and the findings of this study also support that, several earlier studies have revealed that e-learning is not always effective. For example, (Bird et al., 2022) found that e-learning had a moderate negative impact (3%-6%) on course completion at community colleges in Virginia. Similarly, (Admiraal & Lockhorst, 2009) noted that although e-learning can be an effective tool, its implementation is hindered by attitudinal barriers and technological infrastructure limitations in many small businesses, and if e-learning is not managed well, it can also negatively affect students' psychological health, such as causing excessive stress (Wang & Zhang, 2023). However, it must be understood that traditional and e-learning approaches are not inherently better or worse than traditional instruction. Instead, they serve different and complementary purposes. Each method has its advantages and is suitable for different educational needs (Cook, 2009).

When considering the moderating effects of class size, this study shows that larger classes tend to produce more significant effects on the effectiveness of e-learning in Arabic language learning. The results from **Table 4** and **Figure 2** show that large classes have a higher estimate value (1.274) compared to small classes (0.863), both of which demonstrate statistically significant effects. These findings are consistent with research by which suggests that larger classes can provide more opportunities for diverse interactions, facilitated by short lectures and class-wide discussions, which are key to the success of active learning in large classrooms. Additionally, previous studies have also shown that the large scale of online classes and the diversity of students can create better educational experiences, where more diverse discussions can increase student engagement and learning outcomes (Kulkarni, 2014). Although large classes are difficult to manage, they can increase student participation and engagement when supported by appropriate e-learning strategies.

However, these findings are contrary to earlier studies that emphasize the benefits of smaller class sizes for language learning, such as those by (Blatchford et al., 2001, 2001; Deutsch, 2003; Russell & Curtis, 2013), which reported that smaller classes offer more personalized attention and facilitate better communication between students and instructors. Based on these results, it is clear that class size plays an important moderating role in the effectiveness of e-learning in Arabic language learning, with larger classes yielding stronger outcomes. This indicates that further research is needed to explore how specific strategies can maximize the effectiveness of e-learning in both small and large classes.

D. CONCLUSION

The results of this study indicate that e-learning has a significant impact on Arabic language learning overall, as evidenced by the positive and statistically significant effect size. The study also reveals that class size plays a crucial role as a moderating variable in the relationship between e-learning and Arabic language learning outcomes. Larger classes have proven to be more effective in supporting the success of e-learning compared to smaller classes. This suggests that although e-learning can be effectively applied in various class sizes, larger classes yield better

results in the context of Arabic language learning, due to the broader opportunities for interaction among students and increased engagement in class discussions. This finding challenges the traditional view that smaller classes are more effective.

The main contribution of this study is the discovery that class size can moderate the effectiveness of e-learning in Arabic language learning, thereby enriching our understanding of the factors influencing learning outcomes in online settings. However, the limitations of this study include the limited variables tested and the focus on Arabic language instruction, which may not be generalizable to other subjects or educational contexts. Furthermore, this study relied on data from only 21 studies. For future research, it is recommended to explore further how e-learning teaching strategies can be optimized in both small and large classes, as well as conducting longitudinal studies to examine the long-term impact of e-learning on Arabic language learning.

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