

Instructional Media and Arabic Vocabulary Mastery: A Meta-Analysis

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Article History	ABSTRACT
Received 09-03-2026	Background: Instructional media are widely implemented in Arabic vocabulary learning, yet their overall effectiveness and the contextual factors influencing their impact require quantitative synthesis. Purpose: This study aimed to estimate the pooled effect size of instructional media on students' Arabic vocabulary mastery and to examine whether effect size variations were influenced by media type, sample size, and publication year. Method: A quantitative meta-analysis using a random-effects model was conducted on ten one-group pretest–posttest experimental studies at the junior secondary school level. Studies were systematically identified from SINTA-indexed journals and the official website of the <i>Perkumpulan Pengelola Jurnal Kajian Bahasa Arab</i> (PPJKBA) following PRISMA 2020 guidelines and predefined inclusion criteria. Effect sizes were calculated using Cohen's <i>d</i> and corrected to Hedges' <i>g</i>, with standardized mean differences computed using the pooled standard deviation of pretest and posttest scores as the standardizer. Statistical analyses were performed using JASP. Results and Discussion: The meta-analysis revealed a large and statistically significant pooled effect size (SMD = 2.549; 95% CI [1.388, 3.710]; $p < 0.001$), indicating substantial improvements in Arabic vocabulary mastery. However, heterogeneity was very high ($I^2 = 94.43\%$), and the 95% prediction interval (−0.99 to 6.08) included zero, suggesting considerable variation in true effects across educational contexts. Moderator analysis showed no significant differences according to media type, sample size, or publication year. Potential publication bias was indicated by significant Begg's test (Kendall's $\tau = 0.854$, $p < 0.001$) and Egger's regression test ($t = 8.448$, $p < 0.001$). Conclusions and Implications: Instructional media have a strong positive effect on Arabic vocabulary learning outcomes and support the integration of diverse instructional media in vocabulary instruction, although the pooled effect size may be overestimated due to the exclusive use of one-group pretest–posttest designs. Future research is encouraged to explore additional contextual and pedagogical moderators.
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	ABSTRAK

Latar Belakang: Media pembelajaran telah banyak digunakan dalam pembelajaran kosakata bahasa Arab, namun efektivitas keseluruhannya serta faktor-faktor kontekstual yang memengaruhi dampaknya masih memerlukan sintesis kuantitatif.

Tujuan: Penelitian ini bertujuan untuk mengestimasi ukuran efek gabungan penggunaan media pembelajaran terhadap penguasaan kosakata bahasa Arab siswa serta menguji apakah variasi ukuran efek dipengaruhi oleh jenis media, ukuran sampel, dan tahun publikasi.

Metode: Penelitian ini menggunakan meta-analisis kuantitatif dengan model efek acak (*random-effects model*) terhadap sepuluh studi eksperimen dengan desain satu kelompok pretest–posttest pada tingkat sekolah menengah pertama. Studi diidentifikasi secara sistematis dari jurnal terindeks SINTA dan situs resmi Perkumpulan Pengelola Jurnal Kajian Bahasa Arab (PPJKBA) berdasarkan pedoman PRISMA 2020 dan kriteria inklusi yang telah ditetapkan. Ukuran efek dihitung menggunakan Cohen's *d* dan dikoreksi menjadi Hedges' *g*, dengan *standardized mean difference* dihitung menggunakan simpangan baku gabungan dari skor pretest dan posttest sebagai pembanding (*standardizer*). Analisis statistik dilakukan menggunakan JASP.

Hasil dan Pembahasan: Meta-analisis menunjukkan ukuran efek gabungan yang besar dan signifikan secara statistik (SMD = 2,549; IK 95% [1,388–3,710]; $p < 0,001$), yang mengindikasikan peningkatan yang substansial pada penguasaan kosakata bahasa Arab siswa. Namun, heterogenitas sangat tinggi ($I^2 = 94,43\%$), dan *prediction interval* 95% (–0,99 hingga 6,08) mencakup nilai nol, yang menunjukkan adanya variasi efek yang cukup besar pada berbagai konteks pendidikan. Analisis moderator menunjukkan tidak adanya perbedaan ukuran efek yang signifikan berdasarkan jenis media, ukuran sampel, maupun tahun publikasi. Potensi bias publikasi ditunjukkan oleh hasil uji Begg yang signifikan (Kendall's $\tau = 0,854$; $p < 0,001$) dan uji regresi Egger ($t = 8,448$; $p < 0,001$).

Kesimpulan dan Implikasi: Media pembelajaran memberikan pengaruh positif yang kuat terhadap hasil pembelajaran kosakata bahasa Arab dan mendukung integrasi berbagai jenis media pembelajaran dalam pembelajaran kosakata, meskipun ukuran efek gabungan kemungkinan mengalami overestimasi akibat penggunaan desain satu kelompok pretest–posttest pada seluruh studi. Penelitian selanjutnya disarankan untuk mengeksplorasi moderator kontekstual dan pedagogis lainnya.

Kata Kunci

Penguasaan Kosa-Kata Bahasa Arab; Media Pembelajaran; Meta-Analysis



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INTRODUCTION

Instructional media shape the success of Arabic language learning by clarifying linguistic concepts and strengthening students' skills.[1] Vocabulary learning sits at the centre of this, underpinning language acquisition and the development of all four language skills. Over the past two decades, advancements in educational technology have given rise to various forms of digital instructional media, such as interactive applications, online learning platforms, and educational videos, aimed at enhancing learning effectiveness and student engagement.[2] On the other hand, conventional instructional media such as textbooks, whiteboards, vocabulary cards, and posters remain widely used in *madrasah* settings,[3] particularly at the junior secondary school level. This condition indicates the existence of two primary approaches in Arabic language instruction, namely digital and conventional media, both of which contribute to supporting vocabulary learning.[4]

Theoretically, the effectiveness of instructional media can be explained through Mayer's Cognitive Theory of Multimedia Learning, which emphasizes the integration of verbal and visual channels to enhance information processing.[5] Meanwhile, Edgar Dale's Cone of Experience

theory suggests that learning experiences progress from concrete to abstract forms and remains relevant in facilitating students' understanding of linguistic symbols.[6]

Despite the rapid development of digital media, previous studies have reported mixed findings regarding the effectiveness of digital media compared to conventional media in vocabulary instruction. Several studies indicate that digital media significantly enhance students' motivation and learning outcomes, whereas other research demonstrates that game-based conventional media also produce substantial improvements. A study conducted by Eva Latifah Fauziah and Agus Umar Abdul Aziz (2024) found that the use of the Assemblr Edu application based on augmented reality technology increased vocabulary acquisition and text comprehension by 24%. This finding suggests that digital instructional media are effective in improving students' motivation and engagement in the learning process.[7]

In contrast, a study by Ayu Anggraini (2023) revealed that conventional instructional media, such as the Uno Stacko game, also yielded positive results in improving students' vocabulary skills, with an improvement rate of 56.53% and positive responses from the majority of students.[8] These variations indicate inconsistencies in empirical findings regarding the relative effectiveness of the two types of media. Most existing studies remain contextual and limited to a single type of media without conducting a comprehensive quantitative synthesis. To date, no meta-analysis has specifically synthesized evidence from ten primary studies comparing the effectiveness of digital and conventional instructional media for Arabic vocabulary learning at the junior secondary school level. Furthermore, this study extends previous research by examining whether media type, publication year, and sample size moderate the observed effect sizes, giving a fuller picture of what drives instructional media effectiveness.

This study offers novelty by employing a meta-analytic approach to integrate findings from experimental studies on the effectiveness of digital and conventional instructional media in vocabulary learning among students at junior secondary school level. Unlike previous studies that were limited to single contexts, this research calculates the effect size of each study, estimates the pooled effect size, and examines the degree of heterogeneity across studies. Furthermore, it conducts a moderator analysis to explore factors influencing variations in effect sizes, building a stronger quantitative evidence base.

Theoretically, this study contributes to strengthening the application of multimedia learning theory and the Cone of Experience within the context of Arabic language instruction, particularly in vocabulary mastery. Practically, the findings are expected to assist teachers in selecting the most effective instructional media according to students' characteristics and learning conditions. In addition, this study provides a data-driven basis for decision-making in developing Arabic language teaching strategies amid the ongoing digital transformation in education.

This study uses meta-analysis to synthesize evidence on the effectiveness of digital and conventional instructional media for vocabulary learning at the junior secondary school level. The study includes the calculation of individual effect sizes, estimation of the pooled effect size, assessment of heterogeneity across studies, and moderator analysis based on media type, sample size, and year of publication. Specifically, this study seeks to answer the primary question: To what extent do instructional media influence the improvement of vocabulary mastery, and is there a significant difference between type of media, sample size, and year of publication at the junior secondary school level?

LITERATURE REVIEW

Instructional Media

A. The Concept of Instructional Media

Instructional media refer to any tools or resources that can be used to convey learning messages and to stimulate students' thoughts, feelings, attention, and interest, thereby enabling the teaching and learning process to occur more effectively.[9] Media function as a bridge between teachers and students, ensuring that information reaches students not just through words but through visual, auditory, or combined channels.[10] Therefore, media should not be viewed solely as teaching aids, but also as strategic instruments for creating more meaningful learning experiences.

Kemp and Dayton argue that instructional media improve educational quality by turning abstract concepts into concrete ones, widening learning experiences, and broadening students' perspectives.[11] In the context of Arabic language instruction, particularly vocabulary learning, the use of instructional media is essential because it facilitates the retention of new vocabulary in students' memory, connects words to appropriate contexts, and supports their comprehension and use in various communicative situations.

Richard E. Mayer's Cognitive Theory of Multimedia Learning also reinforces the general effectiveness of instructional media. This theory explains that learning becomes more successful when information is presented through a combination of text, images, audio, and other visual elements, as the integration of multiple sensory channels enhances information processing in working memory and supports its transfer to long-term memory.[5] Accordingly, instructional media that incorporate multisensory principles can enhance students' motivation, concentration, and deeper understanding of new vocabulary in a sustained manner.

Edgar Dale's Cone of Experience adds another angle: learning moves from concrete to abstract, and instructional media in their various forms guide students from direct experience toward symbolic understanding.[6] This makes media particularly effective in vocabulary instruction, as they provide learners with opportunities to engage directly with language materials before representing them symbolically or abstractly. Thus, instructional media are central to building meaningful linguistic learning experiences at the junior secondary school level.

B. Types of Instructional Media

In general, instructional media can be classified into several types based on their characteristics and functions within the learning process. According to Azhar Arsyad,[9] instructional media are divided into four main categories: visual media, audio media, audio-visual media, and computer- or digital technology-based media.

1. **Visual Media:** Visual media are among the most widely used forms of instructional media in classroom settings, as they rely on the sense of sight as the primary channel for receiving information. These include images, maps, graphs, posters, instructional models, and similar materials. The strength of visual media lies in their ability to clarify abstract concepts and simplify complex information.[12] As a result, students can more easily understand meanings and relationships between ideas in a more concrete manner. In addition, visual media can capture students' attention and encourage active participation in the learning process.[13]
2. **Audio Media:** Audio media rely on sound elements to convey instructional messages. Examples include educational radio broadcasts, audio recordings, voice-based learning programs, and educational podcasts.[14] This type of media is particularly important in language learning, as it supports the development of listening skills and accurate pronunciation. Through audio media, students can directly hear correct pronunciation, intonation, and rhythm, thereby enhancing their communicative competence more effectively.[15]
3. **Audio-Visual Media:** Audio-visual media combine sound and moving images, making them one of the most effective tools for presenting concepts and information. Examples include instructional videos, educational films, educational television programs, and interactive digital

presentations.[16] These media provide learning experiences that closely resemble real-life situations, as students can simultaneously see and hear explanations. This dual input strengthens comprehension and increases both the attractiveness and effectiveness of the learning process.

4. Computer- and Digital Technology–Based Media: Computer- and digital technology–based media utilize computers, the internet, and smart devices in the instructional process. Examples include learning applications, e-learning platforms, interactive videos, and digital simulations.[17] These media offer advantages in terms of flexibility, interactivity, and accessibility at any time and place. Furthermore, digital media enable students to learn independently according to their individual abilities and pace, thereby enhancing motivation and overall learning effectiveness within an integrated digital environment.

With the advancement of technology, this classification has gradually converged into two primary categories that are relevant to this study, namely digital media and conventional media.

1. Digital Media in Instruction

Digital media refer to instructional media based on information and communication technology that utilize electronic devices and the internet as primary tools. Examples include online learning (e-learning), mobile applications, interactive videos, Learning Management Systems (LMS), and social media platforms used for educational purposes. These media are characterized by their interactivity, flexibility in access without spatial and temporal limitations, and their ability to provide diverse learning materials.[18]

In the context of Arabic language instruction, digital media enable students to access electronic dictionaries, listen to native speakers through podcasts, practice speaking skills via interactive applications, and participate in online discussions. Such features support competency-based learning, as students can engage in independent and active learning. Nevertheless, digital media also present certain limitations, including dependence on technological infrastructure and the potential for distraction associated with digital device usage.

2. Conventional Media in Instruction

Conventional media refer to traditional instructional tools that do not rely on digital technology.[19] Examples include whiteboards, textbooks, pictures, vocabulary cards, and other simple teaching aids. Although traditional in nature, conventional media retain several advantages, such as ease of use, relatively low cost, and adaptability to various school conditions.[20] In Arabic language learning, conventional media remain highly relevant. Textbooks serve as primary resources for understanding grammatical rules, including *nahwu* and *sharaf*; vocabulary cards support memorization of vocabulary ; and whiteboards are commonly used to explain sentence structures. However, conventional media have limitations in terms of interactivity and accessibility, as information delivery tends to be one-directional and confined to the classroom setting.

Vocabulary Instruction

A. The Concept of Vocabulary

Vocabulary refers to a set of words that forms the foundation of any language. Arabic vocabulary mastery is a person's ability to use their vocabulary to communicate and interact actively with other people using Arabic.[21] In the context of Arabic language learning, vocabulary holds a central position as the primary element that enables students to understand and use the language for communication purposes.[22] Vocabulary mastery underpins the other language skills listening (*istimāʾ*), speaking (*kalām*), reading (*qirāʾah*), and writing (*kitābah*).[23] Therefore, vocabulary instruction should not be limited to memorizing isolated words; rather, it must also encompass

understanding meanings, recognizing contextual usage, and applying vocabulary appropriately in real communicative situations.

B. Media in Vocabulary Instruction

Instructional media help students understand and retain vocabulary more effectively.[22] Media function as intermediaries between teachers and students in explaining meanings, clarifying concepts, and enhancing interaction during the learning process. In vocabulary instruction, media may include visual tools such as pictures, word cards, and illustrations; audio media such as voice recordings; and audio-visual media such as instructional videos.

At the elementary school level, the selection of media should consider students' cognitive and linguistic development stages.[24] At this stage, learners generally operate within the concrete operational phase; therefore, instruction becomes more effective when connected to real objects, images, movements, and direct activities. Teachers may utilize both visual media and interactive digital tools to help students grasp vocabulary meanings through contextual and meaningful learning experiences. Through this approach, vocabulary instruction moves beyond rote memorization and develops into a process of linking word meanings with situations and objects in students' immediate environment. Consequently, vocabulary learning becomes more communicative, engaging, and aligned with learners' developmental needs at the junior secondary school level.

METHOD

This study employs a quantitative approach, as the analyzed data are derived from previous studies that present numerical and statistical data.[25] The method is meta-analysis, which combines findings from prior studies on the same topic to produce a more accurate effect-size estimate and support broader generalization[26] Meta-analysis is considered one form of Systematic Literature Review (SLR) because it involves collecting studies relevant to a specific topic and analyzing them based on rigorous scientific criteria, producing conclusions more objective than any single study can achieve.[27] This meta-analysis draws on studies examining vocabulary instructional media in Arabic language learning at the junior secondary school level over the past five years (2021–2025). Through this method, the researcher can calculate the level of effectiveness of both digital and conventional media, examine the consistency of results across studies, and identify general patterns that may not be apparent when each study is considered individually.

The research population is defined as a general domain consisting of individuals or objects that possess certain characteristics to be investigated in order to draw conclusions.[28] Meanwhile, a sample refers to a subset of the population selected through a particular technique to represent the population.[29] In this study, a purposive sampling technique was employed, which involves intentionally selecting samples based on specific criteria. Through this technique, the researcher selects data or objects that possess particular characteristics directly relevant to the research objectives.[30]

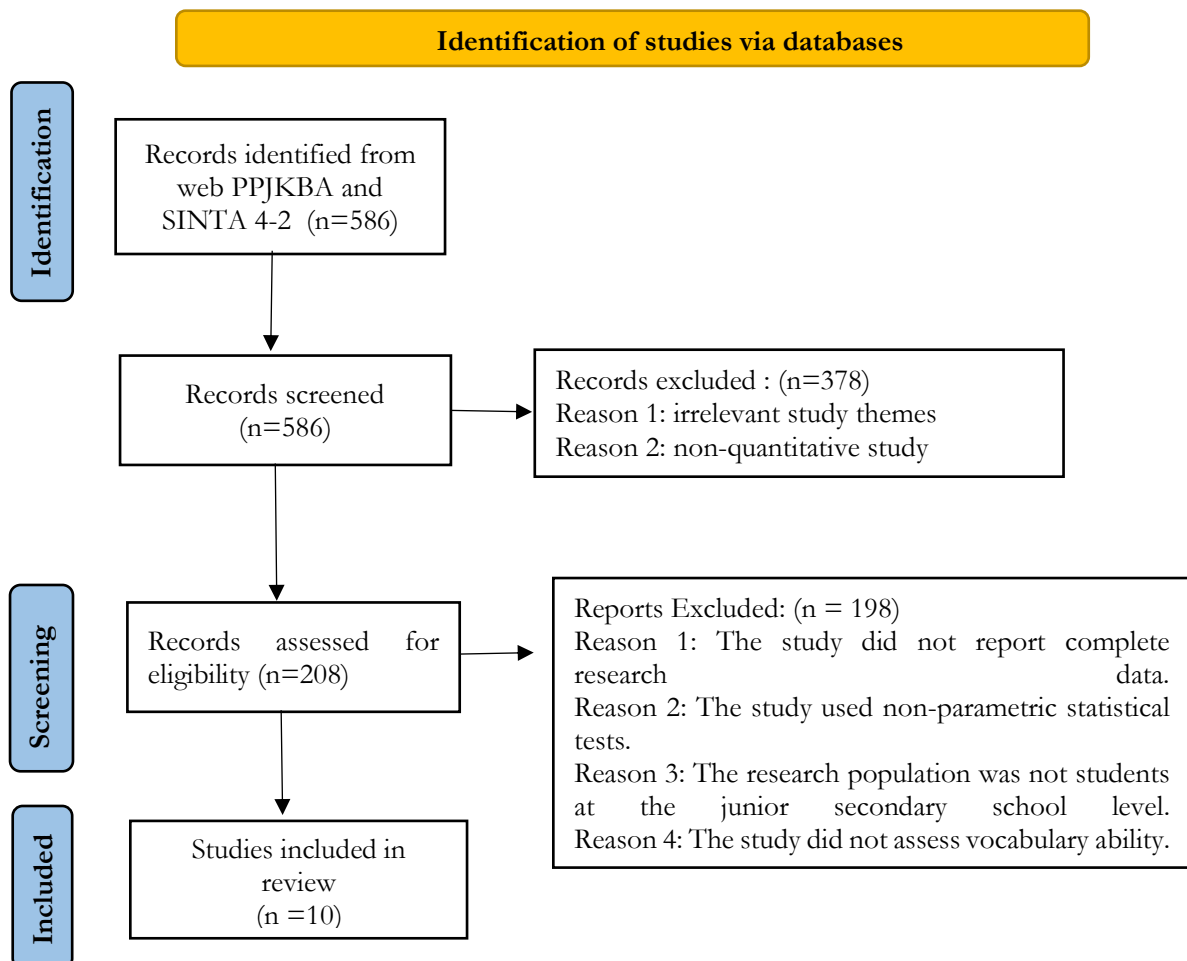
In the context of this meta-analysis study, the research population consists of all studies examining the effectiveness of vocabulary instructional media for students at the junior secondary school level that were published within the last five years (2021–2025). The research sample was determined using purposive sampling based on inclusion and exclusion criteria established by the researcher using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Therefore, the sample in this study does not consist of individual participants or students, but rather of previously published research articles that are relevant and meet the specified criteria, which are subsequently analyzed using the meta-analysis method.

Inclusion Criteria

1. Articles included in this study were limited to those published in scientific journals listed on the website of the *Perhimpunan Pengelola Jurnal Kajian Bahasa Arab* (PPJKBA) and indexed in the Science and Technology Index database at ranks 2–4.
2. The articles discuss instructional media used in vocabulary learning, including both digital and conventional media.
3. The focus of the research is vocabulary learning.
4. The studies employ quantitative research methods, particularly quasi-experimental designs.
5. The research subjects are students at the junior secondary school level.
6. The studies use parametric statistical analyses, such as the t -test, F -test, or correlation coefficient (r).

Exclusion Criteria

1. Articles not published in journals listed by PPJKBA or not indexed in the SINTA database at ranks 2–4.
2. Articles that do not use instructional media or do not clearly explain the type of media used.
3. Articles that do not focus on the learning process.
4. Articles that use qualitative methods without presenting clear quantitative data results.
5. Articles whose research subjects are outside the junior secondary school level.
6. Articles that do not employ t -tests, F -tests, or correlation coefficients (r) in their data analysis.



Picture 1. PRISMA 2020 Flow Diagram of Study Identification, Screening, Eligibility Assessment, and Inclusion Based on the Defined Inclusion Criteria

Picture 1. PRISMA flow diagram illustrating the processes of study identification, screening, eligibility assessment, and final inclusion of articles in the meta-analysis based on the predefined inclusion criteria. Based on the selection stages using the PRISMA Flow Diagram, the processes of identification, screening, eligibility assessment, and inclusion resulted in ten articles that met all the research criteria. These articles include studies conducted by Abdul Aziz Fakhruddin et al. (2021),^[31] Muhammad Fahrudin Nadhif and Annis Berliani Premaswari (2023),^[32] Fahriza Ramadhan and Fatma Yulia (2025),^[33] Lutfia Oktavia et al. (2023),^[34] Rahmi Fatia Azim et al. (2023),^[35] Delia Rosidatu Nabila et al. (2025),^[36] Tri Mutya (2025),^[37] Nurhabibah and Andi Holilulloh (2022),^[38] Ayu Anggraeni et al. (2023),^[8] and Laily Maghfiratun Nafi'ah (2025).^[39] All ten articles were considered eligible because they met the predefined inclusion criteria, including the relevance of the educational level, a focus on Arabic vocabulary learning, the use of a one-group experimental design, and the availability of quantitative data that enabled the calculation of effect sizes for the purposes of the meta-analysis.

This study follows the stages of meta-analysis as proposed by Christian Hansen, Holger Steinmetz, and Jochen Block,^[40] which consist of eight main steps. These stages were then adapted to the research topic concerning the effectiveness of vocabulary instructional media for students at the junior secondary school level. The stages are as follows:

1. Formulating the Research Questions

The researcher first formulated the research questions, namely:

- To what extent do vocabulary instructional media demonstrate effectiveness in improving vocabulary learning among secondary-level students based on studies published in Arabic language education journals indexed in Science and Technology Index ranks (SINTA) 2–4?
- What factors contribute to the differences in results among the studies included in this meta-analysis?

2. Literature Search

A systematic search for articles was conducted using the framework of PRISMA 2020. The sources of the studies were limited to journals managed by the *Perkumpulan Pengelola Jurnal Kajian Bahasa Arab (PPJKBA)* in Indonesia and indexed in the SINTA database at ranks 2–4. This scope was intentionally defined to ensure the inclusion of nationally accredited journals that maintain comparable quality standards and specifically publish research on Arabic language education in the Indonesian context. Focusing on PPJKBA journals also provided a consistent and relevant evidence base aligned with the objectives of this study.

The article identification process was conducted manually by compiling a list of all journals affiliated with PPJKBA and indexed in SINTA within the specified ranks. Subsequently, the archive pages of each journal were systematically reviewed one by one to identify articles relevant to the research topic. This manual procedure was necessary because there is currently no software or search system that can directly filter articles based on specific SINTA index rankings. Therefore, each journal archive had to be examined individually to ensure that all potentially relevant studies were identified before applying the predefined inclusion and exclusion criteria. However, limiting the search to PPJKBA journals indexed in SINTA 2–4 may have excluded relevant studies published in international databases as well as grey literature, thereby increasing the potential for language and publication bias and limiting the generalizability of the findings.

3. Determining the Effect Size

The researcher used Hedges' g as the effect size measure because it accommodates differences in sample sizes across studies and provides a less biased estimate for studies with relatively small samples. Effect sizes were calculated manually in Microsoft Excel using two procedures depending on the availability of data reported in the primary studies. For studies reporting pretest and posttest means together with their standard deviations, Cohen's d was calculated as the standardized mean difference between posttest and pretest scores using the pooled standard deviation of the pretest and posttest scores as the standardizer:

$$d = \frac{M_{post} - M_{pre}}{SD_{pooled}}$$

where

$$SD_{pooled} = \sqrt{\frac{SD_{pre}^2 + SD_{post}^2}{2}}$$

For studies that did not report complete descriptive statistics (pretest-posttest means and standard deviations), Cohen's d was calculated from the reported paired-sample t statistic using the following formula:

$$d = \frac{t}{\sqrt{n}}$$

where t is the paired-sample t value and n is the sample size.

The obtained Cohen's d values were subsequently corrected using Hedges' correction factor (J) to produce Hedges' g , thereby reducing small-sample bias.

The correction factor was calculated as

$$J = 1 - \frac{3}{4df - 1}$$

where $df = n - 1$. The corrected effect size was obtained using

$$g = J \times d$$

Because the correlation between pretest and posttest scores was not consistently reported across the included studies, no correlation adjustment was applied when calculating the standardized mean difference. Consequently, the estimated effect sizes should be interpreted with caution, as this approach may overestimate intervention effects compared with controlled study designs.

4. Determining the Analytical Model

This study employed the Random Effects Model, as the analyzed studies showed diverse characteristics, such as sample size, type of instructional media, and publication year to measure learning outcomes. In addition, a homogeneity test was conducted to ensure the appropriateness of the selected analytical model.

5. Determining Statistical Software

The statistical analysis was conducted using the software JASP to calculate effect sizes, test the level of homogeneity, and compare sample size, type of instructional media, and publication year. The software was also used to detect publication bias through Forest Plot and Funnel Plot analyses. In addition, the researcher conducted a moderator analysis to identify factors that influence differences in research outcomes. This analysis was performed using the Q-between (Qb) test to compare effect sizes based on categorical variables such as the type of instructional media, sample size, and year of publication.

6. Data Coding

Articles that passed the selection process were entered into a data coding sheet. The coding process included several key pieces of information, namely the article title, author name, year of publication, sample size, type of instructional media, SINTA index category, and the statistical data reported in the article.

7. Data Analysis

The coded data were analyzed to obtain the mean effect size for each article. Additional analyses were also conducted, including homogeneity tests using the Q-test and I^2 statistics, comparison of the average effect size between the two types of instructional media, and testing for publication bias using Begg's test and Egger's test along with examination of the Funnel Plot. To determine whether the effectiveness of instructional media was influenced by certain variables such as media type, educational level, sample size, or publication year a moderator analysis using the Q-between (Qb) test was performed.

8. Presentation of Results

The research findings are presented in the form of tables and graphs accompanied by analytical explanations. The report includes the average effect size of digital and conventional media, a comparison of their levels of effectiveness, the results of homogeneity tests using Q-test and I^2 , the results of moderator analysis using Q-between (Qb) to examine the influence of moderator variables, and the detection of publication bias using Begg's test, Egger's test and Funnel Plot. These results are then used as the basis for drawing conclusions relevant to vocabulary learning at the secondary education level.

RESULT AND DISCUSSION

Data extraction and coding were conducted by the researcher using a standardized coding sheet in Microsoft Excel. The process began with screening the abstracts of the identified studies to determine their relevance to the research objectives. Full-text articles were then examined to verify whether all required data for the meta-analysis were reported completely, including pretest and posttest means, standard deviations, t -test values, sample size, publication year, journal accreditation, and the type of instructional media. Studies meeting the predefined inclusion criteria were subsequently coded according to the selected variables, including author, publication year, instructional media type, sample size, pretest and posttest descriptive statistics, t -test values, Cohen's d , Hedges' g , and standard error.

All data extraction and coding were performed by a single researcher. To minimize potential coding errors, the extracted data were independently rechecked against the original articles before statistical analysis. Although no formal inter-coder agreement was conducted because the study involved only one coder, the repeated verification process was intended to improve the accuracy and consistency of the coded data.

This study analyzes 10 articles accredited in Science and Technology Index ranks 2–4 that examine vocabulary mastery among students at the junior secondary school level. These articles were published between 2021 and 2025 and met the previously established inclusion criteria. To

facilitate the analysis, each article was classified based on the type of instructional media, sample size, year of publication, and SINTA ranking.

Table 1. Characteristics of the Studies Included in the Meta-Analysis

No	Article	Instructional Media	Category	Sample Size	Publication Year	SINTA
1.	Ayu Anggraeni, et al. (2023)	Uno Stacko	Conventional	22	2023	2
2.	Laily Maghfiratul Nafi'ah (2025)	Flash Card	Conventional	22	2025	4
3.	Tri Mutya (2025)	Monopoly	Conventional	25	2025	4
4.	Rahmi Fatia Azim, et al (2023)	KOKAMI card	Conventional	32	2023	4
5.	Fahriza Ramadhan, Fatma Yulia (2025)	Canva	Digital	31	2025	3
6.	Muhammad Fahrur Nadhif, Annis Berliani Premaswari (2023)	Chain Picture Game	Digital	30	2023	4
7.	Delia Rosidatun Nabila, et al. (2025)	Jigsaw Puzzel	Conventional	29	2025	3
8.	Nurhabibah Andi Holilulloh (2022)	Magic Card	Conventional	26	2022	3
9.	Abdul Aziz Fakhruddin,H (2021)	Wordwall	Digital	16	2021	2
10.	Lutvia Oktavia, et al. (2023)	Canva	Digital	20	2023	4

Table 1 presents the characteristics of the ten primary studies included in this meta-analysis. The studies varied in terms of instructional media, sample size, publication year, and journal accreditation (SINTA ranking), reflecting differences in their methodological characteristics. The studies were published between 2021 and 2025, although the distribution was uneven, with most publications appearing in 2023 and 2025, while no eligible studies were identified in 2024. In terms of journal accreditation, most studies were published in SINTA 4 journals, followed by SINTA 3 and SINTA 2. The sample sizes ranged from 16 to 32 participants, with most studies involving at least 25 participants. These characteristics provide an overview of the evidence synthesized in this meta-analysis and serve as the basis for the subsequent moderator analyses.

The concentration of publications in particular years may reflect the evolving trends in Arabic language education research, which often develop in response to current educational needs and emerging issues in the field.[41] Journal rankings are also associated with selection standards and methodological quality,[42] meaning that differences in accreditation levels may contribute to variations in the strength of the empirical evidence produced. Meanwhile, sample size is an important factor in quantitative research because it affects the stability of statistical estimates and the statistical power of hypothesis testing.[43] Therefore, the diverse characteristics of these studies may represent one of the sources of variation in the meta-analytic results identified in this research.

The dominance of conventional media can be understood within the context of learning implementation in *madrasahs*, where technological facilities are not always adequately available. Nevertheless, the emergence of digital media in 4 of the studies indicates a growing trend toward the integration of technology in Arabic language learning. This finding is consistent with previous studies showing that the use of Wordwall can increase students' interest and participation in

vocabulary learning.[44] In addition, other studies report that the use of Canva in Arabic vocabulary instruction contributes to increased student motivation and learning effectiveness.[45] Furthermore, the development of Android-based media for vocabulary learning has also been reported to be feasible and effective in supporting students' vocabulary acquisition.[46]

From a theoretical perspective, the differences between conventional and digital media can be explained through the Cone of Experience proposed by Edgar Dale.[6] This theory emphasizes that learning experiences that are more concrete and involve active student participation tend to improve learning retention. Physical game media such as cards, puzzles, and board games represent more concrete learning experiences compared to purely verbal methods, which makes them still relevant and effective in vocabulary learning. On the other hand, the effectiveness of digital media can be explained through the Cognitive Theory of Multimedia Learning developed by Richard E. Mayer.[5] This theory suggests that learning becomes more effective when information is presented through an integrated combination of text, images, and audio, following the principles of dual channels and the limited capacity of working memory. Platforms such as Wordwall and Canva allow the integration of visual elements, text, and interactive activities simultaneously, which can strengthen the encoding of vocabulary into long-term memory.

Meanwhile, the effectiveness of conventional media based on games and cards is also supported by previous research indicating that vocabulary card media can increase students' interest in learning Arabic.[47] This suggests that both digital and conventional media possess pedagogical potential in supporting vocabulary learning. Therefore, although conventional media appear more dominant quantitatively in the analyzed studies, both types of media have strong theoretical and empirical foundations in supporting the effectiveness of vocabulary learning. The primary difference lies in the mode of presentation and the level of cognitive and sensory engagement facilitated by each type of instructional media.

Table 2. Effect Size Estimates for Each Study Included in the Meta-Analysis

No.	Article	Cohen's	Hedges'g	SE
1.	Abdul Aziz Fakhruddin, et al. (2021)	1,538	1,459	0,359
2.	Muhammad Fahrur Nadhif, Annis Berliani Premaswari (2023)	1,799	1,752	0,290
3.	Fahriza Ramadhan, Fatma Yulia (2025)	6,217	6,060	0,790
4.	Lutvia Oktavia, et al. (2023)	5,371	5,156	0,845
5.	Rahmi Fatia Azim, et al. (2023)	2,081	2,029	0,309
6.	Delia Rosidatun Nabila, et al. (2025)	1,378	1,340	0,255
7.	Tri Mutya (2025)	3,698	3,581	0,544
8.	Nurhabibah Andi Holilulloh (2022)	1,581	1,533	0,289
9.	Ayu Anggraeni, et al. (2023)	1,348	1,298	0,289
10.	Laily Maghfiratul Nafi'ah (2025)	2,696	2,598	0,445

The calculation of effect sizes using Cohen's *d*, which was corrected to Hedges' *g*, shows that all included studies produced positive effect size values, with a relatively wide range (1.348–6.217). This indicates that the instructional media interventions exerted a strong impact on improving students' vocabulary mastery. From a pedagogical perspective, this improvement can be explained through the principle of active student engagement in the learning process. Rather than receiving information passively, students using instructional media manipulate, identify, and use vocabulary in context. Such activities strengthen the processes of encoding and retention in long-term memory, making vocabulary easier to remember and reuse in communicative contexts.[49]

These findings are consistent with previous studies. Research conducted by Andi Agussalim et al. reported that the use of visual media significantly improved Arabic vocabulary mastery compared to instruction without media.[50] In addition, a study by Siregar and Alkhairi found that

Android-based vocabulary learning media significantly enhanced the learning outcomes of elementary school students.[51] Another study by Baihaqi et al. also demonstrated that the use of educational game-based media in Arabic language learning had a significant effect on improving vocabulary learning outcomes.[52] The consistency of these studies strengthens the findings of this meta-analysis that instructional media interventions have a substantial impact on improving students' vocabulary achievement. Therefore, based on the descriptive effect size results and the support from previous empirical studies, it can be concluded that the use of instructional media is generally effective in enhancing students' vocabulary mastery at the junior secondary school level.

Pooled Effect Size and Model Significance

Table 3. Pooled Effect Size Estimates Based on the Random Effects Model

Variable	SMD (pooled effect)	95% CI (LL-UL)	t value	p-value
Instructional Media	2.549	1.388 – 3.710	t(9) = 4.97	< .001

Table 3 estimates the effect of vocabulary instructional media on learning outcomes among junior secondary school level students. Ten studies meeting the inclusion criteria were pooled using a random-effects model. The pooled effect size is 2.549, with a 95% confidence interval ranging from 1.388 to 3.710. Since this interval does not cross zero, it indicates that statistically there is a positive effect of instructional media on vocabulary learning outcomes. The t-test value of 4.97 with $p < 0.001$ indicates that the effect size is statistically significant. Therefore, based on the results of this meta-analysis, vocabulary instructional media demonstrate a large and significant effect on the learning outcomes of junior secondary school level students, as reflected in the standardized mean difference (SMD) value and its confidence interval.

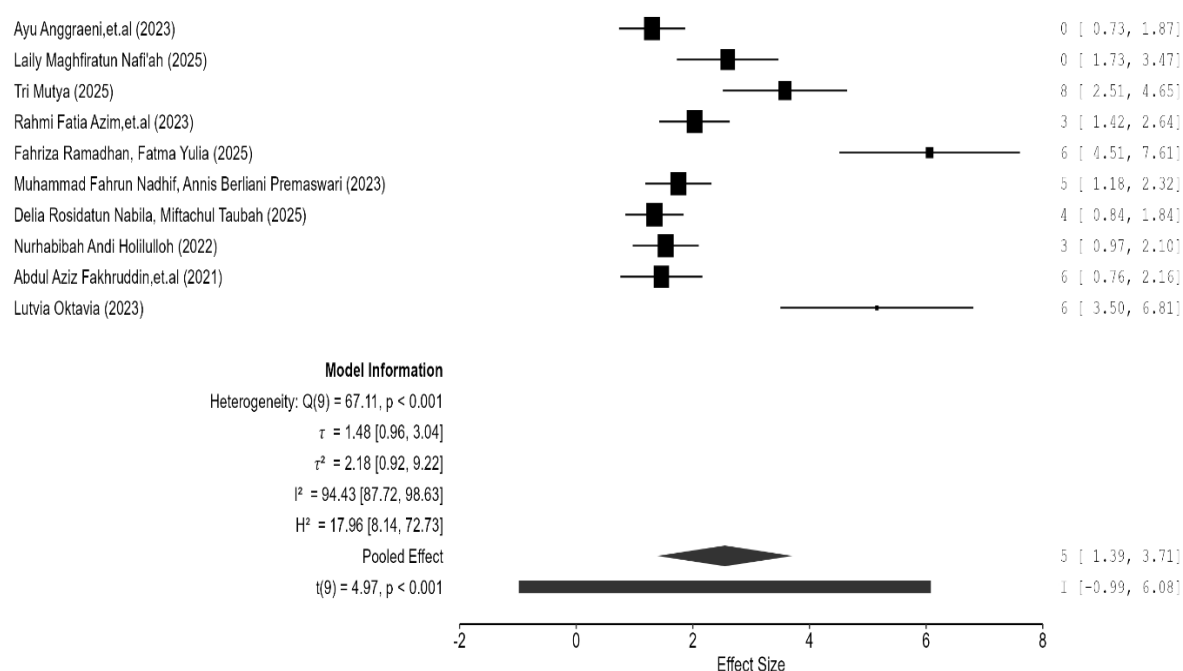
Heterogeneity Analysis

Table 4. Heterogeneity Test Results of the Included Studies

Statistic	Value	95% CI
Q_e	67.11	-
p-value	< .001	-
I^2 (%)	94.43%	87.72 – 98.63

Heterogeneity Test checks whether effect sizes vary substantially across the ten studies in this meta-analysis. The I^2 value of 94.43% indicates that most of the variation in effect sizes originates from true differences between studies rather than random error. Based on the values of Q_e and I^2 , it can be concluded that the level of heterogeneity among the studies included in this meta-analysis falls into the very high category. Accordingly, the pooling of effect sizes in this meta-analysis was conducted using a random-effects model, which allows each study to have a different true effect and accounts for variability across studies. Given the substantial variation in effect sizes identified among the analyzed studies, the use of the random-effects model represents an appropriate analytical approach based on the results of the heterogeneity test.

Forest Plot of Effect Sizes



Picture 2. Forest Plot Showing the Distribution of Individual and Pooled Effect Sizes

The forest plot in Picture 2 shows that all ten studies reported positive effect sizes, as all estimates were located on the right side of the zero line, indicating beneficial effects of vocabulary instructional media on junior secondary students' learning outcomes. Nevertheless, considerable variation was observed in both effect size magnitude and confidence interval width, reflecting differences in effect strength and precision across studies. The pooled effect size, represented by the diamond symbol, was statistically significant (Hedges' $g = 2.55$, 95% CI [1.39, 3.71]) and entirely positioned on the positive side of the zero line. However, substantial heterogeneity was detected ($Q(9) = 67.11$, $p < 0.001$; $I^2 = 94.43\%$), supporting the use of a random-effects model. Moreover, the wide 95% prediction interval (-0.99 to 6.08), which included zero, suggests that the true effects of instructional media may vary considerably across different educational contexts and future

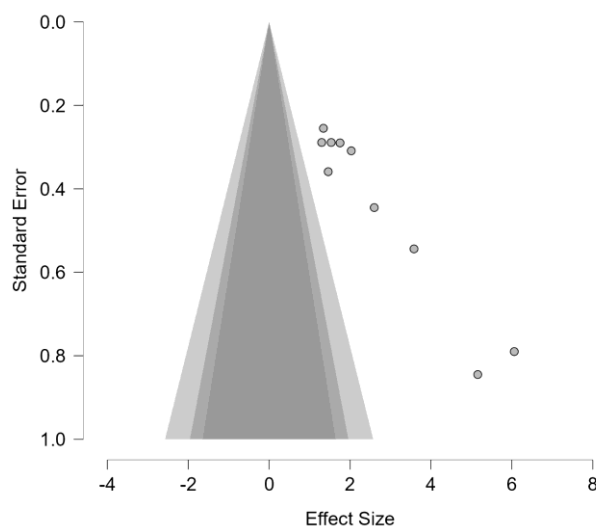
studies, and therefore the pooled effect size should be interpreted with caution, as the effectiveness of instructional media may differ depending on the characteristics of future studies and learning contexts.

Overall, the findings suggest that vocabulary instructional media exert a positive and statistically significant influence on learning outcomes, supporting previous meta-analytic evidence in Educational Technology regarding the beneficial effects of instructional media and learning technologies. For example, a study conducted by Laura A. Schindler et al. found that the integration of educational technology has a positive impact on students' learning outcomes and engagement, although the magnitude of the effects varies substantially across studies.[53] Similarly, a meta-analysis by Yao-Ting Sung et al. reported that the use of technology-based learning devices and media produces a significant positive effect on students' academic achievement.[54]

In the context of language learning, these findings further support the idea that the use of instructional media whether game-based, visual, or interactive digital media generally has a strong impact on vocabulary acquisition. However, the high level of heterogeneity indicates that the effectiveness of instructional media is not uniform and may be influenced by other factors. Therefore, moderator analysis becomes important in order to better understand the sources of variation across studies. Thus, the results of this meta-analysis provide strong quantitative evidence that instructional media have a substantial influence on improving vocabulary mastery among junior secondary school level students, although considerable variation exists among the analyzed studies.

Publication Bias Analysis

1. Funnel Plot



Picture 3. Funnel Plot for Assessing Publication Bias in the Meta-Analysis

The funnel plot in Picture 3 illustrates the relationship between effect size and standard error from the ten studies included in this meta-analysis. Each point represents an individual study. Under conditions where no publication bias is present, the distribution of points is expected to form a symmetrical pattern around the pooled effect size. Based on the funnel plot, the data points are not symmetrically distributed on both sides of the central line. Instead, they appear to be more concentrated on one side, with several points located far outside the funnel area. This pattern indicates asymmetry in the distribution of effect sizes relative to the standard error. Therefore, based on the visual inspection of the funnel plot, there is an indication of imbalance in the

distribution of studies within this meta-analysis, which may suggest the presence of potential publication bias.

2. Begg's Rank Correlation Test and Egger's Regression Test

Table 5. Results of Egger's Regression Test for Publication Bias

Estimates	Asymmetry Test			Limit Estimate μ		
	t	df	p	Estimate	Lower 95% CI	Upper 95% CI
10	8.448	8	< .001	-0.615	-1.330	0.099

Table 6. Results of Begg's Rank Correlation Test for Publication Bias

Estimates	τ	p
10	0.854	< .001

To statistically evaluate the asymmetry observed in the funnel plot, both Begg's rank correlation test and Egger's weighted regression test were performed. Begg's test yielded a Kendall's Tau (τ) value of 0.854 with a significance level of $p < 0.001$, indicating a statistically significant association between effect size and standard error. In addition, Egger's regression test also showed significant funnel plot asymmetry ($t = 8.448$, $df = 8$, $p < 0.001$). The consistent results obtained from both statistical tests support the visual asymmetry observed in the funnel plot and suggest the presence of potential publication bias among the included studies. However, because this meta-analysis included only ten studies, both Begg's and Egger's tests have relatively low statistical power. Therefore, the evidence of publication bias should be interpreted with caution and considered as an indication rather than definitive proof of publication bias.

The results of the funnel plot, Begg's test, and Egger's regression test indicate the presence of potential publication bias in this meta-analysis. The asymmetrical distribution of studies, together with the significant results obtained from both statistical tests, suggests that studies reporting larger effects are more likely to be published than studies reporting smaller or non-significant effects. However, this finding should be interpreted within its proper context. All studies that met the inclusion criteria reported positive and significant results; therefore, the detected bias more likely reflects a tendency toward the publication of positive findings rather than weaknesses in the study selection procedure. In the scientific literature, studies with non-significant results are often not published, a phenomenon widely known as the File Drawer Problem, which makes such studies difficult to identify through systematic searches.^[55]

In addition, restricting the data sources to reputable academic journals may also contribute to the dominance of significant findings, as journals often prioritize studies that demonstrate clear and meaningful effects. Therefore, although the funnel plot, Begg's test, and Egger's regression test indicate potential publication bias, the results of this meta-analysis remain relevant; however, the magnitude of the pooled effect should be interpreted with caution, particularly because publication bias tests based on a small number of studies ($k = 10$) provide limited statistical power and may be less reliable than when applied to larger meta-analyses.

Moderator Analysis**Table 7.** Moderator Analysis Based on Media Type, Sample Size, and Publication Year

Moderator	Subgroup	K	SMD (pooled effect)	95% CI	p (effect)	I ²	Qm (p)
Instructional media	Conventional	6	1.973	1.090 – 2.855	.002	82.63	1.58 (.208)
	Digital	4	3.507	−0.217 – 7.231	.058	95.84	
Sample size	Small	4	2.498	−0.216 – 5.212	.061	93.33	0.01 (.922)
	Large	6	2.607	0.775 – 4.440	.015	95.73	
Publication year	2021-2023	6	2.018	0.697 – 3.339	.011	90.05	1.34 (.247)
	2024-2025	4	3.304	0.168 – 6.439	.044	94.43	

The moderator analysis showed that none of the examined variables significantly explained the variation in effect sizes across studies. No significant differences were found based on media type ($Q_m = 1.58$, $p = 0.208$), sample size ($Q_m = 0.01$, $p = 0.922$), or publication year ($Q_m = 1.34$, $p = 0.247$). Although digital media, larger sample studies, and more recent publications tended to produce higher effect sizes descriptively, these differences were not statistically significant. The tendency for digital media to yield larger effects may be interpreted through Mayer's Cognitive Theory of Multimedia Learning [5] and Dale's Cone of Experience [6], which emphasize the benefits of multimodal and interactive learning experiences. Nevertheless, the findings indicate that both digital and conventional media are similarly effective in improving students' vocabulary mastery, suggesting that instructional effectiveness depends more on instructional design quality, learner engagement, and learning context than on the level of digitalization itself.

This study has several limitations that should be considered when interpreting the findings. First, all included studies employed a one-group pretest-posttest design, which may produce larger standardized effect sizes than controlled experimental designs. Second, the literature search was limited to PPJKBA journals indexed in SINTA 2–4, excluding international databases and grey literature, which may increase the risk of language and publication bias and limit the generalizability of the findings. Third, although publication bias was assessed using the funnel plot, Begg's test, and Egger's regression test, these methods have limited statistical power because only ten studies were included. Therefore, the findings should be interpreted with appropriate caution despite the large pooled effect size.

CONCLUSION AND IMPLICATIONS

This meta-analysis demonstrates that the use of instructional media has a large and significant effect on improving Arabic vocabulary mastery among students at the junior secondary school level. The high pooled effect size confirms that the use of instructional media in mufrodat learning is an effective strategy for enhancing students' learning outcomes. However, the variation in effect sizes across studies is very high. The moderator analysis indicates that digital media tend to produce larger effect sizes than conventional media, although the difference is not statistically significant. Similarly, the variables of sample size and publication year do not show significant differences in their influence on the effectiveness of instructional media.

These findings highlight the importance of integrating instructional media into the teaching of Arabic vocabulary at the junior secondary school level, whether in digital or conventional forms, depending on the learning needs and instructional readiness. The indication of publication bias suggests that the available literature tends to be dominated by studies reporting positive and significant results. This condition implies the need for a more balanced publication of research findings, including studies with non-significant results, so that future evidence syntheses can become more objective and representative. The substantial variation in effect sizes across studies also indicates that the effectiveness of instructional media is influenced by the context of implementation. Therefore, the selection of instructional media should consider students' characteristics, learning materials, and instructional design.

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