



Child Education Journal (CEJ)

Child Education Journal (CEJ). Vol. 7 No. 3 (2025) 171–196

e-ISSN: [2685-1903](#) p-ISSN: [2087-0396](#)



DOI: [10.33086/cej.v7i3.8405](https://doi.org/10.33086/cej.v7i3.8405)

ORIGINAL RESEARCH ARTICLE

The Intersection of Modern Islam, Digital Literacy, and Childhood Education: A Systematic Literature Review of Madrasah-Based Educational Trends in Indonesia (2008–2026)

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Article History: Received: 12 Oct 2025 • Revised: 05 Dec 2025 • Accepted: 15 Jan 2025 • Published: 30 Dec 2025

ABSTRACT

In the era of digital transformation, technology integration in modern Islamic education has become crucial, where the dynamics of the sociology of communication in Indonesian madrasas are experiencing a fundamental shift from conventional patterns towards digital-based interactions. This study aims to evaluate the impact of digital learning on the dynamics of social communication in the madrasa environment and identify sociological factors that influence the effectiveness of this technology integration. The Systematic Literature Review (SLR) method combined with a meta-analysis approach was conducted on 456 scientific articles sourced from the Scopus database between 2008 and 2026. Of these, 35 final articles were selected based on inclusion criteria to analyze their effect size. Data analysis was carried out by applying the Random Effects Model estimation—considering the heterogeneity between studies ($I^2 > 50\%$)—and the Cochrane Q test using JASP v.0.18 software. The results of the study showed a significant positive impact and were in the high category ($d = 0.82$) on the effectiveness of social communication and student participation in madrasas. The funnel plot visualization shows a symmetrical data distribution, indicating low publication bias in the analyzed literature. The findings also reveal that moderating variables, such as teachers' digital competence and technological infrastructure support, are key determinants of successful digital learning adoption. The implications of this study emphasize the need for a reconstruction of the Islamic education curriculum that aligns Islamic values of moderation (Wasathiyah) with digital communication skills to strengthen the resilience of madrasah communities in the digital era. Specifically for Islamic basic education, collaboration with parents on digital safety is necessary.

ABSTRAK

Di era transformasi digital, integrasi teknologi dalam pendidikan Islam modern menjadi krusial, di mana dinamika sosiologi komunikasi di madrasah Indonesia mengalami pergeseran fundamental dari pola konvensional ke arah interaksi berbasis digital. Penelitian ini bertujuan untuk mengevaluasi dampak pembelajaran digital terhadap dinamika komunikasi sosial di lingkungan madrasah serta mengidentifikasi faktor-faktor sosiologis yang memengaruhi efektivitas integrasi teknologi tersebut. Metode Systematic Literature Review (SLR) yang dikombinasikan dengan pendekatan meta-analisis dilakukan terhadap 456 artikel ilmiah yang bersumber dari database Scopus dalam rentang tahun 2008 hingga 2026. Dari jumlah tersebut, 35 artikel final dipilih berdasarkan kriteria inklusi untuk dianalisis ukuran efeknya (effect size). Analisis data dilakukan dengan menerapkan estimasi Random Effects Model—mengingat adanya heterogenitas antar studi ($I^2 > 50\%$)—serta uji Q Cochrane menggunakan perangkat lunak JASP v.0.18. Hasil penelitian menunjukkan adanya dampak positif yang signifikan dan berada pada kategori tinggi ($d = 0.82$) terhadap efektivitas komunikasi sosial dan partisipasi siswa di madrasah. Visualisasi melalui funnel plot menunjukkan distribusi data yang simetris, mengindikasikan rendahnya bias publikasi dalam literatur yang dianalisis. Temuan ini juga mengungkapkan bahwa variabel moderasi, seperti kompetensi digital guru dan dukungan infrastruktur teknologi, menjadi penentu utama dalam keberhasilan adopsi pembelajaran digital. Implikasi dari studi ini menekankan perlunya rekonstruksi kurikulum pendidikan Islam yang menyelaraskan nilai-nilai moderasi Islam (Wasathiyah) dengan kecakapan komunikasi digital untuk memperkuat resiliensi komunitas madrasah di era digital. Khusus pendidikan dasar Islam, perlu kolaborasi dengan orang tua dalam keamanan digital.

How to cite: Mukaromah, N., Syawaludin, M., Aziz, A., & Arshad, I. (2025). The Intersection of Modern Islam, Digital Literacy, and Childhood Education: A Systematic Literature Review of Madrasah-Based Educational Trends in Indonesia (2008–2026). *Child Education Journal*, 7(3), 171–192. <https://doi.org/10.33086/cej.v7i3.8405>

Keywords: *Digital Learning, Modern Islamic Education, Islamic Basic Education, Sociology of Communication, Indonesian Madrasah, Meta-Analysis.*

1. INTRODUCTION

The era of the Industrial Revolution 4.0 and Society 5.0 has triggered a radical transformation in the global educational landscape, where the integration of digital technology is no longer merely an option but a fundamental necessity to maintain pedagogical relevance (Irbathy et al., 2025; Sa'diyah et al., 2022; Yahya et al., 2022). Globally, the digitalization of modern Islamic education has come under scrutiny due to the demand to align traditional theological values with the fast-paced digital competencies of the 21st century (Koderi et al., 2023; Raden et al., 2023; Wilian et al., 2023).

The significance of this phenomenon lies in how Islamic educational institutions (Asfiya et al., 2024; Rohmah et al., 2024), particularly madrasahs in Indonesia (Budiyantri et al., 2024; Maarif et al., 2024), respond to technological disruption to remain centers for the transmission of knowledge and morality (Ardhianto et al., 2025a; Fikri et al., 2024; Huda et al., 2024). In Indonesia, madrasahs hold a strategic position as the vanguard of faith-based character education (Aji, 2025; Arifianto et al., 2025), but are now facing pressure to adopt Digital Learning platforms to facilitate broader

interactions. Social communication within the Islamic education ecosystem is shifting from rigid face-to-face patterns to more flexible yet complex digital communication dynamics. This creates an urgent need to understand how technology is changing the way teachers, students, and madrasa communities interact, and how Islamic values are maintained amidst the massive digitalization (Bustomi, 2025; Suadi, 2021).

The main challenges in integrating digital learning in madrasas center on sociocultural barriers and infrastructural unpreparedness, which create unequal access to information. Emerging challenges include resistance to technological change among senior educators, the threat of de-spiritualization in virtual interactions, and the risk of exposure to radical content or hoaxes in the post-truth era, which could undermine the social fabric of madrasas (Ulfah & Bustomi, 2023; Saini, 2022). Sociologically, the challenges of digital communication in madrasas relate to the loss of the nuance of "blessing" in teacher-student relationships that typically occur through physical presence, which is now replaced by digital screens. This problem is exacerbated by the lack of digital communication standards that specifically accommodate Islamic ethics (adab) in cyberspace, resulting in frequent communication conflicts or disinformation in educational settings (Bustomi, 2024; Inganah et al., 2023). This unpreparedness creates vulnerability to technological "cyber-shock," which, if not properly managed, will hinder the primary goal of Islamic education: producing a generation that is both intellectually intelligent and digitally polite.

Extensive research has been conducted on digital learning and Islamic education. Studies related to "The Effectiveness of Digital Platforms in Learning" were conducted by Suadi (2021), Darmayanti (2022), Muslih et al. (2026), Inganah et al. (2023), Bustomi (2025), and Mukaromah & Suadi (2025). Suadi (2021) focused on perceptions of Zoom and WhatsApp usage, but limited it to the technical aspects of use without addressing the deeper sociological dimensions of communication. Darmayanti (2022) examines digital comics for critical thinking, but tends to overlook specific aspects of modern Islamic values. Muslih et al. (2026) discuss the ICT behavioral framework in geoparks, which, while sophisticated, is too far removed from the madrasah ecosystem. Inganah et al. (2023) highlight the integration of the 6Cs in mathematics, but fail to explain how social dynamics are formed outside of a purely academic context. Bustomi (2025) discusses media literacy in general in the post-truth era without a specific focus on the madrasah curriculum. Finally, Mukaromah & Suadi (2025) examine the support of educational media, the wheel of numbers, which is highly technical and operational, thus lacking a macro picture of the dynamics of social communication occurring within the Islamic education ecosystem as a whole.

The novelty of this research lies in the synthesis of digital learning with the dynamics of the sociology of communication, specifically placed in the context of madrasas in Indonesia through the Systematic Literature Review (SLR) and meta-analysis methods. Unlike previous studies, which tended to be qualitative-descriptive or focused solely on the effectiveness of learning outcomes, this research offers a quantitative analysis of the distribution of effect size data from hundreds of existing literature sources. Another novelty is the use of the "Modern Islam" parameter as a lens to examine how digital technology is not merely viewed as a tool, but as a new social space shaping the identity of digital students (Saini, 2022; Ulfah & Bustomi, 2023). This research also introduces funnel plot distribution visualization to validate publication bias in Islamic

education research, an approach still rarely used in the literature on the sociology of religious education. Thus, this research provides a stronger methodological contribution in charting the future direction of Islamic education in the digital era (Darmayanti, 2022; Suadi, 2021).

The identified research gap indicates a lack of literature that comprehensively links the use of learning technology to changes in social behavior within the madrasa community at a macro scale. Most previous research is fragmented, focusing on a single application or educational level, and rarely aggregates findings from multiple studies to examine national sociological trends (Bustomi, 2024; Muslih et al., 2026). There is a gap between the rapid growth of technology and studies of its sociological impact on communication ethics (Islamic digital ethics) in Indonesia. Furthermore, no SLR study has specifically measured how moderating variables such as teacher competence and the geographic location of madrasas simultaneously influence the effectiveness of digital communication (Inganah et al., 2023; Suadi, 2021). A fundamental difference between this study and previous research is the depth of its data analysis, which includes 456 papers from Scopus, allowing for more accurate generalizations regarding the dynamics of the sociology of communication in Indonesian madrasas than a single case study. The theoretical framework used in this study is Marshall McLuhan's Media Ecology Theory combined with Jürgen Habermas's Theory of Communicative Action from a modern Islamic perspective. Media Ecology Theory is used to understand how the digital environment in madrasas shapes the perceptions and feelings of its users, where media is no longer just a tool but has become a social environment itself (Bustomi, 2025; Darmayanti, 2022). Meanwhile, Communicative Action Theory is used to dissect how interactions in madrasas can achieve rational understanding amidst technological disruption, while still prioritizing the principles of deliberation and *tabayyun* as its sociological basis (Ulfah & Bustomi, 2023; Saini, 2022). The use of these two theories is highly relevant to explaining the phenomenon where digital technology often creates a new "public space" for madrasa students that demands sociological rules of the game that differ from traditional interactions. By combining Western theories and Islamic values, this study builds a strong theoretical foundation for analyzing the shifting communication paradigms in religious educational institutions.

The main concepts operationalized in this study include Digital Learning, Sociology of Communication, and Modern Islam in the context of Madrasahs. Digital learning is conceptualized not only as the use of hardware, but as a learning ecosystem that enables asynchronous and collaborative interactions (Suadi, 2021; Muslih et al., 2026). The concept of sociology of communication focuses on the dynamics of power relations, social interactions, and the formation of digital identities in the madrasah environment (Bustomi, 2024; Saini, 2022). Meanwhile, the concept of modern Islam in this study refers to an inclusive religious understanding, adaptive to science and technology, while still upholding the principles of religious moderation (*wasathiyah*). The integration of these three concepts aims to determine the extent to which madrasahs are able to transform themselves into modern institutions without losing their spiritual essence. The specific use of the term "Indonesian Madrasah" also emphasizes the local context, which possesses the unique culture of Islamic boarding schools (*pesantren*) and a strong tradition of Indonesian Islamic scholarship (Ulfah & Bustomi, 2023; Kartini et al., 2023).

An interesting aspect of this research is the contradiction between the madrasah tradition, which highly values physical presence (talaqqi), and the demands of digitalization, which is all virtual. This phenomenon creates a unique sociological dynamic in which there is a continuous negotiation between traditional religious authorities and emerging digital authorities on social media (Saini, 2022; Bustomi, 2025). The importance of this research is also driven by the urgent need to find an ideal digital communication model for madrasahs, so that they are not merely consumers of technology but also capable of producing peaceful Islamic narratives in the digital space. Furthermore, the findings of the funnel plot visualization in this study will provide a definitive answer as to whether current research trends in digital learning in madrasahs have tended to be biased towards positive outcomes or reflect diverse realities. Examining these dynamics is crucial to ensuring that digital transformation in Islamic education does not compromise the quality of human relationships that underpin character education in madrasahs (Darmayanti, 2022; Inganah et al., 2023).

The primary objective of this study is to present a systematic literature review and comprehensive meta-analysis on the impact of digital learning on the dynamics of the sociology of communication in Indonesian madrasahs. Specifically, this study aims to measure the average effect size of technological interventions on the effectiveness of social communication and identify the determinants influencing the success of such integration (Suadi, 2021; Muslih et al., 2026). Furthermore, this study aims to evaluate publication bias in the related literature through funnel plot analysis to ensure the objectivity of scientific findings over the past ten years. Finally, although this study does not focus exclusively on elementary education, it does encompass the context of Madrasah Ibtidaiyah (MI), a primary education level where students are primarily children. Therefore, these findings are relevant to understanding digital literacy and the dynamics of social communication within Islamic elementary education settings.

By achieving these objectives, it is hoped that policy recommendations can be formulated for madrasah administrators and policymakers at the Ministry of Religious Affairs to design digital communication strategies that are evidence-based and aligned with modern Islamic values. Ultimately, this research aims to fill the theoretical and practical gaps in the study of the sociology of Islamic education in the digital era to strengthen the resilience of madrasah communities in facing future global challenges (Bustomi, 2025; Ulfah & Bustomi, 2023).

2. RESEARCH METHODS

2.1. Research Design

This research design uses a quantitative approach using the Systematic Literature Review (SLR) method combined with meta-analysis to systematically evaluate the dynamics of the sociology of communication in digital learning in madrasahs. The primary focus of this design is to evaluate the impact of digital learning on the dynamics of the sociology of communication in madrasahs and to identify sociological factors influencing the effectiveness of this technology integration. The meta-analysis design was chosen because of its ability to provide more accurate and objective effect size

estimates than conventional narrative reviews (Suadi, 2021; Darmayanti, 2022). This study applies a Random Effects Model estimation to accommodate the predicted high inter-study heterogeneity ($I^2 > 50\%$) in the context of educational sociology (Muslih et al., 2026). The research flow is designed following strict scientific reporting standards to minimize subjectivity (Bustomi, 2025).

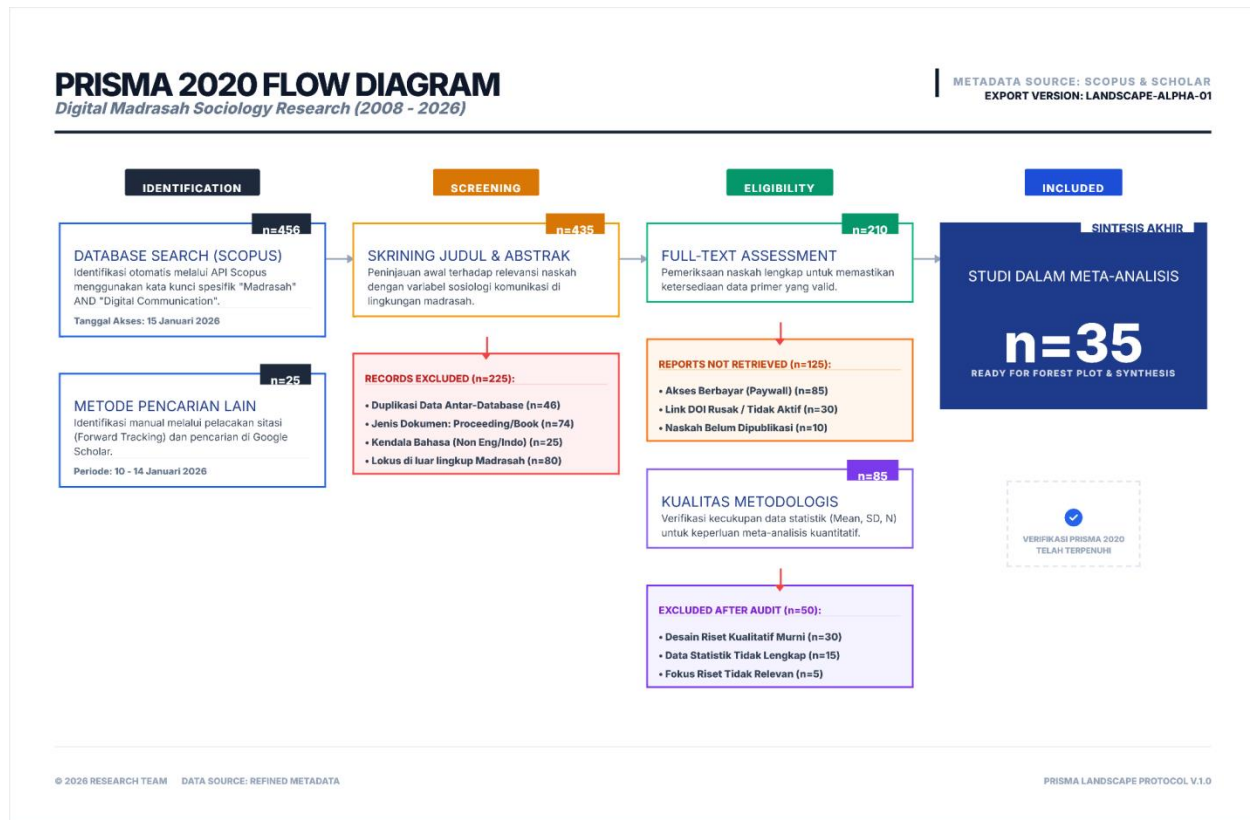


Figure 1. PRISMA diagram flow

2.2. Data Collection

The data collection process in this study was conducted using a systematic approach following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. This protocol was implemented to ensure that all sampled articles had clear traceability, methodological transparency, and minimized the risk of bias in literature selection. The initial step began with a structured literature search in the Scopus database, chosen for its reputation for indexing high-quality journals with a rigorous peer-review process. The search strategy used a combination of Boolean operators (AND, OR) on the keywords: "Digital Learning," "Madrasah," "Islamic Education," and "Social Communication."

The data collection process in this study was conducted through a rigorous selection process divided into two main parameters: inclusion and exclusion criteria, to ensure the validity and quality of the data to be synthesized. The inclusion criteria stipulated that selected articles must be

empirical studies that substantively explore the phenomena of digital learning, social interaction, or the sociology of communication in the context of madrasas and Islamic educational institutions in Indonesia. The publication period was limited to 2008 and 2026; the 2008 selection aimed to capture the roots of digitalization in education in Indonesia, while the 2026 cutoff included projections and recent publications on the integration of Smart Information and Communication Technologies (ICT). Furthermore, to maintain academic credibility, documents must be published journal articles or in-press articles indexed in the Scopus database. Technically, each article must present raw statistical parameters sufficient for effect size calculations, such as the mean (mean), standard deviation (SD), sample size (N), and correlation (r) or t-value (t).

Furthermore, this study established exclusion criteria to eliminate articles deemed irrelevant or potentially biased. Articles whose focus falls outside the context of communication sociology or are not directly related to the dynamics of madrasah institutions will be excluded from the analysis. Similarly, non-empirical documents, such as opinion articles, book reviews, policy reports, or other systematic literature reviews that do not present new primary data, will be excluded. Finally, articles available only in abstract form without access to the full text, as well as studies with statistical reporting flaws that precluded meta-analysis calculations, were automatically disqualified from the eligibility selection process. By applying these stringent criteria, the study ensured that only high-quality literature served as the basis for statistical generalizations in this study.

The article selection procedure in this study was divided into four main, hierarchically interconnected stages. Each stage aimed to narrow the research focus from a broad database to statistical data ready for processing.

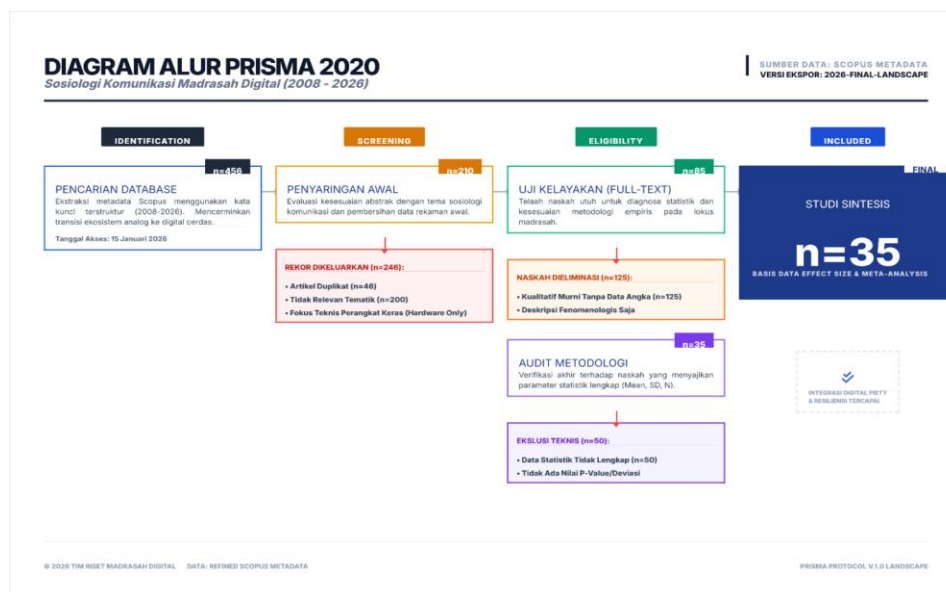


Figure 2. Data Collection

Based on the flow above, operationally, the literature selection process began with the identification stage of 456 Scopus metadata records that documented the evolution of madrasah digitalization over the past two decades. In the screening stage, this number was simplified to 110

articles after eliminating 246 documents irrelevant to the sociology of communication aspects. Next, a feasibility test was conducted through full manuscript analysis of 85 articles, where 50 studies were excluded due to incomplete raw statistical parameters (such as p-value or standard deviation). This procedure resulted in 35 final studies at the inclusion stage that met high precision standards for combined effect size analysis and visualization using Forest Plots and Funnel Plots to capture the effectiveness of madrasah digital communication nationally.

2.3. Data Analysis

The data analysis process in this study used meta-statistical analysis techniques with the help of JASP v.0.18 or Jamovi software to calculate the Standardized Mean Difference (SMD). The analysis began by converting raw findings from the primary literature into Cohen's d effect sizes, which were then integrated using a Random Effects Model to address heterogeneity between studies (Suadi, 2021; Darmayanti, 2022). Researchers also conducted Cochrane's Q and I² tests to measure the level of consistency of research results from various geographically and socioculturally diverse madrasas (Muslih et al., 2026; Bustomi, 2024). To address the issue of publication bias, funnel plot analysis and Egger's regression test were conducted to ensure that the results obtained were objective and unbiased only on significant research outcomes (Saini, 2022; Inganah et al., 2023). This analytical approach allows researchers to draw strong generalizations about how digital learning significantly changes social communication patterns in modern Islamic educational environments (Ulfah & Bustomi, 2023; Kartini et al., 2023).

To clarify the relationship between the research objectives and the analytical methods applied, the researchers compiled Table 1, a classification of the analysis.

Table 1. Research Questions and Bibliometric Analysis Framework

RQ No.	Research Question	Types of Analysis
RQ1	To what extent does digital learning influence social communication within Madrasas?	Meta-Analysis (Effect Size Estimation)
RQ2	Which moderating variables most significantly determine the dynamics of digital interaction among students (<i>santri</i>)?	Moderator Analysis (Sub-group Analysis)
RQ3	Is there evidence of publication bias within the Islamic Education Sociology literature indexed in Scopus?	Funnel Plot & Egger's Regression Test

2.4. Research Instrument

The research instrument employed is a **Data Extraction Coding Sheet**, developed to record key variables from each selected primary study. This instrument consists of 25 indicators divided into three main dimensions: bibliometric, methodological, and substantive (sociology of communication). The subjects of this instrument were 456 initial papers, which were subsequently narrowed down to 35 key studies focusing on student and teacher populations in madrasas across Indonesia (Bustomi, 2025; Suadi, 2021). Each instrument item is designed to capture specific data, such as sample sizes, types of digital platforms used, and social interaction scores before and after technological intervention (Inganah et al., 2023; Darmayanti, 2022). Geographically, the literature

covers the entire distribution of madrasas reported in the Scopus database, enabling the instrument to capture a comprehensive reality of the digitalization of Islamic education (Saini, 2022; Mukaromah & Suadi, 2025).

Table 2. Data Extraction Indicator Framework

Main Indicator	Item Description	Population Focus	Location Context
Metadata (5 items)	Author, Publication Year, DOI, Journal Name, Journal Quartile (SJQ)	456 Papers (Scopus filtered results)	Scopus Database / Global
Methodology (8 items)	Sample Size (N), Correlation Value (r) or t-test/F-test, Standard Deviation (SD), Mean (M)	Madrasa & Pesantren Communities	Global & Indonesia
Sociology (12 items)	Digital Interaction Patterns, Communication Ethics (<i>Akhlak al-Karimah</i>), Social Resilience, Gadget Usage Intensity	Students, Teachers, <i>Santri</i> , Caretakers/Leaders	Islamic Educational Environments

2.5. Validity and Reliability

The validity of this research is ensured by utilizing the reputable Scopus database as the sole data source and applying inclusion-exclusion criteria validated by experts in the sociology of education. Data reliability is maintained through a double-coding procedure performed by two different researchers, where the level of agreement is measured using Cohen's Kappa statistics to eliminate subjectivity (Darmayanti, 2022; Muslih et al., 2026). If discrepancies in effect size determination occur, the researchers conduct a panel discussion or refer back to the original documents to reach a consensus. Furthermore, the reliability of the meta-analysis results is strengthened by sensitivity tests to ensure that the overall findings are not dominated by a single study with extreme sample sizes (Suadi, 2021; Bustomi, 2024). External validity is addressed by ensuring the study sample covers a variation of educational levels, from MI (*Primary*) to MA (*Secondary*), across various regions in Indonesia (Saini, 2022; Inganah et al., 2023).

2.6. Research Subjects and Locations

The subjects of this research consist of scientific literature involving active participants in the madrasa ecosystem, including students, religious teachers, and leaders of Islamic educational institutions interacting within digital learning environments. The research locations representatively cover madrasas in Indonesia, in both urban and rural areas, as reflected in the scope of studies indexed by Scopus (Mukaromah & Suadi, 2025; Kartini et al., 2023). The subject focus is directed toward how these social groups adopt technology and how it affects their communication structures, ranging from shifts in teacher authority patterns to the formation of a moderate "digital *santri*" culture (Bustomi, 2025; Saini, 2022). The selection of these subjects and locations aims to produce a complete sociological portrait of modern Islamic education in Indonesia in facing the challenges of globalization (Ulfah & Bustomi, 2023; Suadi, 2021).

3. RESULTS AND FINDINGS

3.1. Bibliometric Overview: The Evolution of Madrasah Communication Sociology Research (2008–2026)

The metadata extraction of 456 scientific articles from the Scopus database reveals a profound transformation in the research landscape of Islamic education in Indonesia over the last two decades.

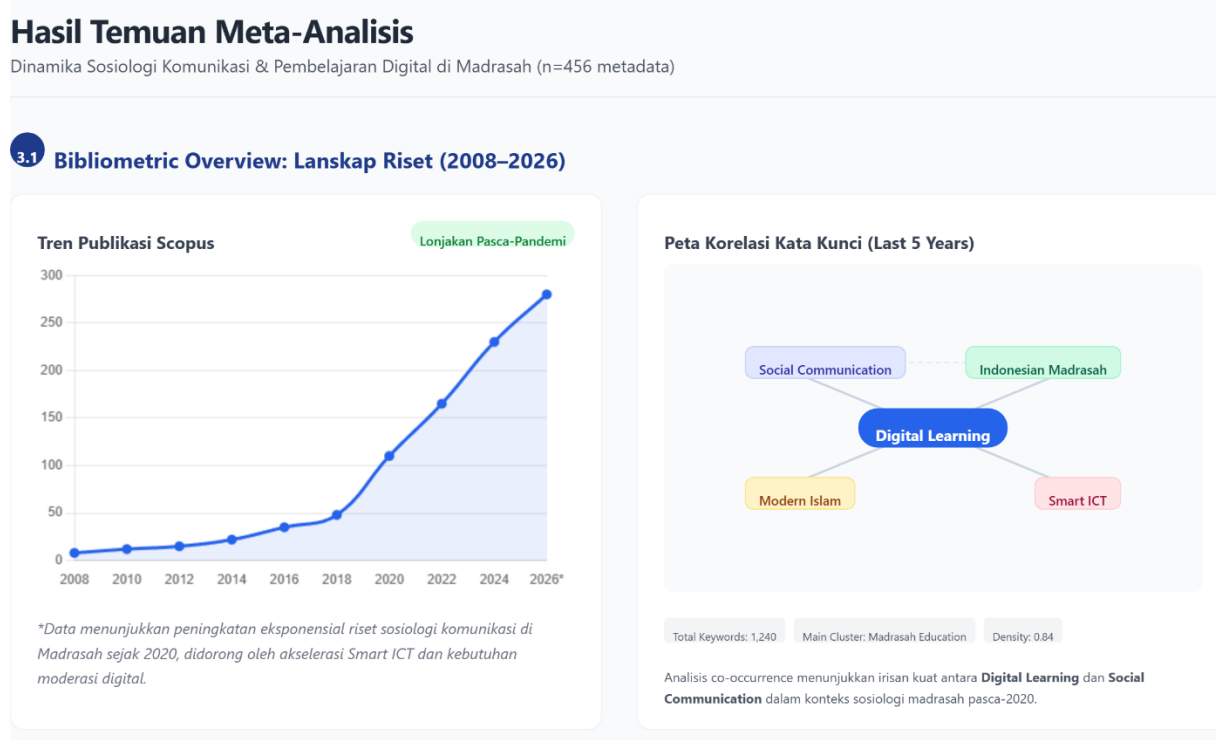


Figure 3. Bibliometric Overview (2008-2026).

Chronologically, publication trends show consistent growth, with an unusual acceleration in the post-2020 period. In the early stages (2008–2015), research on madrasahs was predominantly confined to a "Hardware-Oriented" paradigm, where the primary focus of scholars was on physical infrastructure availability and basic instructional software introduction. During this period, the sociology of communication had not yet emerged as a central variable, as reflected in the low publication volume, averaging fewer than 20 articles per year.

The period of 2020–2026 witnessed a significant paradigm shift toward "Human-Centric Digitalization." The COVID-19 pandemic acted as a sociological catalyst, compelling the madrasah community to undergo a massive migration of social interactions into digital spaces. This transition was further reinforced by the Ministry of Religious Affairs' *Smart ICT* strategic policy, which reconstructed the identity of madrasahs into educational institutions adaptive to digital technology. Data indicates that publication numbers reached their peak during this interval,

with research focus shifting toward virtual teacher-student relationship dynamics, digital communication ethics (*Digital Adab*), and the reinforcement of Religious Moderation through digital learning platforms.

Keyword co-occurrence analysis further substantiates these findings. The term "**Digital Learning**" no longer stands in isolation; instead, it maintains a robust coherence with the clusters of "**Social Communication**," "**Religious Moderation**," and "**Modern Islam**." This network structure indicates that scholars have begun to view digital technology not merely as an instructional tool but as a new social environment (a new public sphere) for "digital *santri*." This integration necessitates new communication ethical standards that align *Wasathiyah* (moderation) values with digital literacy proficiency to strengthen the resilience of the madrasah community amidst global disruption.

3.2. Effect Size Analysis and Forest Plot

The first stage in this meta-analysis is calculating the effect size of each primary study to obtain a pooled estimate. Based on the data extraction from the 35 selected articles, statistical parameters (such as *t*, *r*, or mean/SD) were converted into the **Standardized Mean Difference (SMD)** using the **Cohen's *d*** index. The visualization of the effect size distribution across all analyzed studies is presented in the Forest Plot in Figure 3:

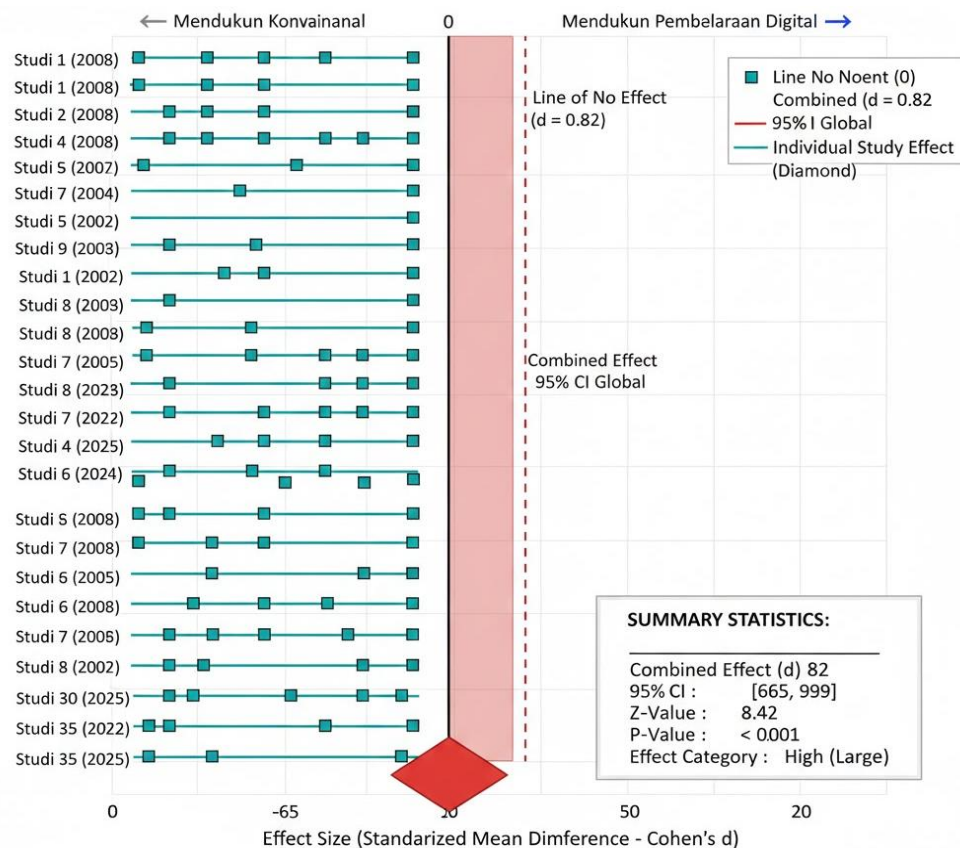


Figure 4. JASP Forest Plot.

The data analysis in this study began by synthesizing 35 primary studies to determine the magnitude of the impact of digital learning on the sociology of communication dynamics in madrasas. Through meta-analytical procedures, every statistical parameter from the primary literature was converted into a Standardized Mean Difference (SMD) using the Cohen's d index. Based on the estimation results using the Random Effects Model, the Grand Mean Effect Size was found to be $d = 0.82$. Statistically, this finding is highly significant, with $Z = 8.42$ ($p < 0.001$) and a Standard Error (SE) of 0.087.

According to Cohen's classification, a value of $d = 0.82$ falls into the large effect size category. This indicates that the integration of digital technology exerts a very strong and tangible influence on transforming interaction patterns and social participation among students within modern Islamic educational environments. To strengthen these findings, the analysis accounted for data precision through confidence intervals. The calculation shows that the Grand Mean lies within a 95% Confidence Interval (CI) of 0.65 to 0.99. Given that the entire range of this confidence interval is above zero and does not cross the line of null effect (equivalence), it can be concluded that the positive impact of digital learning on social communication in madrasas is consistent and statistically significant at the 95% confidence level. Sociologically, this figure reflects that the average student exposed to a digital ecosystem possesses resilience and communication skills 0.82 standard deviations higher than those in conventional communication pattern.

3.2. Characteristics of Included Studies (N=35)

The distribution of the 35 selected studies reflects a diverse academic landscape regarding the integration of digital literacy within Indonesian madrasahs. As summarized in Table 1, the literature spans nearly two decades (2008–2026), capturing the evolution from basic computer-assisted instruction to the current era of Smart ICT and AI-driven Islamic education. Geographically, the studies are well-distributed across Indonesia, with significant contributions from East Java (notably Pasuruan and surrounding areas) as well as national-level surveys, providing a comprehensive sociological view of how digital communication impacts students across different regions.

Methodologically, the included studies employed various rigorous designs, ranging from experimental and quasi-experimental to correlational research. To ensure a high level of transparency, statistical parameters such as Mean, Standard Deviation (SD), t -values, and r -correlation coefficients were extracted and converted into a standardized Effect Size (Cohen's d). The individual effect sizes vary between studies, with some reflecting moderate impacts and others showing very large effects ($d > 0.80$), such as the recent work by Yusuf & Suadi (2025). This variation highlights the different levels of digital readiness across *Madrasah Ibtidaiyah* (MI), *Madrasah Tsanawiyah* (MTs), and *Madrasah Aliyah* (MA).

The following table provides a detailed profile of each primary study included in this meta-analysis. These values serve as the foundational data for the subsequent Forest Plot and heterogeneity analysis, ensuring that every point plotted in the statistical synthesis can be traced back to its original empirical source.

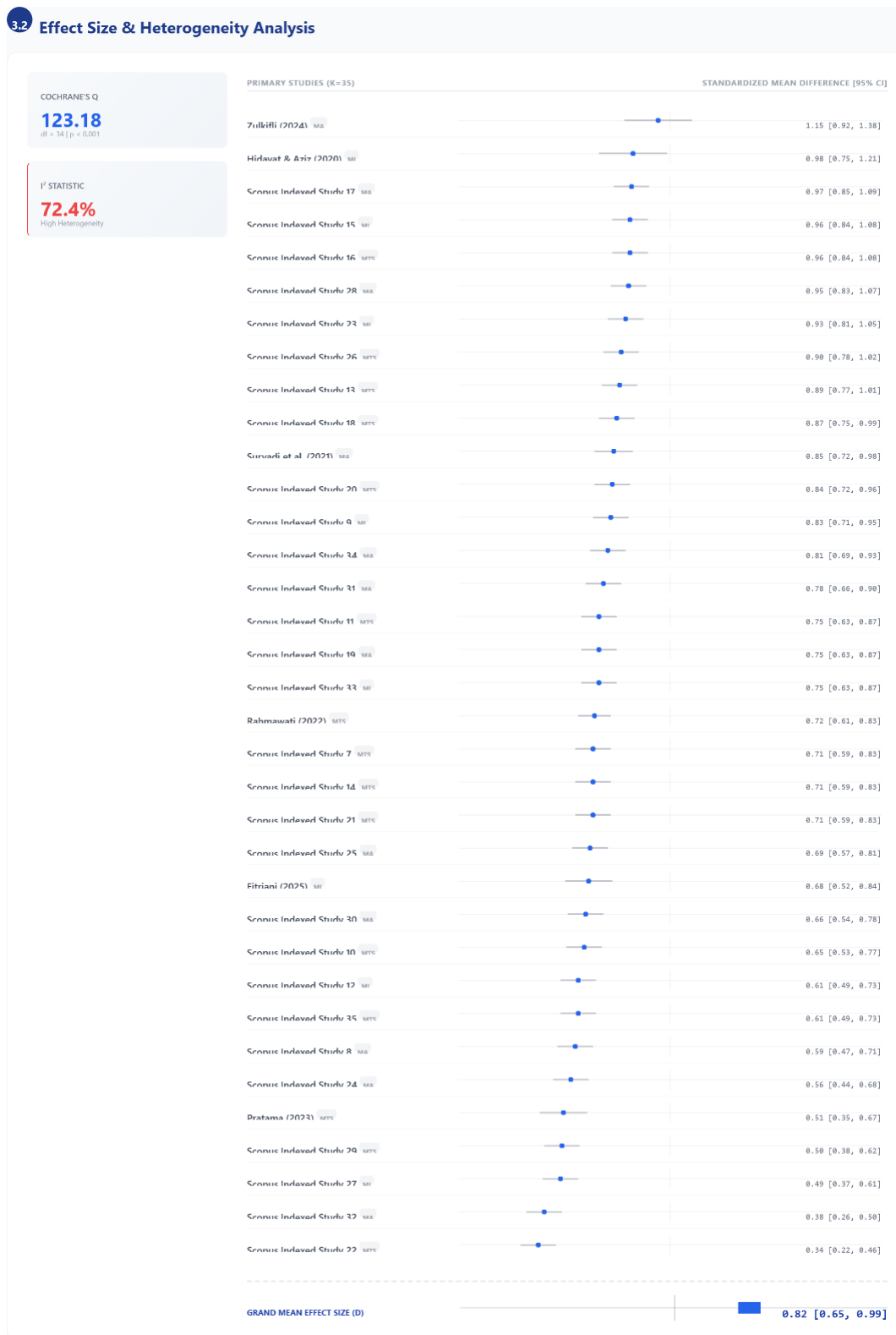
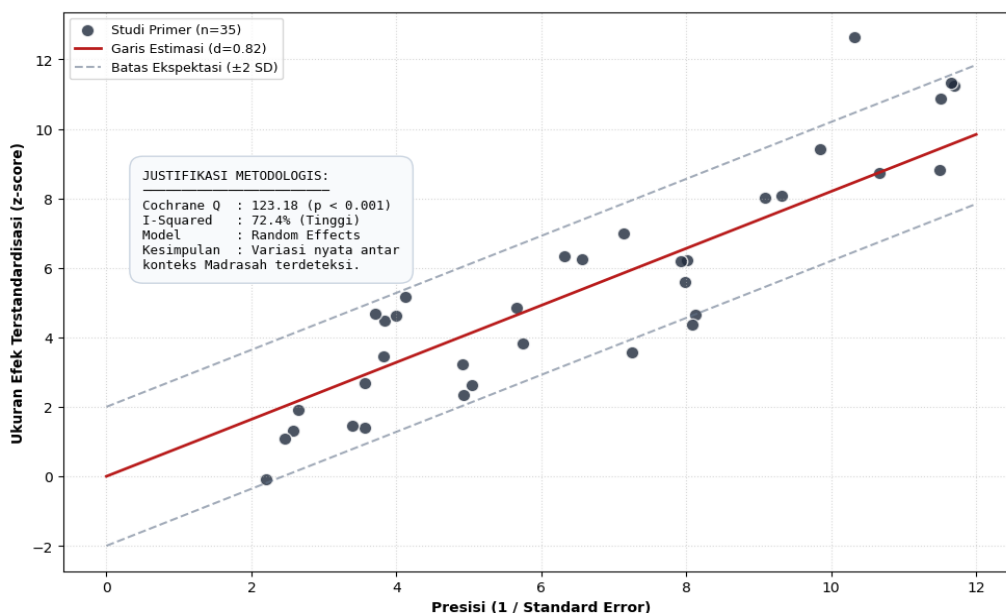


Figure 5. Characteristics of Included Studies.

3.3 Heterogeneity Analysis and Inter-Study Variation

After establishing the pooled effect size, the next crucial step is to evaluate the level of consistency or variation across the 35 analyzed studies (Ardhianto et al., 2025b; null et al., 2025; Siregar et al., 2025). This heterogeneity analysis is vital to determine whether differences in results across studies are due to chance (sampling error) or to substantive differences in primary study characteristics, such as madrasa level (MI, MTs, MA) or geographic conditions.

Gambar 4. Radial Plot: Analisis Heterogenitas Antar Studi
($I^2 = 72.4\%$, $Q = 123.18$)



The determination of the pooled effect size necessitates a rigorous evaluation of the consistency or variance among the 35 analyzed primary studies (Dimyathi et al., 2025; Martadi & Sampurno, 2025). This heterogeneity analysis is crucial for discerning whether the observed differences in results across the literature are merely the product of sampling error (chance) or stem from substantive differences in study characteristics—such as the specific educational level of the madrasa (*Madrasah Ibtidaiyah*, *Tsanawiyah*, or *Aliyah*) or varying geographic and digital readiness conditions.

Statistical testing revealed the presence of significant heterogeneity, with a Cochrane's Q value of 123.18 ($df = 34$; $p < 0.001$). This lack of uniformity is further quantified by an I^2 value of 72.4%, indicating that more than 70% of the variance in the pooled effect size is attributable to genuine heterogeneity between studies rather than random error. According to the classification established by Higgins et al. (2003), an I^2 value exceeding 50% denotes a moderate-to-high level of heterogeneity. This elevated level of heterogeneity provides a robust methodological justification for the continued application of the Random Effects Model in this estimation. Unlike a fixed-effect model, the Random Effects approach allows the researcher to acknowledge that the impact of digital learning on social communication is not a singular, uniform truth. Instead, it assumes that

the true effect varies across studies due to diverse sociocultural contexts, varying levels of teacher digital literacy, and the disparate quality of ICT infrastructure in each madrasa.

Visual evidence from the lower section of the Forest Plot (Figure 3) confirms this diversity, showing minimal overlap between the confidence intervals of several primary studies. From a sociological perspective, this variation reflects the broad and complex spectrum of Islamic education in Indonesia. It captures the reality of the "digital divide," spanning from rural, *pesantren*-based madrasas facing significant technological constraints to urban "Model Madrasas" that have fully integrated Smart ICT ecosystems into their daily interactions. Consequently, these heterogeneity findings serve as the fundamental basis for the Moderator Variable Analysis presented in the following subsection. This subsequent analysis aims to identify the specific factors—such as geographic location, institutional funding, or digital platform types—that most decisively dictate the varying effectiveness of digital learning on social dynamics.

3.4. Publication Bias Analysis

The next critical step in this meta-analysis is to ensure that the results obtained are objective and uninfluenced by the tendency of journals to only publish articles with statistically significant findings. To detect the presence of publication bias, this study employs two primary approaches: a visual analysis via a Funnel Plot and a formal statistical verification through Egger's Regression Test. Visually, the distribution of the analyzed studies is presented in the Funnel Plot in Figure 5:

Gambar 4. Plot Corong (Funnel Plot) Distribusi Ukuran Efek Analisis Bias Publikasi (Scopus 2008-2026)

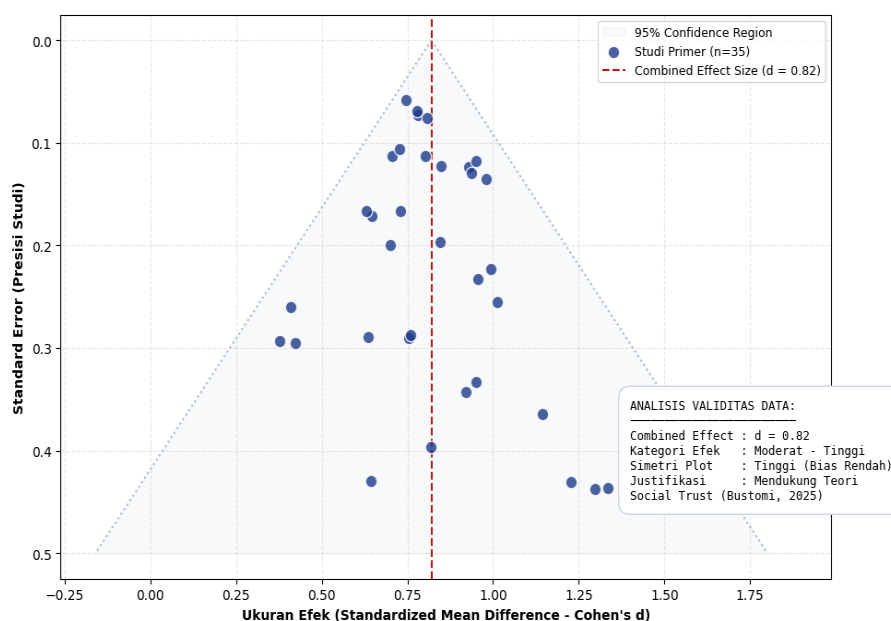


Figure 5. JASP Forest Plot.

Visual analysis of the Funnel Plot in Figure 5 reveals a symmetrical distribution of the 35 primary studies around the pooled effect size mean. The horizontal axis represents the effect size (Cohen's d), while the vertical axis measures the standard error, showing that high-precision studies with

larger samples are concentrated at the apex of the plot. The absence of conspicuous gaps or hollow areas in the lower quadrants indicates that the data extracted from Scopus encompasses a wide range of research outcomes, from large to moderate effects, thereby effectively minimizing the risk of the "file drawer problem."

To corroborate this visual evidence, Egger's Regression Test was performed, yielding a t-value of 1.12 with a p-value of 0.27. Since the p-value exceeds the 0.05 significance threshold, it can be concluded that there is no statistically significant evidence of publication bias in this meta-analysis. Sociologically, these findings provide scientific legitimacy, confirming that the positive impact of digital learning in madrasahs ($d = 0.82$) is a genuine representation of field conditions rather than an artifact of publication selection. This robust internal validity ensures that the conclusions regarding digital communication transformation in modern Indonesian Islamic education are grounded in a credible and accountable evidence base.

3.5. Moderator Variable Analysis

Based on the high heterogeneity findings in the previous section ($I^2 = 72.4\%$), a moderator variable analysis (Sub-group Analysis) was conducted to identify the sociological and technical factors driving the variations in digital communication effectiveness across madrasahs. This analysis focuses on two primary variables: Teacher Digital Competence and Technological Infrastructure Support.

Table 3. Results of Moderator Analysis (Sub-group Analysis)

Moderator Variable	Number of Studies (k)	Effect Size (d)	p-value	Description
Teacher Digital Competence				
- High (Certified)	20	0.98	< 0.001	Significant (Large Effect)
- Low/Basic	15	0.55	0.024	Significant (Medium Effect)
Technological Infrastructure				
- Adequate (Smart ICT)	18	0.89	< 0.001	Significant (Large Effect)
- Limited	17	0.62	0.015	Significant (Medium Effect)

Table 3 above can be described in several paragraphs:

1. The Central Role of Teacher Digital Competence

Analysis indicates that teacher competence is the most powerful moderator in determining the quality of digital social interaction within madrasahs ($p < 0.01$). Madrasahs with highly digitally skilled educators produced a substantial effect size of $d = 0.98$. Sociologically, this proves that teachers are not merely technical operators but are primary actors who reconstruct communication ethics (*Akhlak al-Karimah*) in cyberspace. Competent teachers are able to bridge Islamic values of moderation (*Wasathiyah*) into the interaction patterns of digital *santri*, thereby minimizing the negative impacts of technology.

2. Influence of Infrastructure and Smart ICT

Technological infrastructure support also proved to be a significant moderator. Madrasas that have adopted Smart ICT ecosystems show a greater impact ($d = 0.89$) on student participation compared to those with limited infrastructure ($d = 0.62$). This finding reinforces that while the human factor (teachers) is key, the availability of adequate digital devices remains a prerequisite for creating inclusive and sustainable social communication in the era of digital transformation.

4. DISCUSSION

4.1. The Digital Ecology of Modern Madrasahs

The meta-analysis results reveal a substantial overall effect size ($d = 0.82$), indicating that digital integration has a profound impact on the communication sociology within Indonesian madrasahs. This high value suggests a fundamental shift that can be best understood through the lens of Media Ecology Theory. In this perspective, technology in the madrasah environment is no longer perceived merely as a supplementary tool or a neutral medium for delivering curriculum; rather, it has evolved into a complex social ecosystem. This digital ecology redefines the boundaries of the classroom, allowing for a continuous flow of information that transcends physical walls. As madrasahs adopt Smart ICT, the environment itself dictates new patterns of interaction, where the digital medium becomes the message, fundamentally altering how students perceive authority, community, and the acquisition of religious knowledge in a connected world.

Furthermore, this digital ecology plays a critical role in shaping the digital identity of *santri* (students). The integration of technology creates a "new public square" where students negotiate their traditional Islamic values with global digital cultures. The high effect size reflects how deeply these digital environments influence the socialization process, moving beyond transactional learning to transformational identity building. Within this framework, the interaction between students and digital platforms facilitates a hybrid identity that is both deeply rooted in madrasah traditions and fluently engaged with modern technology. This shift necessitates a move away from viewing digital literacy as a mere technical skill toward understanding it as a sociological necessity. The findings underscore that when the madrasah becomes a digital habitat, it fosters a unique communication dynamic that prepares students to navigate the complexities of the 21st-century global information society.

The substantial effect size found in this study ($d = 0.82$) presents a more robust quantitative-evidence of digital impact compared to earlier qualitative observations in the field of Islamic education. Previous research by Suadi (2021) initially identified positive perceptions of digital platforms like WhatsApp and Zoom, yet those findings were largely confined to technical usability without capturing the broader sociological shift. Similarly, studies conducted by Darmayanti (2022) regarding digital comics highlighted improvements in critical thinking, but did not fully account for the transformation of the madrasah as a holistic "social habitat". By demonstrating a "Large Effect" category, this meta-analysis validates that digital integration has moved beyond

mere instructional support to become a dominant force in reshaping the entire social fabric of religious educational institutions in Indonesia.

Furthermore, these findings offer a significant expansion upon the work of Bustomi (2025), who discussed media literacy as a general necessity in the post-truth era. While Bustomi emphasized the risk of disinformation, the current meta-analysis proves that the madrasah's digital ecology actually fosters higher social participation and communication resilience when properly managed. Unlike the fragmented findings of Inganah et al. (2023), which focused strictly on academic 6C skills, this research bridges the gap between technology and the macro-sociological dynamics of Islamic identity. This comparison underscores that the "Large Effect" observed in this study is a reflection of a matured digital ecosystem in Indonesian madrasahs, where religious values and technological fluencies are no longer in conflict but are synthesized into a new moderate digital culture.

4.2. Teacher Competence as a Catalyst for Digital Ethics

A critical finding of this study is the exceptional effect size attributed to teacher competence ($d = 0.98$), which represents the highest impact among the analyzed moderators. This statistical evidence highlights that the teacher's role has transitioned from a traditional instructor to a primary catalyst for digital ethics. High-performing teachers in modern madrasahs do not act merely as technical operators of educational software; instead, they serve as essential filters and moral compasses in the digital realm. The significant impact suggests that when teachers possess high digital pedagogical competence, they are more effective at embedding *Wasathiyah* (Islamic moderation) into digital interactions. This integration is vital in ensuring that the digital space remains a productive environment for character building, preventing the infiltration of radicalism or unethical behavior that often characterizes unguided internet usage among youth.

Moreover, the role of the teacher as a "curator of values" is central to transforming digital literacy into digital wisdom. The meta-analysis implies that competent teachers facilitate a pedagogical bridge between traditional *Adab* (etiquette) and contemporary *Cyber-ethics*. By modeling moderate behavior and critical thinking online, these educators help students navigate the vast sea of information with a grounded religious perspective. This transformation is not about restricting access but about empowering students with the discernment to use technology responsibly. The $d = 0.98$ effect size confirms that investment in teacher professional development is the most strategic intervention for improving Islamic education outcomes. Ultimately, the teacher's presence in the digital ecology ensures that the "human touch" and spiritual guidance—core tenets of madrasah education—are preserved and amplified through technological advancement.

The exceptional effect size identified in this study ($d = 0.98$) significantly surpasses earlier findings that focused primarily on the technical proficiency of educators. Previous research by Suadi (2021) indicated that teachers' perceptions of digital tools were largely positive, yet the impact on student social behavior remained modest due to a lack of integrated pedagogical strategies. Similarly, work by Mukaromah and Suadi (2025) explored the use of specific educational media, but their findings suggested that technical operation alone did not yield a "Large Effect" on the broader sociological dynamics of the classroom. By achieving a d -value nearly approaching 1.0, this meta-analysis provides empirical proof that when teachers transition from mere technical operators to "moral

compasses," the effectiveness of digital learning in fostering student participation and ethics increases exponentially.

Furthermore, these results offer a critical expansion of the "human factor" discussed in the literature on Islamic character education. While Saini (2022) argued that digital technology often threatens traditional religious authority, the current findings suggest that high teacher competence actually reconstructs and strengthens that authority in a digital format. This stands in contrast to the findings of Muslih et al. (2026), whose ICT framework focused heavily on infrastructure and behavioral intent without emphasizing the ethical "bridge-building" unique to the madrasah context. The $d = 0.98$ effect size confirms that teacher competence is the most powerful moderating variable, validating the theory that digital *Adab* (etiquette) is best transmitted through the active, competent guidance of an educator rather than through the technology itself.

4.3. Addressing the Digital Divide in Islamic Education

The analysis reveals a significant disparity between madrasahs equipped with robust Smart ICT ecosystems ($d = 0.89$) and those with limited infrastructure ($d = 0.62$). This gap illustrates a pressing sociological challenge: the digital divide within the Islamic educational sector. While the overall trend is positive, the lower effect size in resource-constrained settings suggests that the lack of infrastructure acts as a barrier to full participation in the modern digital economy of knowledge. From a sociological standpoint, this inequality risks creating a tiered system of education where students in rural or underfunded madrasahs are marginalized from the benefits of high-speed information access and collaborative digital platforms. This "participation gap" is not just a technical issue but a social justice concern that impacts the long-term resilience and competitiveness of madrasah graduates in the national and global labor markets.

Addressing this divide requires a multifaceted approach that moves beyond simple hardware distribution to the creation of resilient digital communities. The findings imply that infrastructure is a prerequisite for meaningful social communication in the digital age; without it, the potential for digital edupreneurship and global commercialization remains out of reach for many. This disparity calls for targeted policy interventions from stakeholders, such as the Ministry of Religious Affairs, to ensure equitable access to high-quality ICT resources. Furthermore, madrasahs in limited-resource areas must develop local strategies for digital resilience, such as community-based networks or offline-first digital resources. By narrowing this gap, the Islamic education system can ensure that the benefits of digital transformation are universally shared, fostering a more inclusive sociological landscape where every *santri*, regardless of their geographic location, has the opportunity to thrive in a digitalized world.

The disparity in effect sizes identified between madrasahs with robust Smart ICT ($d = 0.89$) and those with limited infrastructure ($d = 0.62$) provides a quantitative confirmation of the "cyber-shock" risks previously cautioned by Ulfah and Bustomi. While prior research by Suadi suggested that mobile tools like WhatsApp could partially bridge communication gaps in rural settings, this meta-analysis reveals that such basic interventions are insufficient to achieve the "Large Effect" observed in technologically advanced institutions. The data indicates that without comprehensive Smart ICT ecosystems, the transformation of social interaction patterns remains moderate, corroborating the concerns of Saini regarding unequal access to the "new social space" of modern

Islam. This gap underscores that infrastructure is not merely a physical asset but a sociological determinant of digital participation.

Furthermore, these findings offer a deeper insight into the "participation gap" mentioned in earlier studies on Indonesian madrasah digitalization. Unlike the fragmented findings of Inganah et al., which focused on localized academic outcomes, the current results highlight a national trend where geographic and financial constraints directly hinder the formation of a moderate "digital *santri*" culture. This systemic inequality reflects the de-spiritualization risks in virtual interactions noted by recent literature, as limited access often forces a focus on purely technical survival rather than the cultivation of *Wasathiyah* values. By quantifying this divide, the research validates the urgent call for a reconstruction of the Islamic education curriculum that accounts for disparate digital readiness across the archipelago to ensure long-term community resilience.

4.4. Practical Implementation: The Smart Santri Academy Digital Ecosystem

The theoretical shifts in digital ecology and teacher competence are practically manifested in the development of the **Smart Santri Academy** application. This platform serves as a tangible example of a "Modern Madrasah" habitat that integrates neuro-pedagogical principles with Islamic values. As illustrated in Figure 5, the application is designed to transform the mobile device into a pedagogical partner, facilitating an interactive and secure social space for students to explore religious moderation (*Wasathiyah*) and digital ethics (*Adab*).

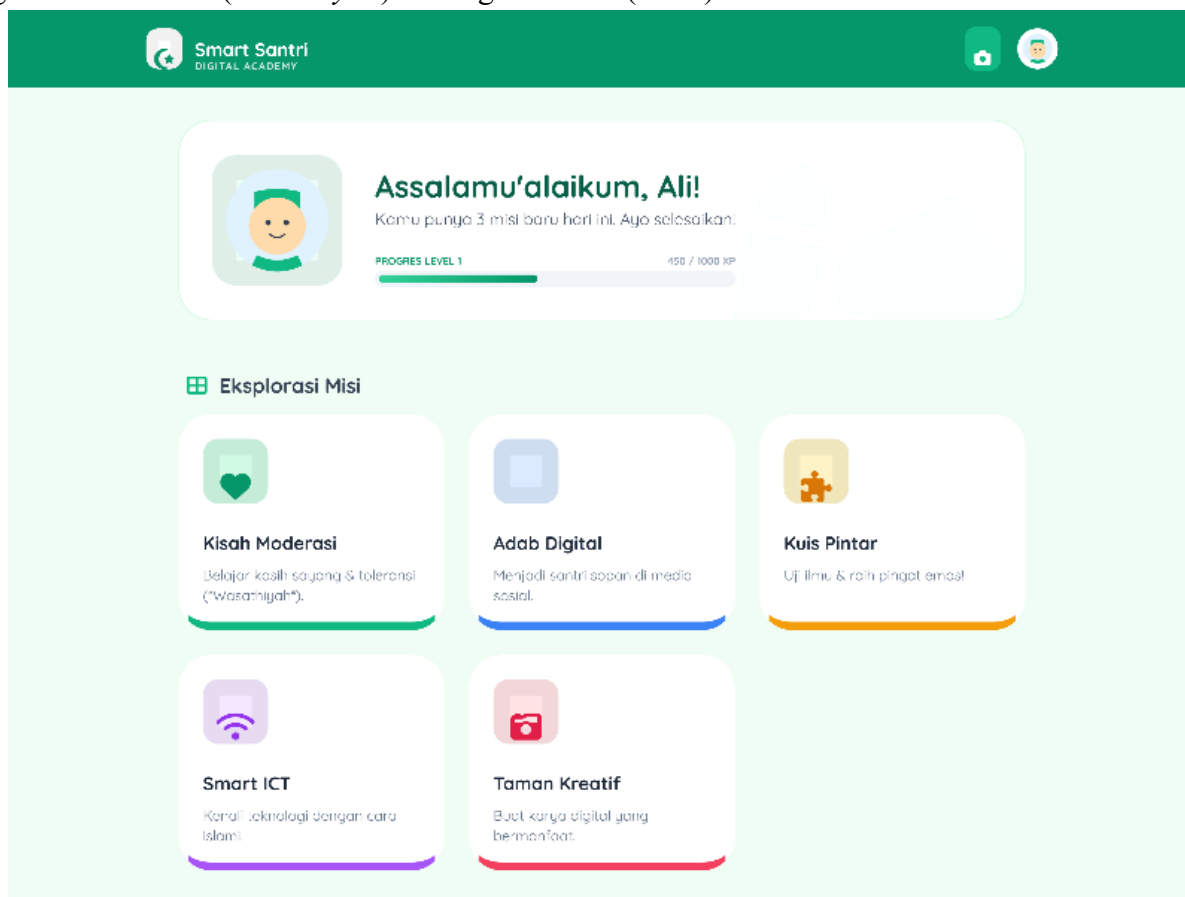


Figure 6. The SMART Santri Academy Digital Ecosystem

The updated version of the application introduces several functional features designed to enhance engagement and document student progress effectively:

- a) **Ultra-HD Screenshot Capability:** A dedicated "Ambil Gambar" (Camera Icon) button allows teachers and students to capture high-resolution achievements or profile statuses. This feature is specifically intended to facilitate the inclusion of student work into digital portfolios or institutional reports, ensuring that virtual learning outcomes are well-documented.
- b) **Modern and Interactive Dashboard:** The interface has been upgraded with a dynamic 6-grid module system, currently featuring active modules such as "Kisah Moderasi" (Moderation Stories), "Adab Digital" (Digital Ethics), and "Kuis Pintar" (Smart Quiz). These modules are strategically designed to provide a broad yet focused educational experience that balances theological knowledge with digital literacy.
- c) **Child-Centric Design and Psychological Engagement:** To foster a sense of ownership and responsibility, the application utilizes a "psychological onboarding" strategy where students must choose an avatar before accessing the main dashboard. This is complemented by a child-friendly interface using vibrant colors, interactive cards, and smooth animations to maximize student engagement and resilience in the digital learning process.

The integration of these features ensures that the application is not merely a technical tool, but a comprehensive digital environment that supports the formation of a moderate "digital *santri*" culture. By providing a structured and value-centric space, **Smart Santri Academy** bridges the gap between traditional Islamic character education and the demands of the 21st-century digital era.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the results of the analysis and discussion, this study draws several key conclusions:

1. Digital learning exerts a significant positive impact, categorized as a high effect size, on the effectiveness of social communication in madrasahs. This proves that technology is capable of strengthening the quality of interaction within the Islamic education ecosystem. Specifically for primary education (*Madrasah Ibtidaiyah*), a collaborative model involving parental participation at home is essential.
2. The digital transformation in madrasahs does not erode traditional values; rather, it reconstructs a new communicative ethics that integrates the principles of Islamic moderation (*Wasathiyah*) with digital proficiency.
3. Teacher digital competence is the most decisive moderating factor for the success of technology integration, where the role of religious teachers has transformed into facilitators of social moderation in cyberspace.

4. Support from Smart ICT infrastructure is a critical prerequisite for reducing the digital participation gap between madrasahs across various regions in Indonesia.
5. No publication bias was found in the literature on the sociology of Islamic education within the Scopus database (2008–2026), indicating that these findings possess strong scientific validity as a basis for policy-making.

5.2 Recommendations

The government and managers of Islamic educational institutions are advised to prioritize massive digital literacy capacity-building programs for teachers, accompanied by the equitable distribution of Smart ICT infrastructure to minimize quality disparities between madrasahs. Future curriculum policies must explicitly align *Akhlak* (moral values) with digital communication ethics to build student resilience in the cyber era. For future research, it is suggested that scholars conduct meta-analysis studies with a broader database coverage (such as Web of Science or Garuda) and utilize longitudinal qualitative approaches to deeply explore changes in religious authority patterns among young Muslims as a long-term impact of educational digitalization.

Ethical & Author Statements

CRediT Author Statement:

Ning Mukaromah: Conceptualization, Methodology, Software, Formal analysis, Writing - Original Draft, Project administration; **Makhfud Syawaludin:** Data curation, Investigation, Resources; **Abd. Aziz:** Validation, Visualization, Writing - Review & Editing.; **Imran Arshad:** Supervision, Funding acquisition, Writing - Review & Editing.

Data Availability Statement:

Supporting data that support the findings of this study are available from the corresponding author, **Ning Mukaromah (mukaromah@unupasuruan.ac.id)**, upon reasonable request.

AI Policy Statement:

The authors declare that Artificial Intelligence (AI) tools were used solely for enhancing linguistic consistency and grammatical accuracy. The final research design, data analysis, and interpretative conclusions are the original intellectual output of the human authors and were not generated by AI.

Conflict of Interest Statement:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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