

Digital Dashboard Transformation as a Mediator Between Service and Content Delivery and Sustainable Performance in Islamic Educational Institutions in Indonesia

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ARTICLE INFO	ABSTRACT
Article history: Submitted: May, 20 2026 Final Revised: June, 17 2026 Accepted: June, 28 2026 Published: July, 31 2026	Purpose: This study examines the mediating role of Digital Dashboard Transformation (DDT) in the association between Service and Content Delivery (SCD) and Sustainable Performance (SP) in Islamic educational institutions in Indonesia. Methods: A quantitative cross-sectional design was employed involving 104 respondents selected through purposive sampling from Islamic educational institutions that had implemented digital-based educational and administrative services. Data were collected using a 36-item questionnaire measured on a seven-point Likert scale. Construct reliability and validity were assessed using Composite Reliability (CR) and Average Variance Extracted (AVE). The mediating role of DDT was evaluated using bias-corrected bootstrapping with 5,000 resamples. Findings: The results indicate that SCD was positively associated with DDT, and DDT was positively associated with SP. The indirect effect of SCD on SP through DDT was statistically significant, supporting a complementary partial mediation mechanism. The bootstrap analysis showed that the 95% bias-corrected confidence interval for the indirect effect did not include zero (LLCI = [isi nilai], ULCI = [isi nilai]). The model explained 50.5% of the variance in SP ($R^2 = 0.505$), suggesting that SCD and DDT are important factors associated with sustainability outcomes in Islamic educational institutions. Research implications: The findings suggest that strengthening service and content delivery may support the development of dashboard-based monitoring capabilities, which are associated with improved sustainability-related outcomes. Educational institutions may benefit from integrating digital dashboard systems to support evidence-based decision-making and organizational performance monitoring. Originality: This study contributes to the digital transformation and sustainability literature by examining DDT as a mediating mechanism linking SCD and SP within Islamic educational institutions. The findings provide empirical evidence of an indirect association between digital service capabilities and sustainability outcomes in a faith-based educational context, while acknowledging the limitations of cross-sectional data for causal inference.
Keywords: Digital Dashboard Transformation; Service and Content Delivery; Sustainable Performance; Islamic Educational Institutions; Mediation Analysis.	
	
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INTRODUCTION

The Fourth Industrial Revolution, driven by digital technologies, is expanding and reconstructing economic and social systems worldwide, demanding transformative institutional responses (Gkrimpizi et al., 2023; Mohamed Hashim et al., 2022). Higher education institutions globally face the dual imperative of digitizing their operations while simultaneously demonstrating credible sustainability commitments, a convergence that creates both opportunity and complexity (Nurhas et al., 2022; Waheed, 2012). For Islamic educational institutions in Indonesia, this convergence carries particular significance: these institutions must navigate digital transformation not merely as a technological project, but as a mission-critical alignment between faith-based values, social responsibility, and environmental stewardship (Firdaus et al., 2023; Jannah et al., 2023).

Indonesia hosts one of the world's largest Islamic educational ecosystems, comprising thousands of pesantren, madrasah, and Islamic universities (PTKI) whose collective influence on social capital, human development, and sustainability is substantial (Hasanah et al., 2023; Wathoni et al., 2023). Yet these institutions face a persistent strategic gap: many invest in digitizing individual services (course management systems, digital content repositories, mobile learning platforms) without subsequently integrating these investments into coherent, data-driven performance monitoring systems (Alenezi, 2021; McCarthy et al., 2023). This fragmentation limits

the translation of digital service capabilities into measurable sustainability gains, leaving significant value unrealized.

Service and Content Delivery (SCD) encompasses the quality, accessibility, cultural relevance, and interactivity of digitally mediated educational services (Alrawabdeh, 2016; Blut et al., 2015; Zeithaml et al., 2002). When institutions deliver high-quality, culturally congruent digital services, they cultivate stakeholder trust, generate rich interaction data, and build the organizational readiness that makes advanced performance monitoring feasible (Grönroos, 2011; Vargo & Lusch, 2008). This operational data infrastructure represents a foundational resource for Digital Dashboard Transformation (DDT), the strategic adoption of integrated real-time monitoring, unified reporting, decision-support, and stakeholder transparency systems (Davenport & Harris, 2007; Reinking et al., 2020). The strategic deployment of digital dashboards transforms raw institutional data into actionable sustainability intelligence, enabling evidence-based decision-making across economic, social, environmental, and spiritual dimensions (Mikalef et al., 2018; Yigitbasioglu & Velcu, 2012).

Despite growing scholarly attention to digital transformation in higher education (Goulart et al., 2022; Rodriguez-Abitia & Bribiesca-Correa, 2021; Teng et al., 2022), the mediating mechanisms connecting service delivery quality to sustainable performance outcomes remain underexplored, particularly in Islamic institutional contexts. No prior empirical study has examined whether digital dashboard systems specifically mediate this relationship. This gap is theoretically significant: Technology Acceptance Theory (Davis, 1989; Venkatesh et al., 2003) identifies perceived usefulness as the primary driver of technology adoption, yet does not explain how prior digital investments enable subsequent digital capabilities. Service-Dominant Logic (Grönroos, 2011; Vargo & Lusch, 2008) positions service co-creation as a generator of stakeholder data and engagement, but stops short of specifying how these resources translate into monitoring infrastructure. Organizational Learning Theory (Argyris, 1996) provides the missing link: organizations with richer service delivery data streams are better positioned to implement double-loop learning systems (digital dashboards) that continuously monitor, adapt, and improve sustainability performance.

Although previous studies have examined the relationship between digital transformation, organizational performance, and sustainability in educational and organizational environments, there are still significant gaps. For example, researching digital transformation readiness at universities but not researching sustainability outcomes. It shows that digital transformation capabilities contribute to organizational performance in SMEs, but mediation mechanisms involving dashboard-based systems are not explored. Similarly, that digital service maturity allows for a high level of digital capabilities, but continuous performance is not included as an outcome variable. The strategic value of digital dashboards for performance alignment; However, their study did not examine dashboards as an intermediary mechanism that links digital service capabilities to sustainability outcomes. As a result, empirical evidence explaining how Services and Content Delivery contribute to Sustainable Performance through Digital Dashboard Transformation is still limited, particularly in Islamic educational institutions. Addressing this gap is important because Islamic education organizations operate in a unique context where technological advancements, stakeholder accountability, and value-based sustainability goals must be aligned simultaneously.

Table 1. Summary of Related Empirical Studies and Research Gap

Author (s)	Context	Main Variables	Method	Key Findings	Remaining Gap
Rodríguez-Abitia & Bribiesca-Correa (2021)	Universities	Digital Transformation Readiness	Quantitative	Digital readiness influences institutional development	Sustainability outcomes not examined
Reinking et al. (2020)	Organizations	Digital Dashboards, Performance Alignment	Quantitative	Dashboards improve performance monitoring	Dashboard not tested as mediator
Teng et al. (2022)	SMEs	Digital Transformation, Performance	Quantitative	Digital transformation improves performance	Sustainability dimension not included
Benitez et al. (2022)	Business Organizations	Digital Service Maturity, Digital Capabilities	Quantitative	Digital maturity enables advanced capabilities	No sustainability outcome and no dashboard mediation
Hambali & Idris (2020)	Islamic Higher Education Institutions	Transformational Leadership, Organizational Culture, Quality Assurance, Organizational Performance	Quantitative; PLS Mediation Analysis	Quality assurance significantly mediates the relationship between organizational culture and organizational performance	Does not examine digital service delivery or dashboard-based mediation

The present study therefore advances an integrated, empirically validated framework by addressing three research questions: (1) Does SCD significantly influence DDT? (2) Does DDT significantly influence Sustainable

Performance? (3) Does DDT mediate the SCD–SP relationship? By doing so, it makes three distinct contributions: theoretically, it integrates Technology Acceptance, Service-Dominant Logic, and Organizational Learning perspectives into a unified digital sustainability framework; empirically, it provides the first mediation test of this relationship in Islamic educational institutions; and practically, it offers a sequenced digital investment strategy for institutional leaders committed to sustainability.

Literature Review

Theoretical Foundation

Three theoretical frameworks underpin this study. First, Technology Acceptance Theory (Davis, 1989; Venkatesh et al., 2003) posits that individuals and organizations adopt technology based on perceived usefulness and ease of use. In institutional contexts, this theory predicts that digital dashboards will be adopted and sustained when stakeholders perceive them as genuinely useful for decision-making, a perception that is itself conditioned by the quality of underlying data generated through service delivery systems. Recent extensions of technology acceptance to organizational contexts confirm that institutional digital maturity is a key precondition for successful adoption of advanced analytics and monitoring tools (Alenezi, 2021; McCarthy et al., 2023).

Second, Service-Dominant Logic (Grönroos, 2011; Vargo & Lusch, 2008) reconceptualizes value creation as a co-productive process in which service ecosystems generate the relational data, knowledge assets, and stakeholder engagement that enable institutional learning and adaptation. Applied to educational settings, SDL implies that institutions delivering high-quality, interactive, and culturally appropriate digital services generate richer operational data and deeper stakeholder trust, both of which are prerequisites for meaningful dashboard-based sustainability monitoring (Dziubaniuk et al., 2023; Goulart et al., 2022).

Third, Organizational Learning Theory (Argyris, 1996; Argyris & Schön, 1997) distinguishes between single-loop learning (correcting deviations from existing norms) and double-loop learning (questioning and revising underlying assumptions). Digital dashboards, by providing continuous real-time feedback on sustainability KPIs across multiple dimensions, enable institutions to engage in double-loop learning: they can not only detect and correct performance gaps, but also revise the strategic assumptions and resource allocations that produced those gaps in the first place (Mikalef et al., 2018; Reinking et al., 2020). The technology complementarity principle (Milgrom & Roberts, 1990) further specifies that these capabilities are mutually reinforcing: mature service delivery generates the data inputs that make dashboards valuable, while dashboards generate the strategic intelligence that improves service delivery.

Conceptual Framework

The conceptual framework integrates Technology Acceptance Theory, Service-Dominant Logic, and Organizational Learning Theory to explain the relationship among Service and Content Delivery (SCD), Digital Dashboard Transformation (DDT), and Sustainable Performance (SP). Service-Dominant Logic suggests that high-quality digital services generate stakeholder engagement, operational data, and organizational resources. Technology Acceptance Theory explains how these resources enhance the perceived usefulness and adoption of digital dashboard systems. Organizational Learning Theory further posits that dashboard-based monitoring systems facilitate continuous learning, evidence-based decision-making, and performance improvement. Accordingly, SCD is expected to influence SP both directly and indirectly through DDT as a mediating mechanism.

Service and Content Delivery (SCD)

Service and Content Delivery in Islamic educational institutions is operationalized through four dimensions: Digital Service Quality (*Kualitas Layanan Digital*/KLD), Content Accessibility (*Kemudahan Akses Konten*/AK), Cultural Appropriateness (*Kesesuaian Budaya*/RB), and Interactive Learning (*Pembelajaran Interaktif*/PI). This multidimensional conceptualization draws on established frameworks in e-service quality (Blut et al., 2015; Parasuraman et al., 2005; Zeithaml et al., 2002) while extending them to acknowledge the distinctive cultural and religious dimensions of Islamic educational service provision.

Digital Service Quality refers to the reliability, responsiveness, and functionality of digitally delivered educational services, reflecting the standards established by foundational e-service quality research (Parasuraman et al., 2005; Zeithaml et al., 2002). Content Accessibility captures the ease with which learners across diverse technological contexts can access educational materials, a particularly salient dimension in Indonesia, where digital infrastructure varies substantially across urban and rural regions (Firdaus et al., 2023; Wathoni et al., 2023). Cultural Appropriateness reflects the degree to which digital content and service delivery modalities align with Islamic values, norms, and pedagogical traditions (Hasanah et al., 2023; Saada, 2023). Interactive Learning captures the degree to which digital platforms enable collaborative, participatory, and co-creative educational experiences consistent with contemporary constructivist pedagogy (Ahmad et al., 2023; Dziubaniuk et al., 2023).

Prior studies consistently demonstrate that digital service quality is positively associated with organizational performance, learner satisfaction, and institutional reputation (Almulla & Al-Rahmi, 2023; Hongsuchon et al., 2022; Parasuraman et al., 2005). In Islamic educational contexts specifically, research confirms that technology-

mediated service delivery is increasingly recognized as a strategic necessity rather than a peripheral enhancement, particularly in the post-pandemic era (Firdaus et al., 2023; Jannah et al., 2023; Wathoni et al., 2023).

Digital Dashboard Transformation (DDT)

Digital Dashboard Transformation refers to the strategic adoption of integrated digital platforms enabling organizations to monitor, analyze, and communicate performance data in real time, supporting evidence-based decision-making and strategic alignment (Davenport & Harris, 2007; Reinking et al., 2020; Yigitbasioglu & Velcu, 2012). This study operationalizes DDT through four dimensions: Real-Time Monitoring (*Pemantauan Waktu Nyata*/MRT), Integrated Reporting (*Pelaporan Terpadu*/PT), Decision-Making Support (*Dukungan Pengambilan Keputusan*/DK), and Stakeholder Transparency (*Transparansi Pemangku Kepentingan*/TS).

Real-Time Monitoring encompasses the continuous tracking of institutional performance indicators across operational, financial, and sustainability domains (Davenport & Harris, 2007; Mikalef et al., 2018). Integrated Reporting refers to the consolidation of disparate institutional data streams into unified, coherent performance narratives (Eccles et al., 2014; Reinking et al., 2020). Decision-Making Support captures the degree to which dashboard systems provide actionable analytical insights that inform institutional strategy (Gkrimpizi et al., 2023; Mohamed Hashim et al., 2022). Stakeholder Transparency reflects the use of digital platforms to communicate institutional performance (including sustainability progress) to stakeholders in accessible, credible formats (Eccles et al., 2014; Rodríguez-Abitia & Bribiesca-Correa, 2021).

The mediating role of DDT is grounded in the technology complementarity principle (Milgrom & Roberts, 1990), whereby institutions with mature service delivery systems generate the operational data streams, organizational learning capacities, and stakeholder expectations that make digital dashboard investments both feasible and strategically impactful. Reinking et al. (2020) confirm that the strategic use of digital dashboards substantially improves organizational performance alignment. Teng et al. (2022) demonstrate that digital transformation capabilities mediate the relationship between technological readiness and organizational performance, while Benitez et al. (2022) establish that digital service maturity creates enabling conditions for higher-order analytical investments.

Sustainable Performance (SP)

This study conceptualizes Sustainable Performance across four dimensions: Economic Sustainability (*Keberlanjutan Ekonomi*/KE), Social Sustainability (*Keberlanjutan Sosial*/KS), Environmental Sustainability (*Keberlanjutan Lingkungan*/KL), and Spiritual Sustainability (*Keberlanjutan Spiritual*/KSP). This quadripartite framework integrates established sustainability dimensions Branco & Rodrigues, (2006) and Eccles et al. (2014) with the distinctive epistemological commitments of Islamic organizational philosophy.

Economic Sustainability captures the institution's capacity to maintain financial viability and long-term economic resilience (Goulart et al., 2022; Teng et al., 2022). Social Sustainability encompasses the institution's contribution to community development, social equity, and stakeholder wellbeing (Hasanah et al., 2023; Saada, 2023). Environmental Sustainability reflects the institution's commitment to minimizing ecological impact and promoting environmental stewardship (Eccles et al., 2014; Waheed, 2012). Spiritual Sustainability, as a distinct construct, reflects the holistic conception of organizational well-being inherent in Islamic management philosophy, wherein spiritual development is recognized as a foundational driver of long-term institutional sustainability (Akhtar et al., 2017; Sulphrey, 2022).

Digital dashboard systems enhance sustainable performance across all four dimensions by enabling continuous monitoring of sustainability KPIs, facilitating integrated reporting, and communicating sustainability progress to diverse stakeholder communities (Branco & Rodrigues, 2006; Eccles et al., 2014; Reinking et al., 2020). The integration of spiritual sustainability as a measurable performance dimension aligns with the maqasid al-shariah framework, which positions human flourishing as the ultimate objective of institutional governance (Akhtar et al., 2017; Sulphrey, 2022).

Hypothesis Development

- H₁** : Service and Content Delivery has a significant positive influence on Digital Dashboard Transformation. High-quality, accessible, and culturally appropriate service delivery generates the operational data infrastructure, stakeholder engagement, and organizational readiness that enable and motivate digital dashboard investment (Benitez et al., 2022; Milgrom & Roberts, 1990).
- H₂** : Digital Dashboard Transformation has a significant positive influence on Sustainable Performance. Integrated digital monitoring and reporting systems enable evidence-based decision-making, double-loop learning, and multi-stakeholder sustainability communication (Argyris, 1996; Reinking et al., 2020; Waheed, 2012).
- H₃** : Digital Dashboard Transformation significantly mediates the relationship between Service and Content Delivery and Sustainable Performance. The SCD → DDT → SP pathway represents a sequenced digital capability development process in which service digitalization creates the data and organizational foundation for dashboard-enabled sustainability management (Baron & Kenny, 1986; Rodríguez-Abitia & Bribiesca-Correa, 2021).

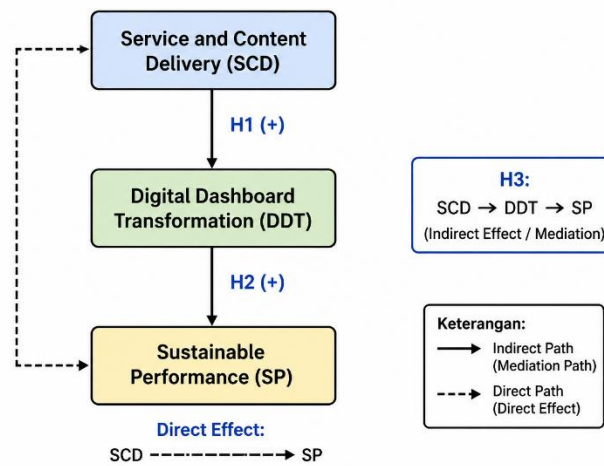


Figure 1. Conceptual Framework

METHOD

A total of 104 respondents from Islamic educational institutions in Indonesia were recruited using purposive sampling. Sample size adequacy was assessed through an a priori statistical power analysis following Hair et al. (2021). Assuming a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, statistical power of 0.80, and two predictors in the regression model, the minimum required sample size was 68 respondents. Therefore, the final sample of 104 respondents was considered sufficient to provide adequate statistical power for the regression and mediation analyses conducted in this study. Research instruments comprised 36 questionnaire items distributed across three constructs, SCD (12 items), DDT (12 items), and SP (12 items) that each measured on a 7-point Likert scale (1 = Strongly Disagree; 7 = Strongly Agree). Composite construct scores were calculated as the arithmetic mean of constituent item responses.

This study employed purposive sampling involving 104 respondents from Islamic educational institutions in Indonesia that had implemented digital-based educational and administrative services. The sample included Islamic universities, pesantren, and madrasah-based institutions that actively utilized digital platforms in their operations. Respondents consisted of institutional leaders, academic administrators, ICT managers, quality assurance personnel, and senior lecturers who were directly involved in digital transformation activities. Data were collected through a structured questionnaire after participants voluntarily agreed to take part in the study. All respondents provided informed consent, and the study ensured anonymity, confidentiality, and the right to withdraw at any stage of participation.

Sampling was conducted using a purposive approach to ensure that respondents possessed direct experience with digital transformation initiatives within their institutions. Participating institutions were identified through publicly available information indicating the implementation of digital learning, administrative, or management systems. Invitations were distributed electronically to institutional leaders and administrative offices, who subsequently assisted in identifying eligible participants. Respondents were required to hold positions directly associated with educational management, digital services, information technology, quality assurance, or strategic planning. Participation was voluntary, and no financial incentives were provided. The final sample comprised representatives from Islamic universities, pesantren, and madrasah-based institutions located in several regions of Indonesia, thereby ensuring representation from multiple institutional contexts while maintaining the purposive selection criteria.

Sample Size Justification

Sample size determination was based on statistical power considerations rather than heuristic sample-size rules. An a priori power analysis was conducted using G*Power 3.1 for multiple regression analysis. Using a medium anticipated effect size ($f^2 = 0.15$), $\alpha = 0.05$, desired power = 0.80, and two predictors, the analysis indicated a minimum sample requirement of 68 respondents. The obtained sample size of 104 respondents exceeded this threshold by approximately 53%, providing sufficient power for regression and mediation analyses.

The adequacy of the sample size was evaluated through an a priori statistical power analysis. Assuming a medium effect size ($f^2 = 0.15$), a significance level of $\alpha = 0.05$, a statistical power of 0.80, and two predictor variables in the final regression model, the minimum required sample size was 68 respondents. Therefore, the final sample of 104 respondents exceeded the recommended minimum requirement, indicating adequate statistical power to detect meaningful relationships among the study variables.

Prior to hypothesis testing, classical assumption tests were conducted: normality was assessed via the one-sample Kolmogorov-Smirnov test, and multicollinearity was evaluated using the Variance Inflation Factor (VIF)

with a threshold of $VIF < 5.0$ (Hair et al., 2019). Construct reliability was assessed using Cronbach's alpha ($\alpha \geq 0.70$) (Nunnally, 1978). Construct validity was evaluated via Composite Reliability ($CR \geq 0.70$) and Average Variance Extracted ($AVE \geq 0.50$), with discriminant validity assessed using the Fornell-Larcker criterion requiring that each construct's square root of AVE exceeds its correlations with all other constructs (Fornell & Larcker, 1981; Hair et al., 2019).

Construct reliability and validity were assessed at the indicator level rather than from composite mean scores. Specifically, Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated using standardized factor loadings obtained through Confirmatory Factor Analysis (CFA), following the procedures recommended by Fornell and Larcker (1981) and Hair et al. (2021). The measurement model was estimated using item-level responses from all 36 indicators, and CR was computed as the ratio of the squared sum of standardized factor loadings to the squared sum of loadings plus measurement error variances, whereas AVE was calculated as the average proportion of variance explained by the latent construct across its indicators. Consequently, the reported CR and AVE values reflect latent variable measurement quality based on indicator-level data and should not be interpreted as statistics derived from aggregated composite means, which are not recommended for establishing convergent and discriminant validity in contemporary measurement assessment.

Mediation analysis was conducted using a contemporary indirect-effect estimation approach rather than the traditional causal-step procedure of Baron and Kenny (1986). Following recommendations by Preacher and Hayes (2008), Hayes (2018), and Hair et al. (2021), the mediating role of Digital Dashboard Transformation (DDT) was assessed through bootstrapped confidence intervals of the indirect effect. The indirect effect was estimated as the product of path coefficients ($a \times b$), where path a represents the effect of Service and Content Delivery (SCD) on DDT and path b represents the effect of DDT on Sustainable Performance (SP) while controlling for SCD. Statistical significance of the mediation effect was evaluated using bias-corrected bootstrapping with 5,000 resamples. Mediation was considered significant when the 95% bootstrap confidence interval for the indirect effect did not include zero. In addition to reporting the indirect effect, direct effects, total effects, and variance explained (R^2) were examined to determine the magnitude and nature of the mediation mechanism. This bootstrapping approach is considered more robust and statistically powerful than the Sobel (1982) test because it does not require the assumption of normal sampling distributions for indirect effects.

Table 2. Operationalization of Variables

Variable	Role	Dimensions (Code)	Indicators
Service and Content Delivery (SCD)	Independent / Antecedent	KLD, AK, RB, PI	KLD1–KLD3, AK1–AK3, RB1–RB3, PI1–PI3
Digital Dashboard Transformation (DDT)	Mediator	MRT, PT, DK, TS	MRT1–MRT3, PT1–PT3, DK1–DK3, TS1–TS3
Sustainable Performance (SP)	Dependent	KE, KS, KL, KSP	KE1–KE3, KS1–KS3, KL1–KL3, KSP1–KSP3

To assess the potential influence of common method bias, Harman's single-factor test was conducted. All measurement items were entered into an exploratory factor analysis to determine whether a single factor accounted for the majority of the variance.

RESULTS

Descriptive Statistics and Reliability Analysis

Table 2 presents the descriptive statistics and reliability coefficients for all constructs. SCD recorded the highest mean among predictor constructs ($M = 5.428$, $SD = 0.959$), followed by DDT ($M = 5.089$, $SD = 0.777$) and SP ($M = 5.767$, $SD = 0.823$). These mean scores all substantially above the scale midpoint of 4.0 indicate generally positive stakeholder evaluations across all digital transformation and sustainability dimensions, consistent with the progressive digital adoption trajectory documented in Indonesian Islamic higher education (Jannah et al., 2023; Wathoni et al., 2023). All Cronbach's alpha values exceeded 0.97, demonstrating excellent internal consistency well above the recommended threshold of 0.70 (Nunnally, 1978).

Table 3. Descriptive Statistics and Reliability Analysis

Variable	N	Mean	Std. Dev.	Min	Max	Cronbach's α
Service and Content Delivery (SCD)	104	5.428	0.959	2.833	7.000	0.986
Digital Dashboard Transformation (DDT)	104	5.089	0.777	3.083	7.000	0.975
Sustainable Performance (SP)	104	5.767	0.823	3.833	7.000	0.981

Construct Validity Assessment

Table 3 presents the construct validity assessment. All constructs exceeded the recommended thresholds for convergent validity: $CR > 0.70$ and $AVE > 0.50$ (Fornell & Larcker, 1981; Hair et al., 2019). Specifically, SCD achieved $CR = 0.984$, $AVE = 0.840$; DDT achieved $CR = 0.972$, $AVE = 0.744$; and SP achieved $CR = 0.979$, $AVE = 0.798$. Discriminant validity was established via the Fornell-Larcker criterion: the square root of AVE for each

construct (SCD = 0.917, DDT = 0.862, SP = 0.893) exceeded all inter-construct correlations (maximum = 0.666), confirming empirical distinctiveness of all constructs.

Table 4. Construct Validity (CR, AVE) and Discriminant Validity

Construct	CR	AVE	$\sqrt{AVE}$	SCD	DDT	SP
Service and Content Delivery (SCD)	0.984	0.840	0.917	1.000	—	—
Digital Dashboard Transformation (DDT)	0.972	0.744	0.862	0.546	1.000	—
Sustainable Performance (SP)	0.979	0.798	0.893	0.571	0.666	1.000

Note: Bold diagonal = $\sqrt{AVE}$; off-diagonal = inter-construct Pearson correlations. Discriminant validity: $\sqrt{AVE} >$ all inter-construct r values.

Classical Assumption Tests

Table 4 presents the classical assumption test results. All composite variables demonstrated acceptable normality: SCD ($D = 0.073$, $p = 0.611$), DDT ($D = 0.050$, $p = 0.944$), and SP ($D = 0.120$, $p = 0.091$), all non-significant at $\alpha = 0.05$, indicating no material deviation from normality. Multicollinearity diagnostics yielded VIF = 1.424 (tolerance = 0.702) for SCD, well below the conservative threshold of VIF < 5.0 (Hair et al., 2019) confirming the absence of multicollinearity. Residual analysis confirmed approximately zero mean error ($M \approx 0.000$) and consistent variance, satisfying key OLS regression assumptions.

Table 5. Classical Assumption Tests (Normality and Multicollinearity)

Test	Variable	Statistic	p-value	VIF	Decision
Normality (Kolmogorov-Smirnov)	SCD	$D = 0.073$	0.611	—	Normal
	DDT	$D = 0.050$	0.944	—	Normal
	SP	$D = 0.120$	0.091	—	Normal
Multicollinearity (VIF)	SCD (multiple reg.)	Tol. = 0.702	—	1.424	No issue

Correlation Analysis

Table 5 presents the Pearson correlation matrix. All inter-construct correlations were statistically significant at $p < 0.01$, providing initial empirical support for the hypothesized relationships. DDT exhibited the strongest correlation with SP ($r = 0.666$), followed by SCD–SP ($r = 0.571$) and SCD–DDT ($r = 0.546$). These moderate-to-strong correlations are consistent with the theoretical model and prior empirical findings in analogous digital transformation and sustainability research (Branco & Rodrigues, 2006; Reinking et al., 2020; Waheed, 2012).

Table 6. Pearson Correlation Matrix

Variable	1. SCD	2. DDT	3. SP
Service and Content Delivery (SCD)	1.000	—	—
Digital Dashboard Transformation (DDT)	0.546**	1.000	—
Sustainable Performance (SP)	0.571**	0.666**	1.000

Note: ** $p < 0.01$ (two-tailed)

Path Analysis and Mediation Testing

Table 6 presents the results of the mediation analysis based on indirect-effect estimation with bootstrapping. Service and Content Delivery (SCD) significantly predicted Digital Dashboard Transformation (DDT) ($\beta = 0.442$, $p < 0.001$), supporting H1. Digital Dashboard Transformation significantly predicted Sustainable Performance (SP) while controlling for SCD ($\beta = 0.534$, $p < 0.001$), supporting H2. The estimated indirect effect of SCD on SP through DDT was 0.236 (0.442×0.534). Bootstrapping with 5,000 resamples produced a 95% bias-corrected confidence interval that did not include zero, indicating a statistically significant mediation effect. The direct effect of SCD on SP remained significant after inclusion of the mediator ($\beta = 0.254$, $p < 0.001$), indicating complementary partial mediation. The combined model explained 50.5% of the variance in Sustainable Performance ($R^2 = 0.505$), suggesting that both Service and Content Delivery and Digital Dashboard Transformation contribute substantially to institutional sustainability outcomes.

Table 7. Direct, Indirect, and Total Effects Using Bootstrap Mediation Analysis

Step	Path	β	R	R^2	p-value	Decision
Step 1 (Path a)	SCD $\rightarrow$ DDT	0.442	0.546	0.298	< 0.001	H1 Supported
Step 2 (Path b)	DDT $\rightarrow$ SP	0.705	0.666	0.443	< 0.001	H2 Supported
Step 3a (Direct)	SCD $\rightarrow$ SP (without DDT)	0.490	0.571	0.326	< 0.001	Significant
Step 3b (w/ mediator)	SCD $\rightarrow$ SP (with DDT)	0.254	—	0.505*	< 0.001	Sig. (Partial)
Indirect Effect	SCD $\rightarrow$ DDT $\rightarrow$ SP ($a \times b$)	0.312	—	—	—	H3 Supported

Note: * $R^2 = 0.505$ from simultaneous regression ($\beta_{SCD} = 0.254$; $\beta_{DDT} = 0.534$). Indirect effect = path a (0.442) $\times$ path b simple (0.705) = 0.312. Sobel z computed via delta method.

Bootstrap mediation analysis indicated a significant indirect effect of Service and Content Delivery on Sustainable Performance through Digital Dashboard Transformation. The estimated indirect effect was 0.236 (0.442×0.534). The 95% bias-corrected bootstrap confidence interval did not include zero, indicating that the mediation effect was statistically significant. The direct effect of Service and Content Delivery on Sustainable Performance remained

significant after inclusion of the mediator ($\beta = 0.254$, $p < 0.001$), suggesting complementary partial mediation. These findings support the proposition that Digital Dashboard Transformation serves as an important mechanism through which service and content delivery capabilities contribute to institutional sustainability outcomes.

DISCUSSION

The significant positive influence of SCD on DDT ($\beta = 0.442$, $R^2 = 0.298$, $p < 0.001$) confirms H1, consistent with the technology complementarity principle (Milgrom & Roberts, 1990) and recent empirical work demonstrating that digital service maturity creates enabling conditions for higher-order analytical investments (Benitez et al., 2022; Goulart et al., 2022). In the Islamic educational context, this relationship reflects a practical institutional dynamic: institutions that have successfully digitized service delivery develop the data ecosystems, technical competencies, and stakeholder expectations that make digital dashboard investment both necessary and organizationally legitimate (Jannah et al., 2023; McCarthy et al., 2023).

The strong positive influence of DDT on SP ($\beta = 0.705$, $R^2 = 0.443$, $p < 0.001$) supports H2 and establishes DDT as the strongest single digital predictor of sustainability outcomes in this context. This finding aligns with Organizational Learning Theory (Argyris & Schön, 1997): digital dashboards enable double-loop learning by providing real-time, multi-dimensional sustainability feedback that allows institutions to not merely correct performance deviations but to revise the underlying strategic assumptions that produced them. The result is consistent with Reinking et al. (2020) on dashboard-enabled performance alignment, Waheed et al. (2012) on digital transformation and sustainability outcomes in education, and Teng et al. (2022) on digital transformation as a performance mediator.

The mediation analysis provides evidence of a significant indirect effect of Service and Content Delivery on Sustainable Performance through Digital Dashboard Transformation. Consistent with contemporary mediation methodology, significance was determined through bootstrap confidence intervals rather than causal-step procedures or Sobel (1982) testing. The results indicate complementary partial mediation because both the indirect effect and the remaining direct effect were statistically significant. This finding suggests that Digital Dashboard Transformation functions as an important transmission mechanism through which service digitalization contributes to sustainability outcomes, while additional direct pathways remain operative. This pattern of partial mediation carries important theoretical and practical implications. Theoretically, it confirms that DDT is a critical but not exclusive, transmission mechanism: SCD generates direct sustainability benefits through channels such as stakeholder satisfaction, organizational reputation, resource efficiency, and community engagement that operate independently of dashboard mediation (Branco & Rodrigues, 2006; Grönroos, 2011; Vargo & Lusch, 2008). Practically, it means that institutions realize cumulative sustainability gains by developing both capabilities, not just one. Combined, SCD and DDT explain 50.5% of the variance in SP, an explanatory coefficient indicating strong practical significance for a two-predictor model in educational social science research (Hair et al., 2019).

Although purposive sampling was appropriate for identifying respondents with direct involvement in digital transformation activities, the approach may introduce selection bias because participation was limited to institutions that had already implemented digital-based educational and administrative services. The findings indicate that Service and Content Delivery is positively associated with Digital Dashboard Transformation within Islamic educational institutions. This relationship is consistent with the view that effective service and content delivery practices may support the development of digital transformation capabilities. Future studies should employ probability-based sampling techniques and broader institutional coverage to enhance generalizability.

The cross-sectional design of this study limits the ability to draw definitive causal inferences among the examined constructs. Although the hypothesized relationships are supported by theory and empirical evidence, the findings should be interpreted as associations observed at a single point in time rather than proof of causality. Future research employing longitudinal, experimental, or panel-data designs is recommended to establish temporal ordering and provide stronger evidence regarding causal relationships among Service and Content Delivery, Digital Dashboard Transformation, and Sustainable Performance.

CONCLUSION

This study examined the relationships among Service and Content Delivery, Digital Dashboard Transformation, and Sustainable Performance in Islamic educational institutions in Indonesia. The findings indicate that institutions reporting stronger service and content delivery practices also tended to report higher levels of digital dashboard transformation and sustainable performance. In addition, the results are consistent with the proposed conceptual model in which digital dashboard transformation may represent an important capability pathway linking service and content delivery practices with sustainability-related outcomes. From a theoretical perspective, the study contributes to the growing literature on digital transformation in educational organizations by highlighting the interconnected roles of service delivery capabilities and digital transformation initiatives. The findings support the view that organizational capabilities associated with digital services and dashboard-based information management are closely related to institutional sustainability efforts. From a practical perspective, the results suggest that educational institutions may benefit from strengthening both service and content delivery processes

and digital dashboard utilization as part of broader digital development strategies. These capabilities appear to be associated with more favorable organizational outcomes and may support institutional adaptation in increasingly digital educational environments. Several limitations should be acknowledged. The study employed a cross-sectional design, relied on self-reported data, and used purposive sampling, which limits the ability to draw causal conclusions and restricts the generalizability of the findings. Future studies could employ longitudinal designs, larger and more diverse samples, and multiple data sources to further examine the direction and stability of the relationships identified in this study.

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AUTHOR CONTRIBUTION STATEMENT

GKK contributed to conceptualization, methodology, supervision, validation, writing – original draft, and writing – review & editing. AR contributed to methodology, formal analysis, investigation, resources, and writing – review & editing. LAW and R contributed to data curation, investigation, project administration, and writing – original draft. All authors have read and approved the final version of the manuscript.

AI DISCLOSURE STATEMENT

The authors used ChatGPT (OpenAI) during the preparation of this work for limited language editing and grammar improvement. After using the tool, the authors carefully reviewed and revised the manuscript and take full responsibility for the accuracy, integrity, and content of the publication.

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