



Madene-based educational leadership in digital education for strengthening student character

Heryon Bernard Mbuik*, Hingrida Margarita Anastasia Hendrik, Yulsy Marselina Nitte

Universitas Citra Bangsa

Corresponding author: bernardmalole@gmail.com, hingridahendrik@gmail.com, yulsynitte9@gmail.com

Received 28 April 2026; First Revised 10 May 2026; Accepted 24 May 2026
First Available Online 1 June 2026; Publication Date 1 June 2026

Abstract

This study examines the role of Madene-based educational leadership in digital education implementation and student character strengthening in Rote Ndao Regency. Digital education transformation in Indonesia continues to face challenges in aligning technological innovation with local cultural values, creating tensions in character development efforts. This study aims to analyze the effect of Madene-based leadership on digital education and student character, as well as to examine the mediating role of digital education. A quantitative explanatory survey design was employed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The sample consisted of 270 elementary school teachers selected through proportionate random sampling. Data were collected using validated Likert-scale questionnaires. The findings reveal that Madene-based leadership significantly influences digital education and student character. Digital education also exerts a significant positive effect on student character and partially mediates the relationship between leadership and character development. The structural model demonstrates substantial predictive capability. This study introduces a novel culturally grounded leadership model that integrates Madene cultural values with transformational and digital leadership practices, providing empirical evidence that local wisdom can serve as a strategic foundation for digital transformation and character education in primary schools.

Keywords: Madene leadership; digital education; student character; educational leadership; PLS-SEM.

INTRODUCTION

Digital transformation has fundamentally reshaped contemporary education systems through the integration of digital technologies into teaching, learning, assessment, and school management. Digital education extends beyond technological utilization and involves systemic changes in instructional processes, institutional governance, and learning environments. Previous studies indicate that digital transformation improves educational access, flexibility, and interaction while supporting innovative learning practices (Bond et al., 2021; Redecker & Punie, 2022; Handayani et al., 2025). However, the effectiveness of digital education depends not only on technological infrastructure but also on the ability of educational institutions to integrate pedagogical goals, ethical values, and socio-cultural contexts.

Current digital education practices frequently adopt a technocentric orientation that prioritizes infrastructure development and digital literacy while paying limited attention to cultural and character dimensions (Dwivedi et al., 2023; Haleem et al., 2022). This condition creates a gap between technological advancement and student character development. Character education requires the integration of ethical values, social responsibility, and cultural identity into educational processes. Consequently, digital transformation in education requires leadership that is not only technologically adaptive but also culturally and ethically grounded.

In Indonesia, the implementation of Merdeka Belajar has accelerated the adoption of digital learning systems and student-centered approaches in schools. Although

these policies have increased access to digital technologies, several studies indicate that the integration of local cultural values into digital education remains limited (Kultsum et al., 2025; Mahmuddah & Junaidi, 2025). This imbalance raises concerns regarding the sustainability of digital transformation, particularly in regions where cultural identity strongly influences social behavior and educational values. These conditions indicate that digital transformation cannot rely solely on technological innovation but must also incorporate contextual cultural frameworks capable of strengthening ethical awareness, social responsibility, and character development.

Educational leadership plays a central role in determining the success of educational transformation. Transformational leadership emphasizes organizational vision, motivation, and institutional change, whereas digital leadership focuses on leaders' abilities to manage technological innovation and develop digital competence within educational institutions (Sheninger, 2019). Empirical evidence demonstrates that effective leadership positively influences institutional effectiveness, teacher performance, and student outcomes (Arjanto, 2023; Fullan, 2025). Nevertheless, most leadership models remain context-neutral and provide limited attention to cultural dimensions embedded within local educational environments. This limitation reduces the ability of leadership frameworks to address socio-cultural complexities in diverse educational settings.

Leadership practices are deeply embedded within cultural contexts, reflecting the values, beliefs, assumptions, and social norms that shape organizational and community life (Noman & Gurr, 2020). Leadership is socially constructed through cultural interaction and communal legitimacy rather than merely administrative authority. Integrating cultural leadership with transformational and digital leadership therefore provides a more comprehensive framework for understanding educational leadership in contemporary contexts. However, existing studies have paid

limited attention to how indigenous cultural values can serve as the foundational logic of educational leadership in the context of digital transformation. While transformational and digital leadership have been widely examined, leadership models grounded in local wisdom remain underdeveloped and insufficiently validated empirically. As a result, little is known about how culturally grounded leadership can simultaneously facilitate digital education implementation and strengthen student character within culturally embedded educational settings.

Local wisdom constitutes an important contextual resource in educational transformation, particularly in culturally embedded societies where educational values are strongly influenced by communal traditions and indigenous social systems. In Rote Ndao Regency, Madene represents a distinctive system of indigenous values emphasizing solidarity, collective responsibility, mutual respect, moral integrity, and communal harmony. Madene is deeply embedded within the socio-cultural structure of the Rotenese community and functions as a normative foundation for interpersonal interaction, leadership behavior, and ethical conduct.

From an epistemological perspective, Madene reflects an indigenous knowledge system constructed through collective social interaction, customary deliberation, oral tradition, and intergenerational cultural transmission. Knowledge within Madene emerges from participatory communal practices that shape collective awareness, moral responsibility, and social identity. This epistemic orientation positions Madene as a contextual framework of meaning that guides leadership practices and communal accountability within educational and social life. In educational contexts, Madene provides an alternative leadership paradigm emphasizing ethical engagement, relational responsibility, collective participation, and value-based decision-making rather than purely managerial or technocratic authority.

Anthropologically, Madene represents a communitarian cultural structure characterized by reciprocity, social cohesion, collective solidarity, and moral obligation.

These values function as social control mechanisms that preserve communal harmony and reinforce collective identity within Rotenese society. Leadership legitimacy within the Madene tradition is strongly associated with moral integrity, exemplary conduct, dialogic interaction, and the ability to maintain social balance. This cultural orientation aligns with anthropological perspectives that conceptualize leadership as socially embedded and culturally legitimized rather than exclusively hierarchical or administrative.

Conceptually, this study positions Madene as a culturally grounded educational leadership construct integrating moral-spiritual leadership, collective leadership, exemplary leadership, dialogic leadership, and transformational cultural leadership. Madene-based leadership therefore extends beyond conventional transformational or digital leadership models by embedding indigenous cultural values as structural dimensions of educational governance and character development. The relevance of Madene values within digital education is increasingly important because digital learning environments require ethical awareness, responsible behavior, collaboration, and social engagement in addition to technical competence. Madene-based leadership provides a value-oriented framework capable of aligning technological innovation with character education and sustainable educational transformation.

Despite its relevance, the integration of local wisdom into digital leadership and character education models remains largely conceptual and lacks empirical verification, particularly in primary education contexts. Previous studies concerning local wisdom in education predominantly use qualitative and descriptive approaches. Limited quantitative research has empirically examined the relationships among culturally grounded leadership, digital education, and student character using advanced analytical models. In addition, limited attention has been given to the mediating mechanisms explaining how leadership influences student outcomes

through digital education processes. This gap highlights the need for empirical research using Structural Equation Modeling to examine complex relationships among leadership, digital education, and character development.

This study addresses these gaps by developing and empirically testing a culturally grounded leadership model rooted in Madene local wisdom within digital education contexts in elementary schools. Madene-based leadership is conceptualized as a reflective-reflective second-order construct integrating moral-spiritual leadership, collective leadership, exemplary leadership, dialogic leadership, and transformational cultural leadership dimensions. Rather than treating culture as a contextual variable, this model positions indigenous cultural values as the foundational framework shaping leadership practices, educational transformation, and character development. Madene-based leadership is conceptualized as a reflective-reflective second-order construct integrating moral-spiritual leadership, collective leadership, exemplary leadership, dialogic leadership, and transformational cultural leadership dimensions. This study examines the direct effect of Madene-based leadership on digital education and student character, as well as the mediating role of digital education.

Four hypotheses are proposed: (1) Madene-based leadership positively influences digital education, (2) Madene-based leadership positively influences student character, (3) digital education positively influences student character, and (4) digital education mediates the relationship between Madene-based leadership and student character.

This study contributes theoretically by proposing and validating a culturally grounded leadership model rooted in Madene local wisdom as a framework for understanding educational leadership in the digital era. The model extends existing leadership theories by positioning indigenous cultural values as a central source of leadership legitimacy, decision-making, and educational transformation. Empirically, the

study provides evidence regarding the mediating role of digital education in strengthening student character. Practically, the findings offer implications for policymakers and educational practitioners regarding the importance of aligning digital transformation strategies with local cultural values to support sustainable and character-oriented education systems.

RESEARCH METHODS

This study employed a quantitative approach with an explanatory survey design to examine the causal relationships among Madene-based educational leadership, digital education, and student character. A cross-sectional design was applied, where data were collected at a single point in time to capture empirical conditions and test the proposed hypotheses. This approach enables objective measurement of latent constructs and supports robust analysis of complex relationships using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is appropriate for predictive and multivariate analysis involving higher-order constructs and mediation effects (Hair et al., 2022; Sarstedt et al., 2023).

The study was conducted in public elementary schools in Rote Ndao Regency, Indonesia, consisting of 230 schools. The population included all teachers and principals, totaling approximately 2,300 individuals, comprising around 2,070 teachers and 230 principals. Teachers and principals were selected as respondents because they play central roles in implementing educational leadership and digital learning practices within schools. Their professional responsibilities provide direct observational experience regarding leadership implementation, digital learning processes, and student behavioral development in classroom and school environments.

Although educators possess substantial experience in evaluating student behavior, this study recognizes that the assessment of student character based solely on teachers' and principals' perceptions may potentially create perceptual bias due to the absence of direct student responses. Therefore, future studies are recommended to incorporate

students as additional respondents and apply multi-source assessment approaches to strengthen construct validity and data triangulation.

The sampling technique employed proportionate random sampling to ensure representation across schools. Based on the 10-times rule in PLS-SEM and minimum sample size recommendations, a total of 270 respondents was selected. The sample consisted of approximately 220–230 teachers and 40–50 principals selected randomly from the population. This sample size is considered adequate for analyzing structural models involving multidimensional constructs, hierarchical latent variables, and mediation relationships (Hair et al., 2022).

This study involved three main constructs, namely Madene-based educational leadership, digital education, and student character. Madene-based educational leadership was conceptualized as a reflective-reflective second-order construct because it theoretically represents a multidimensional leadership system rooted in indigenous cultural values. The higher-order construct reflects the overarching domain of Madene leadership, whereas the first-order dimensions represent its specific manifestations, namely moral-spiritual leadership, collective-communitarian leadership, exemplary leadership, dialogic leadership, and transformational cultural leadership. These dimensions are conceptually interrelated and collectively form an integrated cultural leadership framework.

The reflective-reflective hierarchical component model was employed because variations in the higher-order Madene leadership construct are theoretically expected to be reflected across all lower-order dimensions simultaneously. This specification aligns with the assumption that Madene leadership operates as an integrated cultural value system rather than independent leadership components. The second-order modeling approach also reduces model complexity while preserving the multidimensional characteristics of the construct (Hair et al., 2022).

The higher-order construct was estimated using the repeated indicator approach recommended for reflective-reflective hierarchical latent variable models in PLS-SEM. This approach enables simultaneous estimation of relationships between higher-order and lower-order constructs while maintaining construct reliability and validity. The analysis was conducted to confirm that all first-order dimensions significantly represented the overarching Madene-based leadership construct.

Digital education was positioned as a mediating construct consisting of four dimensions, namely technology integration, teacher digital competence, digital learning management, and digital school culture. Student character was modeled as the endogenous construct consisting of religiosity, integrity, responsibility, social care, and discipline. All constructs were operationalized using reflective indicators adapted from recent theoretical and empirical studies to ensure conceptual adequacy and contextual relevance within elementary education settings.

Data were collected using a structured questionnaire with a five-point Likert scale ranging from strongly disagree to strongly agree. Instrument development was based on established theoretical frameworks related to educational leadership, digital education, and character education. The questionnaire items were subsequently contextualized to reflect the socio-cultural characteristics of Madene values within the educational environment of Rote Ndao Regency.

Content validity was evaluated through expert judgment involving specialists in educational management, educational leadership, and cultural education to ensure conceptual adequacy, contextual relevance, and item clarity. A pilot test was subsequently conducted to evaluate readability, item consistency, and preliminary reliability before large-scale data collection.

The questionnaire consisted of reflective indicators representing each construct dimension. Due to space limitations, this article presents representative questionnaire items to illustrate construct operationalization.

Data collection was conducted both offline and online to increase respondent accessibility and participation. Supporting documentation, including school profiles, digital learning records, and institutional reports, was additionally used to strengthen contextual interpretation of the findings

The operationalization of variables used in this study is presented in Table 1.

Table 1.
Research Variables and Indicators

Variable	Dimension	Indicators
Madene Leadership (X)	Togetherness	Collaboration, participation, communication
	Moral responsibility	Integrity, honesty, ethics
	Social solidarity	Empathy, care, inclusivity
	Decision wisdom	Value-based consideration, contextual decisions
Digital Education (M)	Spiritual-ethical	Spiritual values, role modeling
	Technology use	LMS utilization, digital media
	Digital literacy	Access and evaluation of information
Student Character (Y)	Digital interaction	Online collaboration, communication
	Responsibility	Discipline, commitment
	Collaboration	Cooperation, tolerance
	Ethics	Politeness, responsible technology use

The detailed operationalization of constructs is presented in Table 2.

Table 2.
Operationalization of Variables

Variable	Code	Dimensions	Number of Indicators	Construct Type	Measurement Scale
Madene-based Educational Leadership	X	5 dimensions	20 reflective indicators	Second-order construct	Five-point Likert scale

rship					
Digital Education	M	4	16	Multidimensional construct	Five-point Likert scale
Student Character	Y	5	20	Multidimensional construct	Five-point Likert scale

Madene-based educational leadership (X) was operationalized as a second-order construct consisting of five dimensions with 20 reflective indicators. Digital education (M) consisted of 16 indicators across four dimensions, while student character (Y) consisted of 20 indicators across five dimensions. All indicators were measured using a five-point Likert scale.

Representative questionnaire items used in this study are presented in Table 3.

Table 3. Representative Questionnaire Items

Variable	Dimension	Representative Item
Madene-Based Leadership	Moral-Spiritual Leadership	“School leaders demonstrate ethical and responsible behavior in managing digital learning.”
Madene-Based Leadership	Collective Leadership	“School leaders involve teachers collaboratively in educational decision-making.”
Madene-Based Leadership	Exemplary Leadership	“School leaders become role models in the responsible use of digital technology.”
Madene-Based Leadership	Dialogic Leadership	“School leaders encourage open communication and mutual respect in school interactions.”
Madene-Based Leadership	Transformational Cultural Leadership	“School leaders integrate local cultural values into digital education practices.”
Digital Education	Technology Integration	“Teachers regularly utilize digital platforms to

		support classroom instruction.”
Digital Education	Digital Learning Management	“Digital learning activities are systematically organized and monitored.”
Digital Education	Digital Interaction	“Students actively participate in collaborative online learning activities.”
Digital Education	Digital Literacy	“Teachers are able to evaluate and utilize digital information effectively.”
Student Character	Responsibility	“Students complete digital learning assignments responsibly and on time.”
Student Character	Discipline	“Students follow digital classroom rules consistently.”
Student Character	Social Care	“Students demonstrate respectful behavior during online interactions.”
Student Character	Integrity	“Students avoid dishonest behavior during digital learning activities.”
Student Character	Collaboration	“Students cooperate effectively with peers during digital learning activities.”

The representative items presented in Table 3 illustrate the operationalization of latent constructs within the proposed model. All questionnaire items were evaluated through expert judgment and pilot testing prior to large-scale implementation to ensure content validity, construct clarity, and contextual suitability.

The structural model was designed to examine both direct and indirect relationships among variables. Madene-based leadership was positioned as the exogenous variable influencing digital education and student character. Digital education served as a mediating variable linking leadership and

student character. The conceptual model follows this structure:

Madene Leadership → Digital Education → Student Character
 Madene Leadership → Student Character

The structural equations are formulated as follows:

$$\text{Digital Education} = \beta_1 (\text{Madene Leadership}) + \varepsilon_1$$

$$\text{Student Character} = \beta_2 (\text{Madene Leadership}) + \beta_3 (\text{Digital Education}) + \varepsilon_2$$

Hypothesis testing in this study includes four hypotheses:

- H1: Madene-based leadership positively affects digital education.
- H2: Madene-based leadership positively affects student character.
- H3: Digital education positively affects student character.
- H4: Digital education mediates the relationship between leadership and student character.

The structural model of this study is presented in Figure 1.

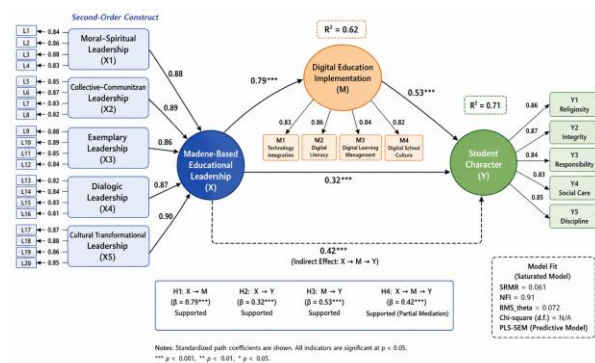


Figure 1.
Structural model of Madene-based educational leadership, digital education implementation, and student character.

As shown in Figure 1, Madene-based educational leadership is modeled as a second-order construct influencing digital education and student character, both directly and indirectly through a mediating

mechanism. The second-order structure enables comprehensive representation of Madene leadership as a multidimensional cultural construct integrating ethical, collective, dialogic, and transformational dimensions within educational leadership practices.

Data analysis was conducted using SmartPLS software following a two-step approach consisting of measurement model evaluation and structural model evaluation. The measurement model was assessed through convergent validity using outer loading values above 0.70 and Average Variance Extracted (AVE) above 0.50, discriminant validity using the Fornell-Larcker criterion and Heterotrait-Monotrait Ratio (HTMT), and reliability assessment using Composite Reliability and Cronbach's Alpha values above 0.70 (Hair et al., 2022).

The structural model was evaluated using path coefficients, R-square values to assess explanatory power, effect size (f-square) to determine the magnitude of influence, and predictive relevance (Q-square) to evaluate model predictive capability. R-square values of 0.25 indicate weak explanatory power, 0.50 moderate explanatory power, and 0.75 strong explanatory power.

Hypothesis testing was conducted using bootstrapping with 5,000 resamples to obtain t-statistics and p-values. Hypotheses were considered significant when t-values exceeded 1.96 and p-values were below 0.05. Mediation analysis was performed using indirect effect testing and Variance Accounted For (VAF) analysis to determine the mediating role of digital education.

The second-order construct of Madene-based leadership was evaluated using the repeated indicator approach recommended in PLS-SEM literature for reflective-reflective hierarchical latent variable models (Hair et al., 2022). This approach enables simultaneous estimation of higher-order and lower-order construct relationships while maintaining construct reliability and validity. The procedure was conducted to confirm that all first-order dimensions significantly represented the higher-order Madene leadership construct.

Model fit was evaluated using standardized root mean square residual (SRMR) values below 0.08 and normed fit index (NFI) values above 0.90 to assess overall model adequacy. Additional statistical tests were conducted to ensure data quality. Multicollinearity was assessed using variance inflation factor (VIF) values below 5. Normality was examined using skewness and kurtosis values, although PLS-SEM does not require strict normality assumptions. Common method bias was tested using Harman's single-factor test and full collinearity assessment with threshold values below 3.3. These procedures ensured that the data were reliable and free from systematic bias.

With this methodological design, the study provides robust empirical testing of the proposed model and establishes a strong analytical foundation for examining the role of Madene-based educational leadership in digital education and student character development.

RESULTS AND DISCUSSION

Measurement Model Evaluation

The measurement model was evaluated to assess convergent validity, discriminant validity, and reliability of all constructs.

Convergent Validity

Convergent validity was assessed using outer loading and Average Variance Extracted (AVE) criteria following the recommendations of Joseph F. Hair Jr. et al. (2022). Outer loading values above 0.70 indicate satisfactory indicator reliability, while AVE values exceeding 0.50 confirm that the construct explains more than half of the variance of its indicators.

As presented in Table 3, all constructs demonstrated loading factor values above the recommended threshold, with loading ranges varying between 0.71 and 0.91. The AVE values ranged from 0.65 to 0.68, exceeding the minimum criterion of 0.50 and indicating adequate convergent validity.

Construct reliability was also confirmed through Composite Reliability and Cronbach's Alpha values. According to Joseph F. Hair Jr. et al. (2022), values above 0.70 indicate acceptable internal consistency

reliability. The Composite Reliability values ranged from 0.93 to 0.95, while Cronbach's Alpha values ranged from 0.92 to 0.94, demonstrating strong reliability across all constructs.

Construct	Indicator	Outer Loading
Madene Leadership	X1	0.72
Madene Leadership	X2	0.81
Madene Leadership	X3	0.91
Digital Education	M1	0.73
Digital Education	M2	0.84
Digital Education	M3	0.89
Student Character	Y1	0.71
Student Character	Y2	0.85
Student Character	Y3	0.90

Table 3
Convergent Validity and Reliability

Construct	Loading Range	AVE	Composite Reliability	Cronbach Alpha
Madene Leadership (X)	0.72 – 0.91	0.68	0.95	0.94
Digital Education (M)	0.73 – 0.89	0.65	0.93	0.92
Student Character (Y)	0.71 – 0.90	0.67	0.94	0.93

Discriminant Validity

Discriminant validity was assessed using the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT) as recommended in PLS-SEM literature. The Fornell–Larcker approach proposed by Claes Fornell and David F. Larcker (1981) suggests that the square root of each construct's AVE should be higher than its correlations with other latent constructs. Complementarily, the HTMT criterion developed by Christian M. Ringle, Marko Sarstedt, and colleagues (2015) recommends threshold values below 0.90 to establish adequate discriminant validity.

As shown in Table X, the square root of AVE for each construct exceeded the inter-construct correlation values, fulfilling the Fornell–Larcker criterion. Likewise, all HTMT ratios remained below the recommended cutoff value of 0.90, indicating that the constructs were empirically distinct and conceptually discriminant.

Table 4.
Fornell -Larcker Criterion

Construct	X	M	Y
X	0.82		
M	0.78	0.81	
Y	0.74	0.79	0.82

Diagonal values (\sqrt{AVE}) are higher than inter-construct correlations, confirming discriminant validity.

Table 5.
HTMT Ratio

Relationship	HTMT
X → M	0.86
X → Y	0.84
M → Y	0.88

All HTMT values are below 0.90, indicating acceptable discriminant validity.

Structural Model Evaluation Coefficient of Determination (R²)

Table 6
R-Square Values.

Endogenous Variable	R ²	Interpretation
Digital Education (M)	0.62	Moderate
Student Character (Y)	0.71	Strong

Madene-based leadership explains 62% of variance in digital education and, together with digital education, explains 71% of student character.

Effect Size (f²)

Table 7.
Effect Size

Relationship	f ²	Interpretation
X → M	0.42	Large
X → Y	0.21	Medium
M → Y	0.36	Large

These results indicate that leadership has a strong influence on digital education and a moderate direct effect on student character.

Predictive Relevance (Q²)

Table 8.
Q-Square Values

Variable	Q ²
Digital Education (M)	0.41
Student Character (Y)	0.49

All Q² values are above zero, confirming strong predictive relevance.

Model Fit

Index	Value	Threshold
SRMR	0.061	< 0.08
NFI	0.91	> 0.90

The model demonstrates good overall fit.

Hypothesis Testing

Bootstrapping with 5,000 resamples was conducted.

Table 9.
Path Coefficients

Hypothesis	Path	Coefficient	t-value	p-value	Result
H1	X → M	0.79	18.45	0.000	Supported
H2	X → Y	0.32	4.87	0.000	Supported
H3	M → Y	0.53	8.92	0.000	Supported

All direct relationships are positive and significant.

Mediation Analysis

Table 10.
Indirect Effect

Path	Indirect Effect	t-value	p-value
X → M → Y	0.42	7.65	0.000

Variance Accounted For (VAF)

$$VAF = 0.42 / (0.32 + 0.42) = 0.57$$

Interpretation: Partial mediation (57%)

Digital education partially mediates the relationship between leadership and student character.

Discussion

The findings confirm that Madene-based educational leadership exerts a strong and significant influence on digital education implementation ($\beta = 0.79$, $p < 0.001$). This result underscores the central role of culturally grounded leadership in driving the adoption, integration, and sustainability of digital learning practices in schools. The magnitude of this effect indicates that leadership functions not merely as a facilitating factor but as a structural determinant of digital transformation. In this

context, Madene-based leadership operates as a value-driven system that aligns technological innovation with socio-cultural norms, thereby strengthening institutional readiness, teacher engagement, and pedagogical coherence.

This finding is consistent with digital leadership theory, which emphasizes the strategic role of leadership in shaping technological ecosystems and fostering innovation (Sheninger, 2019; Kultsum et al., 2025). Empirical evidence further shows that digital literacy development and learning transformation are strongly influenced by leadership capacity in managing digital ecosystems (Handayani et al., 2025). Prior studies also confirm that digital leadership significantly enhances innovation capacity, digital engagement, and organizational transformation through structured mechanisms (Zia et al., 2024; Sawaeen & Aburumman, 2025). In addition, evidence from educational contexts highlights that digital leadership effectiveness increases when aligned with organizational culture, which strengthens learning quality and transformation outcomes (Halim et al., 2024). Complementary findings also show that cultural grounding in leadership strengthens trust and reduces resistance to technological change in school environments (Chompoowong et al., 2022).

More importantly, the strength of this relationship suggests that culturally grounded leadership provides a comparative advantage over technocentric leadership models. Unlike approaches that prioritize technological infrastructure alone, Madene-based leadership integrates ethical values, collective responsibility, and social cohesion into digital transformation processes. This integration enhances alignment between institutional goals and community expectations, which is essential in socio-culturally dense education systems. Previous studies have demonstrated that digital leadership becomes more effective when combined with organizational culture and contextual values (Fatima, 2023; Sagbas et al., 2023). In line with this, empirical evidence confirms that organizational culture not only supports but also strengthens the

relationship between digital leadership and educational outcomes, particularly in improving learning quality through digital transformation (Halim et al., 2024). Regional studies further indicate that leadership in Southeast Asia is more effective when cultural legitimacy and communal values are embedded in institutional practices (Budianto et al., 2023; Nugroho et al., 2024). Therefore, this study extends digital leadership theory by positioning indigenous cultural values as the primary explanatory mechanism rather than a peripheral contextual factor.

The direct effect of Madene-based leadership on student character is also statistically significant ($\beta = 0.32$, $p < 0.001$), although the effect size is moderate. This indicates that leadership practices rooted in cultural values contribute directly to shaping students' behavioral, ethical, and social development. Madene values such as solidarity, responsibility, and moral integrity serve as cultural resources that regulate social interactions and collective behavior within the school community. These values contribute to the development of a positive school climate by shaping teachers' professional conduct, students' social relationships, and the shared expectations that govern everyday practices. Such findings resonate with instructional and cultural leadership scholarship, which conceptualizes leadership not merely as a managerial function but as a process of cultivating organizational values, norms, and meanings that influence teaching, learning, and school improvement (Hallinger, 2020; Noman & Gurr, 2020). They are also consistent with empirical evidence showing that culturally responsive leadership strengthens ethical awareness, social responsibility, and student identity formation in both traditional and digital learning environments (Mahmuddah & Junaidi, 2025). Recent SEM-based studies further confirm that leadership influences behavioral outcomes through both direct and indirect organizational and psychological pathways (Papadakis et al., 2024; Yang, 2025).

Furthermore, digital education demonstrates a strong positive effect on student character ($\beta = 0.53$, $p < 0.001$). This

indicates that technology-enhanced learning environments can significantly support character development when implemented through structured pedagogical design. Digital learning environments facilitate interaction, collaboration, reflection, and accountability, which are essential components of character formation. These findings align with digital competence frameworks that emphasize ethical awareness, responsible technology use, and social participation as core elements of digital education (Redecker & Punie, 2022). Empirical studies also show that digital and blended learning environments enhance engagement, collaboration, and self-regulated learning, which contribute to both cognitive and affective development (Haleem et al., 2022; Scherer et al., 2021). Recent evidence further confirms that digital systems mediate leadership influence by translating strategic vision into instructional practice and learning behavior (Sismanto, 2023; Handayani et al., 2025). This mechanism is strengthened when supported by organizational culture that ensures coherence between leadership vision and classroom practice (Halim et al., 2024).

The mediation analysis provides deeper insight into the mechanism through which leadership influences student character. The results indicate that digital education partially mediates the relationship between Madene-based leadership and student character (indirect effect $\beta = 0.42$, VAF = 57%). This suggests that leadership operates through both direct and indirect pathways, reinforcing the systemic nature of educational transformation. Leadership influences character formation not only through value transmission but also through instructional system design and digital learning structures. This finding supports systemic leadership theory, which views leadership as a multidimensional force shaping organizational processes and learning environments (Fullan, 2025; Arjanto, 2023). It is also consistent with SEM-based literature showing that mediation mechanisms are essential for explaining complex relationships in educational systems (Hair et al., 2023; Sarstedt et al., 2023; Zia et al., 2024). The mediation effect confirms that digital education functions as a translational

mechanism that converts leadership values into observable student outcomes.

The structural model demonstrates strong explanatory power, with $R^2 = 0.62$ for digital education and $R^2 = 0.71$ for student character. These values indicate substantial explanatory strength, confirming the robustness of the proposed model. The high R^2 values demonstrate that leadership and digital education are dominant predictors of student outcomes in contemporary educational contexts. Additionally, Q^2 values above zero confirm strong predictive relevance, indicating that the model has applicability beyond the sample context. These findings align with established PLS-SEM literature that emphasizes the predictive robustness of structural models in educational research (Hair et al., 2022; Sarstedt et al., 2023). Recent empirical studies further confirm that digital leadership models incorporating mediation mechanisms demonstrate strong predictive validity across diverse educational contexts (Li et al., 2024; Sawaeen & Aburumman, 2025).

From a theoretical perspective, this study advances a culturally grounded leadership model rooted in the indigenous values of Madene. Unlike conventional digital and transformational leadership frameworks that frequently position culture as an external contextual factor, the proposed model conceptualizes culture as the foundational structure through which leadership is enacted, legitimized, and translated into educational practice. The findings demonstrate that Madene values function not merely as cultural complements to leadership practice but as generative mechanisms that shape digital transformation, institutional conduct, and student character formation. Rather than operating as static cultural symbols, these values actively guide decision-making processes, influence organizational relationships, and mediate the adoption of technological innovations within the school environment. Such evidence contributes to emerging discussions on context-sensitive leadership by illustrating how cultural traditions can interact with ethical commitments and digital modernization

agendas. In this regard, the study supports calls for leadership frameworks that move beyond technocratic approaches and recognize the dynamic interplay between cultural identity, moral purpose, and technological change in educational organizations (Noman & Gurr, 2020; Mansur & Sholeh, 2024; Handayani et al., 2025).

The study therefore extends contemporary digital leadership theory by showing that leadership effectiveness in digitally transforming schools is contingent upon cultural legitimacy and value congruence. Rather than treating local wisdom as a supplementary component, the culturally grounded leadership model positions indigenous knowledge as a strategic resource that shapes organizational adaptation, collective engagement, and sustainable educational change. In this regard, the findings contribute to emerging scholarship on culturally responsive and indigenous educational leadership by providing empirical evidence that locally embedded cultural values can serve as structural drivers of digital innovation and character-oriented educational transformation (Fatima, 2023; Yang, 2025; Halim et al., 2024).

An important contribution of this study lies in demonstrating that indigenous cultural values can be operationalized as measurable leadership dimensions within a structural model. While previous studies have largely discussed local wisdom as a contextual or normative element, the present study empirically validates Madene-based leadership as a higher-order construct influencing both digital education and student character development. This finding expands the theoretical discourse on educational leadership by illustrating how culturally grounded leadership can bridge the often-separated domains of digital transformation and character education within primary school settings.

From a practical perspective, the findings highlight the importance of aligning digital education strategies with local cultural values. Educational institutions should integrate cultural principles into digital leadership development to ensure sustainable

transformation. Leadership training programs should emphasize cultural competence, ethical leadership, and digital capability as integrated competencies. These implications align with global policy frameworks that emphasize digital competence and ethical values in education systems (OECD, 2022; UNESCO, 2023). Evidence from regional studies also confirms that culturally grounded digital leadership enhances policy effectiveness and institutional sustainability in diverse educational contexts (Chompoowong et al., 2022; Budianto et al., 2023). Ultimately, aligning digital transformation with cultural values is essential for building inclusive, meaningful, and sustainable educational systems.

This study has several limitations that should be considered in interpreting the findings. First, the assessment of student character was primarily based on teachers' and principals' perceptions without direct student participation. Although teachers and school leaders possess substantial observational experience regarding students' behavioral development, the absence of student self-assessment may increase the potential for perceptual bias and common source bias. Future research is therefore recommended to involve students as primary respondents and apply multi-informant approaches integrating teachers, principals, students, and parents to obtain more comprehensive and objective measurements of student character development.

CONCLUSION

This study confirms that Madene-based educational leadership plays a critical role in strengthening digital education and student character in elementary schools. Leadership grounded in local cultural values significantly enhances the implementation of digital learning and contributes to character formation. Digital education also functions as an important mechanism through which leadership values are translated into effective learning practices and student development outcomes.

The findings demonstrate that digital education partially mediates the relationship

between Madene-based leadership and student character, indicating that leadership influences student outcomes through both direct value-based practices and indirect instructional processes. The structural model exhibits substantial explanatory and predictive power, suggesting its applicability in educational contexts characterized by strong socio-cultural foundations. Nevertheless, the findings related to student character should be interpreted with caution because the assessment relied primarily on teachers' and principals' perceptions rather than direct student self-reports. While educators possess extensive observational experience regarding student behavior, the absence of student perspectives may limit the comprehensiveness of character assessment.

The principal theoretical contribution of this study is the development and empirical validation of a culturally grounded leadership model rooted in Madene local wisdom. Unlike conventional leadership frameworks that frequently position culture as a contextual influence, the proposed model conceptualizes indigenous cultural values as the foundational mechanism through which leadership shapes digital transformation and student character development. The findings demonstrate that values such as collective responsibility, moral integrity, social cohesion, and dialogic engagement operate as structural drivers of educational transformation. By empirically validating Madene-based leadership as a higher-order construct, this study contributes to the growing body of scholarship on culturally grounded and indigenous educational leadership in the context of digital education.

From a practical perspective, the findings highlight the importance of aligning digital education strategies with local cultural values. Schools and policymakers should develop leadership practices that integrate cultural principles with technological innovation to support both academic achievement and character development. Sustainable digital transformation requires not only technological readiness but also ethical and cultural foundations capable of fostering responsible

digital behavior and meaningful educational engagement among students.

Future research should expand the proposed model by incorporating additional variables such as school climate, teacher digital competence, parental involvement, and community engagement. Further studies are also encouraged to involve students directly as primary respondents and employ multi-informant assessment approaches integrating teachers, principals, students, and parents to obtain more comprehensive measurements of student character development. Longitudinal investigations are additionally needed to examine the long-term sustainability of culturally grounded leadership in shaping educational transformation and character development over time.

THANK-YOU NOTE

The authors express sincere gratitude to all principals, teachers, and educational stakeholders in public elementary schools in Rote Ndao Regency who participated in and supported this study. Appreciation is also extended to academic colleagues and experts who provided valuable feedback during the instrument development and validation process. The authors further acknowledge the contribution of local cultural leaders and community members whose insights regarding Madene values enriched the conceptual foundation of this research. Their support and collaboration greatly contributed to the successful completion of this study.

BIBLIOGRAPHY

- Arjanto, P. (2023, May). Leadership journey in school: A bibliometric analysis of instructional leadership from 1941 to 2022. Paper presented at the International Conference on Research in Education and Science, Cappadocia, Türkiye.
- Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, 18(1),

50. <https://doi.org/10.1186/s41239-021-00282-x>
- Bellibaş, M. Ş., Karaferye, F., & Walker, A. (2025). How cultural context shapes school leadership and its effectiveness: A systematic review. *Educational Management Administration & Leadership*. Advance online publication. <https://doi.org/10.1177/17411432251396683>
- Chompoowong, P., Karapakdee, J., Srisawat, S., Issaro, S., & Khampuong, P. (2022). Digital culture leadership in elementary education. *International Journal of Educational Communications and Technology*, 2(2), 24–32.
- Crawford, J., Lewis, G., & Kelder, J. (2024). Authentic student leadership development: Structural equation model testing. *Educational and Developmental Psychologist*. <https://doi.org/10.1080/20590776.2024.2365846>
- Dwivedi, Y. K., et al. (2023). So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications. *International Journal of Information Management*, 71, 102642. <https://doi.org/10.1016/j.ijinfomgt.2023.102642>
- Fatima, T. (2023). Digital leadership and organizational innovation: A systematic review. *Technological Forecasting and Social Change*, 188, 122256. <https://doi.org/10.1016/j.techfore.2022.122256>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage Publications.
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainability*, 14(9), 5225. <https://doi.org/10.3390/su14095225>
- Halim, D., Salam, R., & Purna, Z. A. (2024). Digital leadership and digital transformation in school management: Implications for learning quality enhancement with organizational culture as moderator. *Pinisi Discretion Review*. <https://doi.org/10.26858/pdr.v1i1.79119>
- Hallinger, P. (2020). Instructional leadership and its evolving role in school effectiveness research. In D. Townsend (Ed.), *International handbook of leadership for learning*. Springer.
- Handayani, T., Mokay, M. M., Sukmayadi, D., & Fitriani, A. (2025). Digital literacy and learning outcomes: Analyzing the impact of blended learning in higher education during the post-pandemic era. *International Journal of Educational Research Excellence*, 4(2), 678–684. <https://doi.org/10.55299/ijere.v4i2.1552>
- Handayani, W., Hidayat, S., & Elan. (2025). Transformational leadership of school principals as a catalyst for digital learning implementation in primary schools. *Journal of Innovation and Research in Primary Education*, 4(3). <https://doi.org/10.56916/jirpe.v4i3.1826>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135.

- <https://doi.org/10.1007/s11747-014-0403-8>
- Karadağ, E., & Sertel, G. (2025). The effect of educational leadership on students' achievement: A cross-cultural meta-analysis research on studies between 2006 and 2024. *Educational Administration Quarterly*. <https://doi.org/10.1177/17411432251327645>
- Kultsum, U., Hidayat, D., & Lee, J. Y. (2025). Digital leadership: Developing digital literacies in schools in Indonesia for empowering education and advancing sustainable development goals (SDGs). In *Towards resilient societies: The synergy of religion, education, health, science, and technology* (pp. 347–352). CRC Press. <https://doi.org/10.1201/9781003645542-56>
- Li, Y., Zhang, L., & Wang, X. (2024). What is “technology integration” and how is it measured in K-12 education? A systematic review of survey instruments from 2010 to 2021. *Computers & Education*, 198, 104742. <https://doi.org/10.1016/j.compedu.2023.104742>
- Mahmuddah, S. S., & Junaidi. (2025). The role of character education in elementary schools in the digital era. *Indonesian Values and Character Education Journal*, 8(1), 84–100. <https://doi.org/10.23887/ivcej.v8i1.90396>
- Mansur, M., & Sholeh, M. (2024). Local wisdom and character education in Indonesian schools. *International Journal of Instruction*, 17(1), 233–250. <https://doi.org/10.29333/iji.2024.17113a>
- Niu, J. (2025). Educational leadership for digital transformation: A comparative framework for sustainable development in global context. *Journal of Information Systems Engineering & Management*, 10(21s), 186–197. <https://doi.org/10.52783/jisem.v10i21s.3300>
- Noman, M., & Gurr, D. (2020). *Contextual leadership and culture in education*. In G. W. Noblit (Ed.), *Oxford Research Encyclopedia of Education*. Oxford University Press. <https://doi.org/10.1093/acrefore/9780190264093.013.595>
- Nugroho, Y., Putra, R., & Santoso, H. (2024). Leadership and digital transformation in Southeast Asia education systems. *Educational Sciences*, 14(3), 312. <https://doi.org/10.3390/educsci14030312>
- OECD. (2022). *Digital education outlook: Pushing the frontiers with AI, blockchain and robotics*. OECD Publishing. <https://doi.org/10.1787/589b283f-en>
- Papadakis, S., Kanadlı, S., Kardaş, A., & Tulubaş, T. (2024). Investigating the relationship between leadership for learning and student achievement through the mediation of teacher performance: A meta-analytic structural equation modeling (MASEM) approach. *Education Sciences*, 14(12), 1320. <https://doi.org/10.3390/educsci14121320>
- Redecker, C., & Punie, Y. (2022). *European framework for the digital competence of educators (DigCompEdu)*. European Commission. https://joint-research-centre.ec.europa.eu/digcompedu_en
- Sawaeen, F. A. A., & Aburumman, O. J. (2025). The impact of digital leadership on SMEs' innovation performance: A mediation-moderated model of digital capability and innovation culture. *International Review of Management and Marketing*, 15(4), 1–10. <https://doi.org/10.32479/irmm.18270>

Sismanto, S. (2023). Digital transformation of character education model and its implementation for diverse students. In *Education technology in the new normal: Now and beyond* (pp. 53–66). CRC Press.
<https://doi.org/10.1201/9781003353423-6>

UNESCO. (2023). *Global education monitoring report*.
<https://www.unesco.org/gem-report>

Zia, A., Khan, M., & Rahman, S. (2024). Digital leadership and innovation performance: Mediating mechanisms. *Technological Forecasting and Social Change*, 197, 122879.
<https://doi.org/10.1016/j.techfore.2023.122879>.