

Transformational Leadership, Digital School Culture, and Student Development in Online Learning: Evidence from Indonesian Primary Schools

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Abstract

Online primary learning environments require schools to maintain effective leadership and supportive digital cultures that promote student engagement and development. This study examined the relationships among transformational leadership, digital school culture, and student development in Indonesian primary schools implementing virtual and blended learning settings. Using a quantitative cross-sectional design, data were collected from 120 primary school teachers and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings showed that transformational leadership positively influenced digital school culture and student development, while digital school culture also positively affected student outcomes and partially mediated the relationship between leadership and student outcomes. The model demonstrated moderate to strong explanatory power for both digital school culture and student development. The findings suggest that student development in digitally mediated learning is shaped not only by instructional practices and technology use but also by leadership-supported cultural environments that guide participation, communication, and responsible behavior in virtual instructional settings. This study contributes to online learning research by emphasizing the importance of leadership and digital school culture as interconnected mechanisms that support student engagement and behavioral growth in primary education.

Keywords: Digital school culture; Education; Leadership; Online learning; Primary schools; Student development

Introduction

The rapid expansion of online and blended learning has significantly reshaped educational systems, influencing how schools organize instruction, communication, collaboration, and learner support within digitally connected environments (Timotheou et al., 2023). Teaching and learning increasingly occur through digital platforms that require new forms of coordination, interaction, and guidance. Educational leadership has become increasingly important in digitally mediated schooling because technology integration requires coordinated organizational adaptation, pedagogical support, and sustained institutional change (McCarthy et al., 2023). In this context, school leadership plays an important role in shaping how teachers and students adapt to digitally mediated instructional settings. Leadership influences not only instructional practices but also the institutional norms and communication structures that guide behavior in technology-supported schooling. As schools continue integrating online learning, leadership and school culture become increasingly important for ensuring that learning remains meaningful, inclusive, and developmentally supportive for students.

Digitally mediated learning contexts also require students to engage through online interaction, communication routines, and self-regulated learning routines that differ substantially from traditional classroom settings. Online learning environments place greater demands on students' self-regulated learning because learners are expected to manage participation, interaction, and task completion with reduced direct supervision (Hashmi et al., 2025). In primary education, these challenges are particularly significant because younger learners often require stronger behavioral guidance, consistent routines, and social support to maintain engagement in online instructional settings. As a result, schools increasingly depend on leadership practices and digital school culture to establish expectations that support participation, interaction, responsibility, and positive learning behavior in digitally supported educational contexts.

Although online learning offers flexibility and broader access to education, it also presents challenges related to student engagement, responsibility, and self-regulation (Miao & Ma, 2022). Research consistently demonstrates that learner engagement in online environments is strongly influenced by interaction quality, communication structure, and instructional presence within digital learning systems. In digitally mediated instructional settings, students are expected to manage their time, regulate their behavior, and interact respectfully with others, often with reduced direct supervision. Consequently, character-related aspects of learner growth, including responsibility, discipline, honesty, and social awareness, may become more difficult to support consistently (Aryadiningrat et al., 2023). Many schools emphasize academic performance and technological readiness, while comparatively less attention is given to how leadership and school culture influence students' personal and social growth in virtual learning settings. This issue is particularly important at the primary school level, where early educational experiences strongly shape students' long-term learning habits and behavioral development.

Existing research on online learning has largely focused on instructional design, technology integration, and teacher competence (Yumna, 2025). Many studies examine learning management systems, digital tools, and instructional strategies that improve academic performance or student satisfaction. Other studies investigate teachers' readiness for online instruction or students' cognitive achievement in virtual classrooms. While this body of research provides valuable insights, it often gives limited attention to the organizational and cultural conditions that shape students' everyday experiences in digitally mediated learning. In particular, relatively few studies examine how school leadership influences digital school culture and, in turn, student engagement and behavioral development. This limitation is especially evident in primary education, where leadership practices and institutional expectations strongly influence students' early values, participation patterns, and social behavior (Azlan et al., 2024). These gaps highlight the need for research that integrates leadership, digital school culture, and student development within online primary learning contexts. Despite growing research on digital pedagogy and educational technology, comparatively limited empirical attention has been given to how leadership-supported institutional culture shapes learner behavior and participation in online primary education.

Transformational leadership provides a relevant framework for understanding how school leaders influence digitally mediated educational settings. Transformational leaders articulate a clear vision, model ethical behavior, encourage collaboration, and support individual growth (Suryadi et al., 2024). Transformational leadership has been shown to strengthen teachers' willingness to adopt and meaningfully integrate educational technologies into instructional practice. In schools, these leadership practices shape how teachers approach online instruction, communicate expectations, and reinforce behavioral values through daily educational practices. Digital school culture refers to the institutionalized norms, communication practices, participation norms, and collaborative routines that shape participation and interaction within virtual learning environments. A constructive digital learning culture helps students internalize expectations for respectful interaction, self-discipline, and active participation, even when

learning occurs remotely. In this study, student development refers to character-related outcomes observed during online learning, including responsibility, discipline, honesty, and social awareness.

The purpose of this study is to examine the relationships among transformational leadership, digital school culture, and student development in online primary learning contexts. Specifically, the study investigates whether transformational leadership directly influences student development and whether digital school culture mediates this relationship (Zhang et al., 2022). Using a quantitative research design, data were collected from primary school teachers who experienced online or blended learning in their schools. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to test the proposed relationships among the variables. By focusing on primary schools, this study addresses an underexplored educational context in which leadership and school culture are especially influential for learner engagement and behavioral growth.

This study contributes to the literature in several ways. First, the study extends online learning research by demonstrating that effective digital learning environments depend not only on instructional technology and pedagogy but also on leadership-supported institutional culture that shapes learner participation and behavioral engagement (Chaidir et al., 2025). Second, it provides empirical evidence regarding the mediating role of digital school culture, demonstrating how leadership practices are translated into student outcomes through institutional expectations and communication structures. Third, by focusing on Indonesian primary schools, the study offers insights from a context where character education is a central educational priority and online learning presents continuing implementation challenges. Unlike prior studies that examine leadership or instructional technology separately, this study integrates transformational leadership, digital school culture, and learner development into a unified online learning framework that explains how institutional culture translates leadership practices into student participation and behavioral outcomes.

This study focuses on teachers' perceptions of transformational leadership, digital school culture, and student development during online and blended learning in Indonesian primary schools. It does not directly examine instructional effectiveness, technology performance, academic achievement, or student-level behavioral outcomes.

The remainder of this paper is structured as follows. The next section reviews relevant literature on transformational leadership, digital school culture, and student development in online learning. This is followed by the conceptual framework and hypotheses (Karakose et al., 2024). The methodology section describes the research design, participants, instruments, and data analysis procedures. The results section presents the empirical findings, followed by a discussion of the findings in relation to previous studies and practical implications. The paper concludes with key conclusions, limitations, and directions for future research.

Literature Review

This section reviews theoretical and empirical studies related to transformational leadership, digital school culture, student engagement, and student development in online primary learning contexts. The review is organized thematically to explain how leadership and culture interact to influence learner outcomes in online learning environments. Recent online learning scholarship increasingly emphasizes that learner outcomes are shaped not only by instructional technologies but also by organizational, pedagogical, and interactional conditions within digitally mediated educational environments (Bond et al., 2020). By synthesizing prior research, this section identifies important patterns, limitations, and research gaps that inform the conceptual framework and hypotheses of the present study.

Transformational Leadership in Online Learning

Transformational leadership refers to a leadership approach in which leaders motivate and inspire followers to achieve shared goals by modeling ethical behavior, articulating a clear vision, encouraging innovation, and providing individualized support. This leadership style is commonly described through four dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Bakker et al., 2022). In educational settings, transformational leadership has been associated with teacher commitment, collaboration, innovation, and school effectiveness. Within educational contexts, transformational leadership has consistently been associated with organizational adaptability, collaborative culture, and instructional improvement during periods of educational change.

In online instructional environments, transformational leadership becomes especially important because technology-supported instruction requires higher levels of coordination, communication, and adaptability. Unlike traditional face-to-face schooling, virtual instruction reduces direct supervision and informal interaction, increasing reliance on shared institutional norms and self-regulated behavior. Research suggests that school leaders who practice transformational leadership can support teachers in adapting to virtual instruction by fostering a sense of purpose, encouraging experimentation with digital tools, and maintaining open communication (Dasruth et al., 2024). Such leadership practices help reduce uncertainty and resistance during transitions to online or blended learning. Research further indicates that transformational leadership strengthens teachers' confidence and willingness to integrate educational technologies into pedagogically meaningful instructional practices.

Empirical studies have shown that transformational leadership positively influences teacher motivation, job satisfaction, and engagement in technology-supported instruction. Leaders who communicate a clear vision for digitally mediated education and provide professional support contribute to more consistent instructional practices and stronger organizational commitment. However, some studies indicate that leadership alone is insufficient to improve learner outcomes unless it is reinforced through a constructive institutional culture (Elkaleh et al., 2025). This observation highlights the importance of examining leadership together with digital school culture, particularly in technology-supported learning contexts where institutional norms and participation routines guide learner engagement more strongly than physical presence.

Digital School Culture

School culture refers to the collective values, beliefs, behavioral expectations, and communication structures that shape how members of a school community communicate and work together (Wuletu et al., 2024). In online learning contexts, digital school culture extends this concept to include norms and routines that govern communication, collaboration, discipline, responsibility, and ethical technology use in virtual educational settings. Digital school culture influences how teachers and students engage with digital platforms, follow institutional expectations, and respond to educational challenges. Digital school culture is increasingly understood as a school-wide system of institutionalized digital norms, communication structures, and collaborative expectations that shape participation within virtual learning environments.

A constructive digital learning culture is characterized by trust, clear communication, collaborative interaction, and shared responsibility. Studies indicate that schools with stable digital cultures are better able to maintain learner engagement and instructional continuity during online learning (Jiang et al., 2025). Institutional practices such as regular communication, consistent feedback, collaborative problem-solving, and ethical technology use contribute to more stable engagement routines. These elements are particularly important in digitally mediated education, where students may experience isolation or reduced social connection with their school community. Studies on digital learning environments suggest that emotionally supportive communication structures and collaborative interaction patterns are essential for sustaining students' sense of belonging and engagement during remote instruction (Kanaris & Mujtaba, 2023).

Research also demonstrates that school leaders play an important role in shaping digital school culture. Transformational leaders influence culture by modeling values, reinforcing institutional norms, and creating structures that support collaboration and accountability (Connie et al., 2026). For example, leaders who prioritize respectful digital communication and shared decision-making help establish collaborative routines that encourage positive participation and responsible behavior. Conversely, weak leadership may result in fragmented practices, inconsistent expectations, and reduced learner participation in virtual instructional settings. Although the importance of digital school culture is increasingly recognized, empirical studies examining its mediating role between leadership and student outcomes remain limited.

Student Development in Online Learning

Student development extends beyond academic achievement to include responsibility, discipline, honesty, self-regulation, and social engagement. Within virtual learning contexts, these dimensions become especially important because students are often required to manage learning activities more independently (Bergdahl, 2022). Online learning environments frequently require students to exercise higher levels of self-regulation because learning activities are conducted with greater autonomy and reduced direct behavioral supervision. Research on online learning has reported mixed findings regarding learner development, with some studies indicating increased autonomy and others identifying challenges related to motivation, accountability, and appropriate behavior.

Character-related development in virtual instruction is influenced by both individual and contextual factors. Although digital tools can support interactive and collaborative learning, they may also create opportunities for disengagement or inappropriate behavior when institutional expectations are unclear. Studies suggest that students develop positive learning behaviors when they participate in school cultures that reinforce shared behavioral norms and consistent participation routines. Institutional practices such as clear guidelines, regular feedback, and reflective activities help students internalize responsibility and socially appropriate behavior. Institutional consistency, reflective learning routines, and value-oriented communication practices have been shown to support responsible learner behavior in online educational settings (Nurdiana & Mustamin, 2025).

Several studies emphasize that learner development is shaped indirectly through teachers' practices and school-wide expectations rather than through direct instruction alone. In online learning contexts, teachers often rely on institutional policies and cultural guidelines to manage learner participation and behavior (Gwada et al., 2025). When these practices are aligned with leadership values and reinforced through a stable digital culture, students are more likely to demonstrate responsibility, cooperation, discipline, and ethical technology use. However, research explicitly connecting transformational leadership, digital school culture, and learner development remains limited, particularly within primary education.

Online Learning Interaction and Engagement

Research on online learning emphasizes that student engagement and participation are strongly influenced by interaction quality, communication structures, and social presence within digital learning environments. Community of Inquiry research demonstrates that meaningful online learning emerges through the interaction of teaching presence, social presence, and cognitive presence, which together shape learner engagement and collaborative participation in digital classrooms. Within online primary education, these dimensions are closely connected to leadership-supported communication structures and culturally reinforced participation practices that shape how learners experience interaction, engagement, and behavioral guidance in digitally mediated instruction. In online primary education, students rely heavily on structured interaction, clear communication routines, and structured instructional support to maintain responsible participation and positive learning behavior in virtual learning settings. Within primary digital classrooms, collaborative interaction and social presence are particularly important because younger

learners depend heavily on guided communication and peer connection during online instruction (Maksum et al., 2025).

Studies on digitally mediated learning also suggest that learner engagement depends not only on instructional technology but also on the broader social and cultural climate of the school. Communication practices, collaborative expectations, and emotionally responsive interaction patterns help students remain connected to learning activities and school communities (Maqbool et al., 2024). These conditions are particularly important in primary education, where students may experience difficulties with self-regulation and independent participation during remote instruction.

This perspective supports the assumption that transformational leadership and digital school culture contribute to student development by shaping interaction structures and participation expectations within digitally mediated instructional contexts. Leadership practices that reinforce constructive communication and collective behavioral expectations may strengthen student engagement, responsibility, and appropriate participation in technology-supported learning settings.

Synthesis and Research Gap

The reviewed literature highlights that transformational leadership positively influences school functioning, teacher engagement, and organizational effectiveness in digitally mediated educational contexts. Digital school culture also plays an important role in shaping communication, participation, and learner behavior in online learning environments. In addition, student development in virtual instruction depends not only on technology and instructional design but also on institutional conditions that support responsibility, engagement, and behavioral growth. However, existing studies often focus separately on leadership or instructional technology, while relatively few integrate transformational leadership, digital school culture, and student development within a unified empirical framework. Research specifically examining primary education contexts and the mediating role of digital school culture also remains limited. To address these gaps, the present study proposes that transformational leadership influences student development both directly and indirectly through digital school culture. Using data from Indonesian primary school teachers, this study examines the relationships among these variables and tests the mediating role of digital school culture in online learning contexts.

Conceptual Framework

The conceptual framework of this study is based on the assumption that leadership in schools functions not only as an administrative role but also as a social and cultural influence that shapes institutional norms, communication structures, and student behavior (Heenan et al., 2023). In digitally mediated instructional settings, this influence becomes especially important because communication and learning activities are conducted through digital platforms and rely heavily on self-regulation and institutional expectations rather than physical supervision. Research on virtual learning environments suggests that online participation increasingly depends on self-regulation, communication routines, and socially structured interaction patterns rather than direct physical supervision. The framework proposes that transformational leadership plays an important role in shaping digital school culture, which in turn supports student development.

Transformational leadership refers to leadership practices that inspire and motivate teachers through ethical role modeling, shared vision, intellectual encouragement, and individualized support. In online learning contexts, transformational leaders influence how teachers adapt to digital instruction, communicate expectations, and reinforce responsible behavior. Transformational leadership has been shown to support teachers' adaptation to digital instruction and meaningful technology integration within online educational environments (Schmitz et al., 2023). Such leadership practices help establish consistency, trust, and collaboration, which are essential for maintaining effective participation in virtual instructional settings.

Digital school culture represents institutionalized digital norms, communication structures, participation routines, and collaborative practices that shape engagement within virtual learning

environments (Purnomo et al., 2024). This includes expectations related to collaboration, discipline, responsibility, respectful communication, and ethical technology use. A strong digital school culture provides students with clear guidance regarding appropriate participation and engagement in online learning, reducing uncertainty and encouraging constructive learning habits. The framework assumes that leadership practices influence digital school culture by reinforcing collective behavioral expectations and communication structures, supporting collaboration, and ensuring the consistent implementation of institutional guidelines across the school.

Student development in this study refers to character-related outcomes observed in online learning, including responsibility, discipline, honesty, and social awareness. These dimensions are closely connected to self-regulated learning because online instructional environments require students to independently manage participation, communication, and task completion. The framework assumes that learner development is influenced not only by direct instructional practices but also by the broader institutional climate of the school. Studies on online learner engagement indicate that supportive institutional climates and collaborative communication practices contribute substantially to responsible participation and sustained learner engagement (Xiao et al., 2024). When students experience a stable and constructive digital learning culture, they are more likely to internalize positive values and demonstrate responsible participation in virtual learning settings. In this study, student development is conceptually grounded in character-related behavioral development within digitally mediated learning environments. The construct emphasizes students' responsibility, discipline, honesty, and social awareness as observable behavioral dimensions that support effective participation in online learning. These dimensions are closely associated with self-regulated participation and socially responsible behavior in virtual instructional settings, where students are required to manage learning activities with reduced direct supervision. Rather than focusing on academic achievement or psychological well-being, the construct specifically addresses behavioral and value-oriented dimensions of learner development that are reinforced through participation expectations and digitally mediated communication structures.

As illustrated in Figure 1, transformational leadership is positioned as the independent variable, digital school culture as the mediating variable, and student development as the dependent variable. The framework proposes both a direct relationship between transformational leadership and student development and an indirect relationship through digital school culture (Kludacz-Alessandri et al., 2025). This mediation perspective is consistent with organizational learning theory, which suggests that leadership effects on learner outcomes are frequently transmitted through institutional culture and socially reinforced participation structures rather than through direct supervision alone. This structure reflects the assumption that leadership influences learner outcomes partly by shaping the institutional conditions in which digitally mediated learning occurs. The mediating role of digital school culture is central to the framework because it explains how leadership practices are translated into everyday educational experiences that influence student behavior and participation.

Figure 1

Conceptual Framework of Transformational Leadership, Digital School Culture, and Student Development in Online Learning



Note. Transformational leadership influences student development directly and indirectly through digital school culture.

The mediation structure of the framework is theoretically appropriate because leadership influence in online learning environments is expected to operate both directly and indirectly through institutional and cultural mechanisms shaping learner participation. The conceptual framework is consistent with the quantitative design of this study and supports the use of mediation analysis through Partial Least Squares Structural Equation Modeling. Each construct in the framework is clearly defined and operationalized through measurable indicators, ensuring alignment among theory, methodology, measurement, and analysis.

Hypotheses Development

Based on the conceptual framework and reviewed literature, four hypotheses were developed to examine the relationships among transformational leadership, digital school culture, and student development in online learning contexts. Transformational leadership is expected to positively influence digital school culture because leaders who communicate a clear vision, encourage collaboration, and model ethical behavior help establish constructive institutional norms and communication practices in digitally mediated learning environments.

- Therefore, H1: Transformational leadership positively affects digital school culture. Transformational leadership is also expected to positively affect student development by shaping institutional expectations related to responsibility, discipline, and ethical participation.
- Thus, H2: Transformational leadership positively affects student development in online learning. Digital school culture is also expected to support learner development through communication, collaboration, and shared responsibility.
- Accordingly, H3: Digital school culture positively affects student development in online learning. Finally, H4: Digital school culture mediates the relationship between transformational leadership and student development. Together, these hypotheses provide the foundation for empirical testing.

Methods

This section describes the research design, participants, instruments, data collection procedures, data analysis techniques, and ethical considerations used in this study. The methodological approach was designed to examine the relationships among transformational leadership, digital school culture, and student development in digitally mediated educational contexts. All procedures are reported in sufficient detail to support transparency and replication.

Research Design

This study employed a quantitative, cross-sectional research design to examine the direct and indirect relationships among the study variables. A quantitative approach was selected because the study aimed to test hypothesized relationships between latent constructs using statistical modeling. Data were collected at a single point in time to capture teachers' perceptions of leadership practices, digital school culture, and student development during the implementation of online and blended instruction.

To analyze the proposed conceptual framework and mediation effects, Partial Least Squares Structural Equation Modeling (PLS-SEM) was used. PLS-SEM was selected because it is suitable for estimating complex predictive models involving latent constructs, mediation pathways, and modest sample sizes in education research (Hair & Alamer, 2022). This method is also suitable for exploratory and predictive research because it does not require strict assumptions of data normality. The use of PLS-SEM aligned with the study's objectives, conceptual framework, and hypotheses.

Participants and Sampling

The study population consisted of primary school teachers working in public and private schools that implemented online or blended learning. Teachers were selected as respondents because they directly experience school leadership practices, contribute to institutional culture, and observe student behavior and development in digitally mediated instructional settings.

A purposive sampling method was used to select participants who met specific inclusion criteria. Teachers were included if they (1) were actively teaching at the primary school level, (2) had at least two years of teaching experience, and (3) had participated in online or blended instruction during the study period. Teachers who did not engage in digitally mediated instruction or who had limited teaching experience were excluded.

A total of 120 teachers participated in the study. A total of 120 teachers participated in the study from approximately 145 distributed questionnaires, resulting in a response rate of 82.8%. This sample size meets the recommended minimum requirement for PLS-SEM analysis, which suggests that samples between 100 and 150 are generally adequate for models involving multiple latent variables and mediation effects. The sample size was considered sufficient to provide reliable estimates and meaningful statistical power for hypothesis testing.

Instruments and Measures

Data were collected using a structured questionnaire designed to measure transformational leadership, digital school culture, and student development. All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was adapted from established instruments and refined to suit the context of online primary education. The instrument adaptation process involved contextual modification of item wording to reflect digitally mediated primary education settings in Indonesia. All adapted items were reviewed by two educational researchers with expertise in online learning and educational leadership to ensure content relevance and clarity. Minor linguistic revisions were made following pilot testing to improve readability and contextual appropriateness for primary school teachers.

Transformational Leadership (TL)

Transformational leadership was measured using items reflecting four core dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. The items assessed teachers' perceptions of school leaders' ability to provide vision, model ethical behavior, encourage innovation, and support teachers in digitally mediated instructional contexts.

Digital School Culture (DSC)

Digital school culture was measured through items related to institutional norms, communication practices, and collaborative routines in online learning settings. The indicators focused on collaboration,

discipline, responsibility, respectful communication, and ethical technology use. These items captured the extent to which schools maintained consistent institutional expectations and constructive practices during virtual instruction.

Student Development (SD)

Student development was measured using items related to character-related outcomes observed by teachers during online instruction. These included responsibility, discipline, honesty, and social awareness. Teachers were asked to evaluate students' behaviors and attitudes during digitally mediated instructional activities.

Measurement Items

Transformational leadership was measured using 16 items, digital school culture using 14 items, and student development using 12 items. All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The sources and dimensions of the measurement instruments are summarized in Table 1.

Table 1

Sources of Measurement Instruments

Construct		Source	Dimensions
Transformational Leadership		Adapted from Bakker et al. (2022)	Idealized influence, inspirational motivation, intellectual stimulation, individualized consideration
Digital School Culture		Adapted from Purnomo et al. (2024) and Barker et al. (2023)	Communication, collaboration, responsibility, digital behavior

Reliability and Validity

Internal consistency reliability, convergent validity, and discriminant validity were evaluated using established PLS-SEM assessment criteria, including composite reliability, average variance extracted, and discriminant validity diagnostics. Internal consistency reliability was evaluated using Cronbach's alpha and composite reliability, with values above 0.70 considered acceptable. Convergent validity was assessed using outer loadings and average variance extracted (AVE), with AVE values above 0.50 indicating adequate validity. Discriminant validity was evaluated using the Fornell–Larcker criterion and cross-loadings to confirm that each construct was empirically distinct.

Data Collection Procedure

Data were collected over a three-month period during the implementation of online and blended learning. The questionnaire was distributed to teachers in both online and paper-based formats to ensure accessibility and improve response rates. Participants were informed about the purpose of the study and assured that participation was voluntary. Prior to the main data collection, a pilot study was conducted with a small group of teachers to evaluate the clarity and relevance of the questionnaire items. Minor revisions were made based on participant feedback to improve wording and contextual appropriateness. The revised questionnaire was subsequently administered to the full sample.

The study was conducted in schools that implemented online or blended learning through digital platforms commonly used in Indonesian primary education, including Google Classroom, WhatsApp, Zoom, and other school-supported communication or learning management platforms. These platforms were used for instructional delivery, digital interaction between teachers and students, assignment

submission, and learning coordination during digitally mediated instructional activities. Teachers were asked to respond based on their experiences with these learning modes. Online instructional activities were typically conducted through synchronous and asynchronous formats. Synchronous activities included live classroom interaction through Zoom or Google Meet, while asynchronous activities involved assignment distribution, recorded instructional materials, discussion activities, and communication through Google Classroom and WhatsApp groups. Teachers commonly used these platforms for attendance monitoring, feedback provision, student interaction, and behavioral supervision during digitally mediated instruction. Participants were instructed to respond based on their experiences with these routine instructional practices implemented during the study period.

Data Analysis

Data analysis was conducted using SmartPLS (version 4.0) following a two-stage procedure involving evaluation of the measurement model and evaluation of the structural model. In the first stage, the measurement model was assessed to examine construct reliability and validity. Indicators with low outer loadings were removed to improve model quality.

Prior to statistical analysis, the dataset was screened for incomplete responses and missing values. Questionnaires with substantial missing data were excluded from the analysis, while minor missing values were handled using mean substitution because the proportion of missing data was minimal. Data screening also included checks for response consistency and outliers to ensure dataset quality before conducting PLS-SEM analysis.

To assess potential non-response bias, early and late responses were compared across the main study constructs using independent samples t-tests. The analysis revealed no statistically significant differences between the two groups, suggesting that non-response bias was unlikely to substantially affect the findings.

Internal consistency, convergent validity, and discriminant validity were evaluated using established statistical criteria. Reliability was assessed using Cronbach's alpha and composite reliability values, while convergent validity was evaluated through average variance extracted (AVE) and outer loadings. Discriminant validity was examined using the Fornell-Larcker criterion and cross-loadings.

In the second stage, the structural model was assessed to test the hypothesized relationships among transformational leadership, digital school culture, and student development. Path coefficients (β values), t-values, and p-values were calculated using a bootstrapping procedure with 5,000 resamples. The coefficient of determination (R^2) was used to assess the explanatory power of the model. Mediation analysis was conducted to examine the indirect effect of transformational leadership on student development through digital school culture.

Because all main variables were collected through teacher self-report questionnaires, procedural controls were applied during data collection to reduce potential common method bias, including anonymity, voluntary participation, and neutral item wording (Podsakoff et al., 2012). Because the study relied on teacher self-report questionnaires, several procedural strategies were implemented to minimize potential method bias, including voluntary participation, respondent anonymity, and carefully structured survey wording designed to reduce evaluation apprehension and response pattern bias (Jordan & Troth, 2020). To further assess the possibility of common method variance, Harman's single-factor test was conducted. The first factor accounted for less than 50% of the total variance, indicating that common method bias was unlikely to substantially affect the findings. Additionally, variance inflation factor (VIF) diagnostics were examined within the PLS-SEM model to identify potential collinearity-related method

bias. All VIF values remained below recommended thresholds, supporting the robustness of the measurement model.

Effect size (f^2) and predictive relevance (Q^2) analyses were also conducted to further evaluate the explanatory and predictive capability of the structural model. These procedures provided additional evidence regarding the robustness and predictive relevance of the proposed relationships within digitally mediated learning contexts. The analytical procedures were aligned with the conceptual framework and hypotheses, ensuring consistency among theory, measurement, and statistical analysis.

Ethical Considerations and Limitations

Ethical standards were strictly observed throughout the study. Informed consent was obtained from all participants before data collection. Participants were informed that their responses would remain confidential and that they could withdraw from the study at any time without penalty. No identifying information was collected.

The study received approval from the relevant institutional ethics committee, and all procedures complied with recognized ethical guidelines for educational research involving human participants.

Several methodological limitations should be acknowledged. First, the cross-sectional design limits the ability to draw causal conclusions. Second, the data relied on teachers' self-reported perceptions, which may be subject to response bias. Third, the study focused on a specific educational context, which may limit the transferability of the findings to other settings. Despite these limitations, the study provides valuable insights into the role of leadership and digital culture in supporting learner development within online primary education.

Results

This section presents the findings of the study based on data collected from 120 primary school teachers. The findings are reported objectively and organized according to the research objectives and hypotheses. Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. The results are presented in four subsections: descriptive statistics, measurement model assessment, structural model assessment, and mediation analysis.

Descriptive Statistics

Descriptive statistics were computed to summarize the demographic characteristics of respondents and provide an overview of the study variables. A total of 120 valid questionnaires were included in the analysis. Respondents represented both public and private primary schools implementing online or blended instruction.

Descriptive results for the primary study variables indicated generally positive teacher perceptions. Transformational leadership had a mean score of $M = 3.98$ ($SD = 0.56$), digital school culture had a mean score of $M = 4.05$ ($SD = 0.52$), and student development had a mean score of $M = 3.92$ ($SD = 0.58$).

Table 2 presents the demographic profile of the participants, including gender, age, teaching experience, and school type. The sample consisted of 84 female teachers (70.0%) and 36 male teachers (30.0%). Most respondents were between 30 and 49 years of age (65.0%), and 41.7% had more than ten years of teaching experience. Public school teachers accounted for 61.7% of the sample, while 38.3% were from private schools.

Table 2

Demographic Characteristics of Respondents (N = 120)

Variable	Category	Frequency	Percentage (%)
Gender	Female	84	70.0
	Male	36	30.0
Age	< 30 years	25	20.8
	30–39 years	40	33.3
	40–49 years	38	31.7
	≥ 50 years	17	14.2
Teaching Experience	2–5 years	28	23.3
	6–10 years	42	35.0
	> 10 years	50	41.7
School Type	Public	74	61.7
	Private	46	38.3

Measurement Model Results

The measurement model was evaluated to assess the reliability and validity of the latent constructs: transformational leadership (TL), digital school culture (DSC), and student development (SD). Reliability and convergent validity were examined using outer loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE).

All retained indicators showed outer loadings above the recommended threshold of 0.70. Table 3 presents the reliability and convergent validity results for each construct. Cronbach's alpha values ranged from 0.83 to 0.87, while composite reliability values ranged from 0.87 to 0.91, indicating satisfactory internal consistency. AVE values exceeded the minimum threshold of 0.50 for all constructs, confirming adequate convergent validity.

Table 3*Reliability and Convergent Validity of Constructs*

Construct	Cronbach's Alpha	Composite Reliability (CR)	AVE
Transformational Leadership	0.85	0.89	0.66
Digital School Culture	0.83	0.87	0.63
Student Development	0.87	0.91	0.68

Discriminant validity was assessed using the Fornell–Larcker criterion. Heterotrait–Monotrait (HTMT) ratio values were also examined, and all values remained below the recommended threshold of 0.85, further confirming discriminant validity among the constructs. As shown in Table 4, the square root of the AVE for each construct exceeded its correlations with other constructs, indicating satisfactory discriminant validity.

Table 4*Fornell–Larcker Criterion for Discriminant Validity*

Construct	TL	DSC	SD
Transformational Leadership (TL)	0.81		
Digital School Culture (DSC)	0.69	0.79	
Student Development (SD)	0.65	0.71	0.82

Variance inflation factor (VIF) values for all indicators remained below 5.0, indicating no multicollinearity concerns. Overall, the measurement model satisfied all recommended reliability and validity criteria. Model fit was additionally assessed using the standardized root mean square residual (SRMR). The SRMR value of 0.061 was below the recommended threshold of 0.08, indicating acceptable overall model fit for the proposed structural model table 5.

Table 5

Bootstrapped Confidence Intervals for Structural Paths

Path	95% CI Lower	95% CI Upper
TL → DSC	0.58	0.82
TL → SD	0.11	0.42
DSC → SD	0.39	0.66

Structural Model Results

After confirming the adequacy of the measurement model, the structural model was evaluated to test the hypothesized relationships among the constructs. The assessment included path coefficients (β), t-values, p-values, and coefficients of determination (R^2). Bootstrapping with 5,000 resamples was used to determine statistical significance. Bias-corrected confidence intervals did not include zero for any hypothesized relationship, further supporting the statistical significance and stability of the structural paths.

Table 6 presents the results of hypothesis testing. Transformational leadership demonstrated a strong positive effect on digital school culture ($\beta = 0.72$, $t = 12.34$, $p < .001$). Transformational leadership also showed a positive direct effect on student development ($\beta = 0.28$, $t = 3.11$, $p = .002$). Digital school culture demonstrated a strong positive influence on student development ($\beta = 0.53$, $t = 8.64$, $p < .001$).

Effect size analysis further indicated that transformational leadership had a substantial effect on digital school culture ($f^2 = 0.52$) and a moderate effect on student development ($f^2 = 0.18$). Digital school culture also demonstrated a substantial effect on student development ($f^2 = 0.41$). In addition, predictive relevance (Q^2) values for all endogenous constructs exceeded zero, indicating that the model possessed acceptable predictive capability within digitally mediated learning contexts.

Table 6

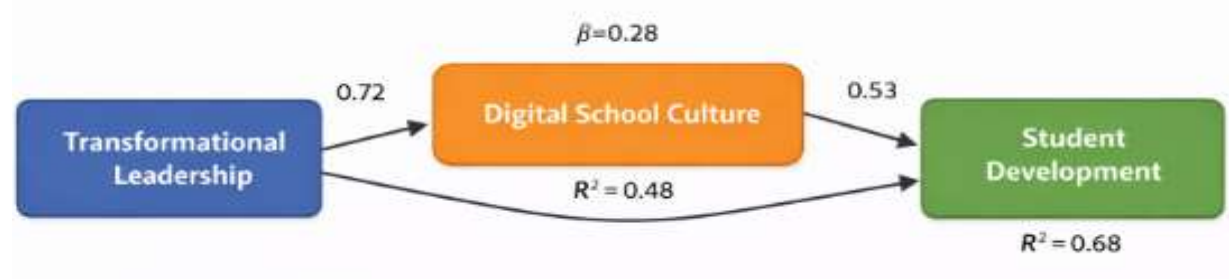
Structural Model Path Coefficients and Hypothesis Testing

Hypothesis	Path	β	t-value	p-value	Result
H1	TL → DSC	0.72	12.34	< .001	Supported
H2	TL → SD	0.28	3.11	.002	Supported
H3	DSC → SD	0.53	8.64	< .001	Supported

The explanatory power of the model was assessed using R^2 values. Transformational leadership explained 48% of the variance in digital school culture ($R^2 = 0.48$). Together, transformational leadership and digital school culture explained 68% of the variance in student development ($R^2 = 0.68$), indicating moderate to strong explanatory power.

Figure 2

Structural Model Results Showing Path Coefficients and R^2 Values



Note. Values represent standardized path coefficients (β). R^2 values indicate explained variance for endogenous constructs.

As illustrated in Figure 2, transformational leadership contributes substantially to the formation of digital school culture, which in turn enhances student development in online learning environments. These findings emphasize the importance of institutional communication structures and culturally reinforced participation practices in supporting responsible learner behavior and engagement during digitally mediated instruction.

Mediation Analysis

Mediation analysis was conducted to examine whether digital school culture mediates the relationship between transformational leadership and student development. The indirect effect was assessed using bootstrapping procedures.

As presented in Table 7, the indirect effect of transformational leadership on student development through digital school culture was statistically significant ($\beta = 0.38$, $t = 5.22$, $p < .001$). The direct effect of transformational leadership on student development remained statistically significant, indicating partial mediation.

Table 7

Direct, Indirect, and Total Effects

Relationship	Direct Effect	Indirect Effect	Total Effect	Significance
TL $\rightarrow$ DSC	0.72	—	0.72	$p < .001$
TL $\rightarrow$ SD	0.28	0.38	0.66	$p < .001$
DSC $\rightarrow$ SD	0.53	—	0.53	$p < .001$

The mediation findings confirm that digital school culture partially mediates the relationship between transformational leadership and student development in online learning contexts. This result

suggests that leadership practices influence learner outcomes not only directly but also indirectly through institutional interaction patterns, communication practices, and collective behavioral expectations established within digitally mediated educational settings.

Summary of Results

All four hypotheses were supported by the empirical findings. Transformational leadership demonstrated significant positive effects on digital school culture and student development. Digital school culture also significantly influenced student development and mediated the relationship between transformational leadership and learner outcomes. These findings provide a comprehensive empirical response to the study objectives and establish the basis for the subsequent discussion section.

Discussion

This study examined the relationships among transformational leadership, digital school culture, and student development in online learning contexts. The purpose of this section is to interpret the empirical findings in relation to the research hypotheses, conceptual framework, and existing literature. The discussion also highlights the theoretical, practical, and policy implications of the findings, acknowledges methodological limitations, and proposes directions for future research.

Summary of Key Findings

The findings indicate that transformational leadership plays an important role in shaping digital school culture and student development in online learning. Transformational leadership demonstrated a strong positive relationship with digital school culture and a moderate direct relationship with student development. Digital school culture also showed a strong positive effect on student development and partially mediated the relationship between leadership and learner outcomes. Together, these findings support the proposed conceptual framework and indicate that leadership influences learner development both directly and indirectly through institutional and cultural mechanisms within online instructional environments. This interpretation is consistent with recent evidence that educational leadership in the digital age increasingly depends on communication, collaboration, remote coordination, and strategic technology integration (Uzorka & Kalabuki, 2025).

Interpretation of Hypotheses (H1–H4)

The first hypothesis (H1) proposed that transformational leadership positively affects digital school culture. The results support this hypothesis, suggesting that leadership practices characterized by vision, ethical role modeling, and constructive interaction contribute to the development of institutional norms and institutional values in online instructional environments (Malik et al., 2022). This finding aligns with the theoretical assumption that leaders shape organizational culture by reinforcing behavioral expectations and guiding collective participation. In virtual instructional contexts, where face-to-face interaction is reduced, leadership-driven cultural coherence becomes especially important for maintaining stable participation practices.

The second hypothesis (H2) proposed a direct positive relationship between transformational leadership and student development in online learning. The findings support this hypothesis, although the effect size was moderate. This result indicates that leadership influences learner development indirectly through teachers' practices and institutional expectations rather than through direct interaction with students (Daly et al., 2025). Transformational leaders establish priorities related to responsibility, discipline, and ethical behavior, which are subsequently communicated to students through instructional practices and school-wide interaction patterns.

The third hypothesis (H3) proposed that digital school culture positively affects student development in online learning. Strong support for this hypothesis highlights the importance of institutional culture in shaping students' character-related outcomes. This result is consistent with evidence

that positive school climate is associated with student engagement through students' identification with school and their broader learning-related attitudes (Yang, 2025). A collaborative digital learning climate provides students with clear expectations, stable communication structures, and a sense of belonging, all of which are essential for responsible behavior and sustained participation during online instruction. This finding reinforces the view that learner development is shaped by everyday experiences within structured and value-oriented educational settings.

The findings also highlight the importance of digitally mediated learning contexts in shaping student behavior and participation. In online instruction, students rely on communication practices, participation expectations, and structured interaction patterns to regulate engagement and learning behavior. The importance of communication and participation is further supported by evidence that social presence and cognitive presence significantly predict student engagement in online courses (Alshammari & Alrehaili, 2025). A collaborative digital learning climate appears to function as a pedagogical support system that helps students maintain responsibility, participation, and appropriate conduct despite reduced face-to-face supervision. The finding also aligns with systematic review evidence showing that student engagement in technology-based education is shaped by online learning design, digital interaction, and the learning environment rather than technology use alone (Balalle, 2024). This finding reinforces the importance of integrating leadership practices with digitally mediated instructional systems rather than treating online learning as a purely technological process.

The fourth hypothesis (H4) proposed that digital school culture mediates the relationship between transformational leadership and student development. The mediation analysis confirmed this hypothesis, indicating partial mediation. This result suggests that transformational leadership influences learner development largely by shaping institutional culture, which subsequently translates leadership values into everyday educational practices. The presence of both direct and indirect effects supports the argument that leadership operates through multiple pathways, with institutional culture functioning as a central mechanism that strengthens and sustains leadership influence.

Comparison with Prior Studies

The findings of this study are consistent with previous research emphasizing the role of transformational leadership in fostering positive educational environments. Earlier studies report that transformational leadership strengthens teacher commitment, collaboration, and organizational effectiveness, including in technology-supported educational contexts. The strong relationship between leadership and digital school culture identified in this study supports these findings and extends them to online primary education.

The significant influence of digital school culture on student development also aligns with previous studies describing institutional culture as an important factor shaping student behavior and engagement. Research on online learning suggests that students benefit from clear expectations, stable communication, and collaborative communication structures, which are central elements of constructive digital learning climates. The mediation effect identified in this study extends previous work by providing empirical evidence that institutional culture functions as a bridge between leadership and learner outcomes.

However, some previous studies emphasize instructional design or technology use as the primary drivers of learner outcomes in online education. Although these dimensions remain important, the present findings suggest that organizational and cultural conditions also play a substantial role in shaping student behavior and engagement. The findings therefore challenge technology-centered interpretations of online learning effectiveness that overlook the social and institutional conditions shaping learner participation. In

this study, leadership-supported cultural processes appeared to play a substantial role in maintaining engagement and responsible behavior within digitally mediated instructional settings.

More importantly, the findings suggest that leadership influence in digitally mediated education may operate less through direct administrative control and more through the institutionalization of communication structures, participation expectations, and culturally reinforced behavioral guidance. This interpretation extends existing online learning leadership literature by emphasizing culture as an active instructional mechanism rather than merely an organizational condition.

Implications for Online Learning Leadership

The findings have important implications for leadership practice in online learning contexts. School leaders should recognize that their influence extends beyond administrative management to shaping digital school culture. Transformational leadership practices, including articulating shared values, supporting teacher collaboration, and modeling ethical behavior, contribute to stable and constructive virtual instructional settings.

From a practical perspective, schools should integrate leadership development programs that emphasize transformational competencies aligned with digitally mediated education. Leaders can strengthen digital school culture by establishing clear communication practices, consistent participation expectations, and collaborative interaction patterns for students and teachers. Such practices support not only academic learning but also learner development, particularly in areas related to responsibility and self-regulation.

At the policy level, educational authorities can strengthen online education by integrating leadership and institutional culture into digital learning strategies. Policies that focus exclusively on infrastructure and technology may overlook the organizational and social conditions necessary for effective virtual instruction. These findings suggest that successful online education requires alignment among technological infrastructure, institutional culture, pedagogical interaction, and leadership practices rather than technology adoption alone. Leadership development and cultural alignment should therefore be considered essential dimensions of online education initiatives.

Limitations

Several limitations should be acknowledged when interpreting the findings. First, the study employed a cross-sectional design, which limits the ability to establish causal relationships. Accordingly, the findings should be interpreted as statistical associations rather than causal effects. Second, the study relied primarily on teachers' self-reported perceptions, which may be influenced by contextual or individual bias. Although teachers were well positioned to evaluate institutional leadership and school-wide practices, student perspectives may reveal additional dimensions of engagement, interaction, and behavioral adaptation that were not fully captured through teacher-reported data alone.

Third, the study focused on primary schools within a specific educational context, which may limit the transferability of the findings to other educational levels or regions. Although the sample size satisfied recommended thresholds for PLS-SEM analysis and produced statistically stable estimates, the relatively moderate sample size may still limit broader generalizability across educational contexts.

Future research could strengthen external validity by incorporating larger multi-regional samples and multiple data sources, including student, parent, or classroom interaction data. Despite these limitations, the study provides important insights into leadership and institutional culture in online education. The use of validated instruments and robust analytical procedures strengthens the credibility and consistency of the findings.

Directions for Future Research

Future research can extend this study in several ways. Longitudinal studies could examine how leadership and digital school culture influence learner development over time. Including multiple data sources, such as student and parent perspectives, may provide a more comprehensive understanding of digitally mediated learning experiences. Future studies may also investigate additional mediating or moderating variables, including teacher digital competence, learner engagement, parental involvement, or instructional interaction quality.

Research conducted across different educational levels and cultural contexts would further strengthen the transferability of the findings. Comparative studies examining online, blended, and face-to-face instructional settings could also provide deeper insight into how leadership and institutional culture function under different educational conditions. These directions may contribute to a more comprehensive understanding of effective leadership and learner development in online education.

Conclusion

This study examined the relationships among transformational leadership, digital school culture, and student development in online learning contexts. The findings demonstrated that transformational leadership positively influences both digital school culture and student development, while digital school culture also positively affects student development and partially mediates the relationship between leadership and learner outcomes. These findings support the proposed conceptual framework and indicate that leadership contributes to learner development both directly and indirectly through institutional culture and communication structures within digitally mediated educational settings. The study contributes to the literature by showing that effective online learning depends not only on instructional technology and pedagogical practices but also on leadership-supported institutional culture. By integrating transformational leadership theory with the concept of digital school culture, this study provides a broader understanding of how virtual learning environments shape learner participation, responsibility, discipline, and engagement. The findings suggest that leadership values are translated into student outcomes through collective behavioral expectations, communication routines, and collaborative participation practices that guide online learning experiences. From a practical perspective, the findings indicate that school leaders should approach online education as both a technological and cultural process. Leadership practices such as communicating a shared vision, supporting teachers, and reinforcing ethical behavior help establish constructive digital learning climates that support learner growth. Schools can strengthen online learning by promoting consistent participation structures, respectful communication, and responsible digital behavior. Despite its contributions, the study has several limitations. The cross-sectional design and reliance on teacher perceptions may limit causal interpretation and generalizability. Future studies may include longitudinal approaches, larger samples, and multiple respondent groups to provide a more comprehensive understanding of learner development in online education. Overall, this study highlights the importance of transformational leadership and digital school culture as interconnected foundations of effective digitally mediated education.

Declaration

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Ethics Statement

This study was conducted in accordance with recognized ethical standards for educational research. Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and respondents were assured of confidentiality and anonymity. The study protocol was reviewed and approved by the institutional ethics committee of the affiliated institution.

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AI Use Statement

Generative artificial intelligence tools were used in the preparation of this manuscript solely for language refinement, grammar checking, and formatting assistance. AI tools were not used to generate research data, conduct data analysis, interpret results, or create original scholarly content. All content was reviewed, verified, and approved by the authors, who take full responsibility for the accuracy and integrity of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest related to the research, authorship, or publication of this article.

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