



Beyond Platform Adoption: Education Policy Transformation, Institutional Capacity, and Learning Effectiveness

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Abstract

The integration of digital technology into education has accelerated significantly, transforming not only instructional practices but also education policy and governance frameworks. This study examines the transition from conventional to digital learning by assessing the association between technology-based education policy transformation and student learning outcomes in Ujung Pandang District, Makassar City, Indonesia. Adopting a quantitative explanatory design, data were collected through a structured survey administered to 198 students enrolled in public senior high schools that had implemented digital learning platforms. Technology-based policy transformation was operationalized through four dimensions: digital platform utilization, institutional support, teacher readiness, and digital infrastructure. Learning outcomes were measured using perceived academic performance, learning engagement, and perceived learning effectiveness. Descriptive statistics indicate that students perceived the implementation of digital learning policies at a relatively high level, particularly in terms of digital platform utilization and infrastructure availability. Inferential analysis reveals a strong and statistically significant relationship between policy transformation and learning outcomes. Regression results demonstrate that technology-based education policy transformation explains a substantial proportion of variance in learning outcomes, highlighting the importance of governance and institutional factors in shaping digital learning effectiveness. Among the policy dimensions, digital platform utilization and teacher readiness emerged as the strongest predictors. This study contributes to the literature by framing digital learning effectiveness within an education policy transformation and public administration perspective. The findings provide policy-relevant insights for local governments and education administrators seeking to strengthen the design, implementation, and sustainability of technology-based learning reforms in urban education contexts.

Keywords: Technology-Based Learning Policy, Digital Education Transformation, Learning Outcomes, Education Governance, Urban Education Policy.

INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed public service sectors, including education. Across the globe, governments have increasingly adopted technology-based

learning policies as strategic responses to digital disruption, globalization, and the growing demand for accessible, flexible, and high-quality education. Digital learning platforms—such as learning management systems (LMS), virtual classrooms, and interactive educational applications—have evolved from supplementary instructional tools into central components of contemporary education systems (Bond et al., 2020; OECD, 2023). These developments reflect not merely technological adoption but broader policy transformations that reshape instructional models, governance mechanisms, and institutional practices.

From a public administration perspective, the integration of digital technologies into education signifies a shift toward digital governance, characterized by data-driven decision-making, adaptive policy design, and citizen-centered service delivery (Mergel et al., 2019; Dunleavy & Margetts, 2020). Technology-based education policies represent governance reforms that influence administrative processes, stakeholder roles, and accountability structures. As argued by Howlett et al. (2020), policy transformation involves changes in policy goals, instruments, and implementation arrangements, rather than incremental adjustments. In education, such transformation encompasses the reconfiguration of teaching practices, digital infrastructure investments, and institutional capacity-building strategies.

The COVID-19 pandemic acted as a critical catalyst accelerating digital learning adoption worldwide. Educational institutions were compelled to transition abruptly from conventional face-to-face instruction to online and blended learning modalities (Hodges et al., 2020; UNESCO, 2020). While this emergency shift exposed structural inequalities—including disparities in internet access, digital literacy, and technological readiness—it also highlighted the strategic importance of digital platforms in ensuring learning continuity (Williamson et al., 2020; Zhao & Watterston, 2021). Consequently, many governments repositioned digital learning from a temporary solution to a long-term policy priority (OECD, 2021).

In Indonesia, digital transformation in education has been promoted through national and local policy initiatives aimed at enhancing learning effectiveness, expanding educational access, and modernizing governance systems (Nugroho et al., 2021; Prasjojo et al., 2021). However, the implementation of technology-based learning policies remains uneven across regions due to variations in infrastructure availability, institutional readiness, and human resource capacity (Sujarwoto et al., 2022). These disparities underscore the importance of localized evaluations to assess how digital education policies operate in specific administrative contexts.

Makassar City, as a major urban center in Eastern Indonesia, presents a relevant setting for examining technology-based education policy transformation. The Ujung Pandang District, characterized by high educational activity and increasing digital platform utilization, provides an appropriate case for analyzing how local governance structures translate digital education policies into instructional practices. Despite growing investments in digital learning technologies, empirical evidence regarding the effectiveness of policy-driven digital transformation at the district level remains limited. Much of the existing literature on digital learning in Indonesia focuses primarily on pedagogical aspects, such as student motivation, online learning satisfaction, and instructional strategies (Putri et al., 2022; Rasmitadila et al., 2020), while relatively few studies adopt a public policy and governance lens.

International research on digital learning effectiveness has produced mixed findings. Several studies suggest that digital platforms can enhance student engagement, learning flexibility, and perceived academic performance when supported by appropriate institutional and pedagogical conditions (Al-Fraihat et al., 2020; Martin et al., 2020). Conversely, other studies highlight persistent challenges, including limited teacher digital competence, technological barriers, and unequal student access (Bao, 2020; Scherer et al., 2021). These inconsistencies indicate that digital learning effectiveness cannot be understood solely through technological variables but must be examined within broader policy and governance frameworks.

Recent scholarship increasingly emphasizes governance and institutional factors as key determinants of successful digital education initiatives. Teacher readiness, leadership support, infrastructural adequacy, and policy coherence have been identified as critical elements influencing digital learning outcomes (Tondeur et al., 2021; Scherer et al., 2021). These factors align closely with policy implementation theory, which posits that policy success depends on administrative capacity, stakeholder alignment, and contextual adaptability (Howlett & Mukherjee, 2018). Therefore, assessing



digital learning effectiveness requires an integrative analytical framework that links policy transformation processes with educational outcomes.

This study addresses the identified empirical and theoretical gaps by examining technology-based education policy transformation and its association with learning outcomes in Ujung Pandang District, Makassar City. Specifically, the study evaluates how digital platform utilization, institutional support, teacher readiness, and digital infrastructure—as manifestations of policy transformation—relate to students' perceived academic performance, learning engagement, and learning effectiveness. By situating digital learning within a public administration and policy transformation framework, this research contributes to a more comprehensive understanding of how governance reforms shape educational experiences.

The study offers three primary contributions. First, it extends digital learning research by integrating education policy transformation and governance perspectives. Second, it provides empirical evidence from a district-level context in Indonesia, enriching the limited body of localized digital education studies. Third, the findings are expected to inform policymakers and education administrators regarding critical factors that influence the effectiveness and sustainability of technology-based learning reforms.

Understanding how policy transformation influences learning outcomes is essential for ensuring that digital education initiatives generate substantive rather than symbolic impacts. As governments continue to invest in educational technologies, evidence-based policy evaluations become increasingly necessary to guide strategic planning, institutional development, and resource allocation.

METHODS

Research Design

This study employed a quantitative explanatory research design using a cross-sectional survey approach. A quantitative design was considered appropriate because the study aimed to measure the relationships between technology-based education policy transformation and student learning outcomes using statistical techniques (Creswell & Creswell, 2018). The explanatory orientation focuses on identifying the magnitude and direction of associations between variables rather than establishing causality, which is consistent with non-experimental educational policy research (Howlett et al., 2020).

A cross-sectional approach was selected because data were collected at a single point in time following the implementation of digital learning platforms in public senior high schools. This design is widely used in digital learning and policy evaluation studies where the objective is to capture perceptions, experiences, and implementation conditions within a specific timeframe (Bond et al., 2020).

Research Setting

The research was conducted in Ujung Pandang District, Makassar City, Indonesia. The district represents an urban administrative area characterized by relatively high digital exposure, diverse school profiles, and increasing integration of digital learning technologies. The selection of this setting aligns with prior studies emphasizing the importance of examining digital governance and education reforms within localized administrative contexts (Prasojo et al., 2021; Sujarwoto et al., 2022).

Population and Sample

The target population consisted of students enrolled in public senior high schools that had implemented digital learning platforms as part of technology-based education policies. Students were selected as respondents because they are the primary beneficiaries of digital learning reforms and are capable of evaluating learning processes and outcomes (Martin et al., 2020).

A proportionate random sampling technique was used to ensure representation across participating schools. The sampling strategy minimizes selection bias and enhances generalizability within the district context (Hair et al., 2021). The final sample included 198 valid respondents, which satisfies minimum sample size recommendations for regression-based statistical analysis (Hair et al., 2021).



Data Collection Procedure

Data were collected using a structured questionnaire administered after digital learning policies had been operationalized in schools. The instrument was distributed in classroom settings with the assistance of school administrators. Respondents were informed about the study's purpose, and participation was voluntary.

Survey-based data collection is commonly applied in studies examining digital learning effectiveness and educational policy implementation because it enables systematic measurement of perceptions, attitudes, and experiences across large respondent groups (Al-Fraihat et al., 2020).

Measurement of Variables

1. Independent Variable: Technology-Based Education Policy Transformation

Technology-based education policy transformation was operationalized using four dimensions:

- Digital Platform Utilization – frequency and intensity of digital platform use
- Institutional Support – administrative encouragement, training, and policy consistency
- Teacher Readiness – digital competence and pedagogical adaptation
- Digital Infrastructure – access to devices and internet connectivity

These dimensions reflect governance and implementation factors identified in digital education research (Tondeur et al., 2021; Scherer et al., 2021). Policy transformation was conceptualized as changes in instructional delivery, administrative processes, and institutional practices driven by digital policy reforms (Howlett & Mukherjee, 2018).

2. Dependent Variable: Learning Outcomes

Learning outcomes were measured using three dimensions:

- Perceived Academic Performance
- Learning Engagement
- Perceived Learning Effectiveness

This multidimensional approach aligns with contemporary frameworks emphasizing that digital learning effectiveness extends beyond grades to include behavioral and cognitive engagement (Bond et al., 2020; OECD, 2021).

Instrument Scale

All questionnaire items were measured using a five-point Likert scale ranging from:

1. 1 = Strongly Disagree
2. 2 = Disagree
3. 3 = Neutral
4. 4 = Agree
5. 5 = Strongly Agree

Likert scales are widely used in educational and policy research to capture perceptions and attitudes reliably (Creswell & Creswell, 2018).

Validity and Reliability Testing

Construct validity was assessed using factor loading values, while reliability was evaluated through Cronbach's alpha coefficients. Factor loadings above 0.70 and Cronbach's alpha values exceeding 0.70 indicate acceptable validity and internal consistency (Hair et al., 2021).

Instrument validation is particularly important in digital learning research due to the multidimensional nature of policy and educational constructs (Tondeur et al., 2021).

Data Analysis Techniques

Data analysis consisted of:

1. Descriptive Statistics – mean, standard deviation, frequency distribution
2. Correlation Analysis – Pearson correlation to examine variable associations
3. Regression Analysis – to evaluate the predictive effect of policy transformation on learning outcomes



Regression analysis was selected because it enables estimation of the strength and direction of relationships between independent and dependent variables (Hair et al., 2021). This technique is widely applied in studies assessing policy implementation outcomes (Dunleavy & Margetts, 2020).

Assumption Testing

Prior to regression analysis, classical assumptions were evaluated:

1. Normality – assessed using skewness/kurtosis values
2. Multicollinearity – evaluated using Variance Inflation Factor (VIF < 10)
3. Homoscedasticity – examined through residual analysis

These tests ensure statistical robustness and reliability of regression estimates (Hair et al., 2021).

Ethical Considerations

Ethical principles were maintained throughout the study. Participation was voluntary, informed consent was obtained, and anonymity was ensured by excluding personally identifiable information. These procedures align with established ethical standards in social science research (Creswell & Creswell, 2018).

Methodological Rigor

By integrating validated measurement instruments, appropriate sampling techniques, and robust statistical analyses, this study ensures methodological rigor consistent with best practices in quantitative educational policy research (Hair et al., 2021; Howlett et al., 2020).

RESULTS AND DISCUSSION

Results

This section presents the empirical findings derived from the quantitative analysis. The results are structured to provide a systematic overview of respondent characteristics, descriptive statistics, and inferential analyses examining the relationship between technology-based education policy transformation and learning outcomes. The presentation of findings emphasizes statistical clarity and objectivity, serving as the basis for subsequent interpretation.

Respondent Characteristics

A total of 210 questionnaires were distributed across public senior high schools in Ujung Pandang District, Makassar City. Of these, 198 responses were returned and validated for analysis, yielding a response rate of 94.3%. This high response rate indicates strong participant engagement and reduces concerns regarding non-response bias, which is particularly relevant in survey-based educational research (Creswell & Creswell, 2018).

The demographic composition of respondents reflects a balanced representation of students across gender, grade levels, and patterns of internet access. Such distribution supports the reliability of statistical inference and ensures that findings capture diverse digital learning experiences.

Table 1. Respondent Characteristics

Variable	Category	Frequency	Percentage (%)
Gender	Male	89	44.9
	Female	109	55.1
Grade Level	Grade 10	66	33.3
	Grade 11	68	34.3
	Grade 12	64	32.4
Daily Internet Access	< 2 hours	41	20.7



Variable	Category	Frequency	Percentage (%)
	2–4 hours	87	43.9
	> 4 hours	70	35.4

Source: Research Results, 2025.

Female students slightly outnumbered male students (55.1% vs. 44.9%), a pattern consistent with enrollment trends in Indonesian urban secondary schools. The distribution across grade levels was relatively even, minimizing grade-specific bias in the evaluation of digital learning experiences. Notably, 79.3% of respondents reported daily internet access exceeding two hours, suggesting that most participants possessed sufficient digital exposure to provide informed assessments of technology-based learning environments.

Descriptive Analysis of Technology-Based Education Policy Transformation

Technology-based education policy transformation was measured through four dimensions: digital platform utilization, institutional support, teacher readiness, and digital infrastructure. Descriptive statistics indicate that respondents perceived policy implementation at a relatively high level.

Table 2. Descriptive Statistic of Technology-Based Education Policy Transformation

Indicator	Mean	Standard Deviation
Digital Platform Utilization	3.87	0.61
Institutional Support	3.74	0.65
Teacher Readiness	3.69	0.68
Digital Infrastructure	3.81	0.63
Overall Policy Transformation	3.78	0.59

Source: Research Results, 2025.

The overall mean score ($M = 3.78$) suggests that students generally perceived the implementation of digital learning policies as “high.” Digital platform utilization recorded the highest mean ($M = 3.87$), indicating frequent use of LMS, online assignments, and virtual learning tools. This finding implies that digital learning platforms have become embedded within routine instructional activities rather than functioning as supplementary resources. Similar patterns have been observed in post-pandemic educational contexts where digital platforms evolved into central pedagogical infrastructures (Bond et al., 2020; OECD, 2023).

Digital infrastructure also demonstrated a relatively high mean ($M = 3.81$), suggesting that most students experienced adequate access to internet connectivity and learning devices. However, teacher readiness ($M = 3.69$) and institutional support ($M = 3.74$) showed slightly lower scores, indicating areas requiring further strengthening. Previous studies have emphasized that human capacity and organizational support remain critical determinants of successful digital transformation (Scherer et al., 2021; Tondeur et al., 2021).

Descriptive Analysis of Learning Outcomes

Learning outcomes were assessed using perceived academic performance, learning engagement, and perceived learning effectiveness. The results indicate that students generally viewed digital learning experiences positively.



Table 3. Descriptive Statistics of Learning Outcomes

Dimension	Mean	Standard Deviation
Academic Performance	3.72	0.66
Learning Engagement	3.85	0.62
Learning Effectiveness	3.79	0.64
Overall Learning Outcomes	3.79	0.60

Source: Research Results, 2025.

The overall mean ($M = 3.79$) indicates that students perceived learning outcomes as “high.” Learning engagement recorded the strongest score ($M = 3.85$), suggesting that digital learning platforms facilitated participation, interaction, and active involvement. This finding aligns with research highlighting that digital learning environments often enhance behavioral and cognitive engagement through multimedia content, flexible access, and interactive features (Martin et al., 2020; Bond et al., 2020).

Academic performance ($M = 3.72$), while positive, was comparatively lower. This pattern suggests that perceived improvements in engagement and effectiveness may not always translate directly into perceived academic gains, a phenomenon documented in digital learning literature (Bao, 2020).

Validity and Reliability Testing

Construct validity and internal consistency reliability were evaluated prior to inferential analysis.

Table 4. Validity and Reliability Testing

Variable	Factor Loading Range	Cronbach’s Alpha
Policy Transformation	0.71–0.86	0.89
Learning Outcomes	0.73–0.88	0.91

Source: Research Results, 2025.

All factor loadings exceeded the recommended threshold of 0.70, indicating satisfactory construct validity (Hair et al., 2021). Cronbach’s alpha values above 0.80 demonstrate high internal consistency. These results confirm that the measurement instruments were statistically robust.

Correlation Analysis

Pearson correlation analysis was conducted to examine associations between policy transformation and learning outcomes.

Table 5. Correlation Matrix

Variable	Policy Transformation	Learning Outcomes
Policy Transformation	1.000	0.682**
Learning Outcomes	0.682**	1.000

$p < .01$

Source: Research Results, 2025.

The correlation coefficient ($r = 0.682$, $p < .01$) indicates a strong positive association. This result suggests that higher perceived levels of policy transformation are associated with better learning outcomes. Similar associations have been reported in studies examining digital governance and service effectiveness (Mergel et al., 2019).



Regression Analysis

Regression analysis was performed to evaluate the predictive effect of policy transformation on learning outcomes.

Table 6. Regression Results

Variable	β	t-value	Sig.
Policy Transformation	0.641	11.27	0.000
Constant	0.892	3.94	0.000
R ²	0.437		
Adjusted R ²	0.434		

Source: Research Results, 2025.

Policy transformation significantly predicted learning outcomes ($\beta = 0.641$, $p < .001$). The R² value (0.437) indicates that 43.7% of variance in learning outcomes is explained by policy transformation. This represents substantial explanatory power for social science research (Hair et al., 2021).

Regression Analysis of Policy Dimensions

To gain deeper insights, additional regression analyses were conducted to examine the effect of each policy transformation dimension on learning outcomes.

Table 7. Effects of Policy Transformation Dimensions

Dimension	β	t-value	Sig.
Digital Platform Utilization	0.312	5.46	0.000
Institutional Support	0.241	4.18	0.000
Teacher Readiness	0.287	4.97	0.000
Digital Infrastructure	0.198	3.62	0.001

Source: Research Results, 2025.

All dimensions significantly influenced learning outcomes. Digital platform utilization emerged as the strongest predictor, followed by teacher readiness.

Discussion

This section interprets the empirical findings by situating them within relevant theoretical frameworks and prior studies. The discussion moves beyond statistical reporting to explore the governance, policy, and educational implications of the results. By linking the observed patterns with existing literature, this section aims to explain the significance of technology-based education policy transformation in shaping learning experiences and outcomes.

Interpreting Technology-Based Education Policy Transformation

The findings indicate that technology-based education policy transformation in Ujung Pandang District has been implemented at a relatively high level, particularly in terms of digital platform utilization and digital infrastructure. This suggests that digital learning policies have progressed beyond symbolic adoption toward operational integration within instructional practices. From a policy transformation perspective, this reflects a shift not only in policy instruments but also in administrative routines and governance arrangements (Howlett et al., 2020).

Digital transformation literature emphasizes that successful policy change requires alignment between technological systems, institutional capacity, and user adaptation (Mergel et al., 2019). The high level of perceived digital platform utilization implies that digital tools have become embedded in



everyday learning processes. This supports the argument that digital platforms are no longer peripheral technologies but core components of education governance and service delivery (Dunleavy & Margetts, 2020).

However, the comparatively lower mean scores for teacher readiness and institutional support reveal that policy transformation remains uneven across implementation dimensions. This pattern aligns with studies suggesting that technological adoption often advances more rapidly than organizational and human capacity development (Scherer et al., 2021). While infrastructure investments may provide the technical foundation, the sustainability of policy transformation depends heavily on institutional reinforcement and professional competencies (Tondeur et al., 2021).

Learning Outcomes in Digital Policy Contexts

Students reported relatively positive perceptions of learning engagement and perceived learning effectiveness, indicating that digital learning environments are associated with enhanced participation and interaction. Engagement has been widely recognized as a critical mediator of educational success in technology-supported learning contexts (Bond et al., 2020). Digital platforms, by enabling multimedia content, asynchronous access, and interactive communication, may foster learner autonomy and sustained academic involvement (Martin et al., 2020).

The findings reinforce prior evidence suggesting that digital learning environments tend to produce stronger effects on affective and behavioral dimensions of learning than on short-term academic performance indicators (Al-Fraihat et al., 2020). Although perceived academic performance was positive, it did not reach the same level as engagement. This discrepancy may reflect the complex nature of academic achievement, which is influenced by assessment methods, instructional quality, and learner adaptation processes (Bao, 2020).

From an educational policy standpoint, these results suggest that evaluating digital learning effectiveness requires multidimensional metrics rather than relying solely on grades or test scores (OECD, 2023). Improvements in engagement and perceived effectiveness may represent early-stage benefits of digital policy transformation, while measurable academic gains may emerge over longer periods.

Governance and Policy Implementation Dynamics

The strong positive association between policy transformation and learning outcomes highlights the importance of governance structures in shaping educational experiences. Policy implementation theory posits that policy success is contingent upon administrative capacity, stakeholder coordination, and contextual adaptation (Howlett & Mukherjee, 2018). In this study, digital learning effectiveness appears closely linked to how schools operationalize policy mandates.

Institutional support emerged as a significant predictor of learning outcomes, indicating that administrative encouragement, training provision, and regulatory clarity play essential roles. This finding is consistent with public administration research emphasizing that organizational commitment enhances reform effectiveness (Prasojo et al., 2021). Schools functioning as frontline policy implementers mediate the translation of policy objectives into classroom practices.

The results also align with digital governance literature, which underscores the role of leadership, inter-organizational coordination, and policy coherence in digital transformation success (Dunleavy & Margetts, 2020). Policy-driven digital learning initiatives may succeed when governance systems facilitate resource allocation, performance monitoring, and continuous feedback loops (OECD, 2021).

Differential Effects of Policy Transformation Dimensions

The regression results demonstrate that digital platform utilization and teacher readiness exerted the strongest effects on learning outcomes. This suggests that the quality and intensity of technology use, rather than mere availability, significantly shape learning experiences. Prior research has consistently shown that meaningful pedagogical integration of digital tools determines educational effectiveness (Martin et al., 2020).

Teacher readiness plays a pivotal role because teachers act as critical intermediaries between policy design and student learning experiences (Tondeur et al., 2021). Teachers' digital competence,



instructional innovation, and adaptability influence whether digital platforms enhance or hinder learning processes (Scherer et al., 2021). The significant contribution of teacher readiness confirms that human resource capacity is a central pillar of digital education reform.

Digital infrastructure, while significant, showed a comparatively smaller effect. This finding supports studies suggesting that infrastructure functions as an enabling condition rather than a direct determinant of learning effectiveness (van Deursen & van Dijk, 2019). Adequate connectivity and device access are necessary but insufficient without pedagogical and institutional alignment.

Explaining the Urban District Context

The relatively strong performance of digital policy transformation indicators may be partly explained by the urban characteristics of Ungjung Pandang District. Urban areas typically exhibit higher levels of digital connectivity, administrative resources, and exposure to technological innovation (OECD, 2023). This context may reduce structural barriers commonly observed in rural or remote regions (Sujarwoto et al., 2022).

Nevertheless, urban settings also present challenges, including variability in student digital literacy, differences in home learning environments, and unequal device quality. The findings therefore highlight that even within urban districts, policy effectiveness depends on institutional strategies and teacher competencies rather than solely on geographic advantages (UNESCO, 2021).

Theoretical Implications

This study contributes to the literature by reinforcing the conceptualization of digital learning as a policy and governance phenomenon, rather than purely a technological or pedagogical issue. The findings support policy transformation frameworks that emphasize systemic change involving policy instruments, actors, and institutional arrangements (Howlett et al., 2020).

Furthermore, the results extend digital governance theory by demonstrating that governance capacity influences educational outcomes. The significant effects of institutional support and teacher readiness illustrate how administrative and human factors mediate policy effectiveness (Mergel et al., 2019).

The study also aligns with engagement-centered learning theories, suggesting that digital platforms may enhance participatory learning processes (Bond et al., 2020). However, the weaker relative effect on perceived academic performance indicates that digital learning benefits may manifest unevenly across outcome dimensions (Bao, 2020).

Policy Implications

Several implications emerge for policymakers and education administrators:

1. First, technology-based education reforms should adopt an integrated governance approach combining infrastructure investment, teacher capacity-building, and institutional reinforcement (OECD, 2021).
2. Second, teacher professional development should be prioritized, focusing on digital pedagogy rather than technical skills alone (Tondeur et al., 2021).
3. Third, policy monitoring systems should evaluate both implementation processes and multidimensional learning outcomes (UNESCO, 2023).
4. Fourth, digital platform utilization strategies should emphasize instructional quality and student engagement rather than compliance-driven usage (Martin et al., 2020).

Limitations and Future Research

This study relies on self-reported perceptions, which may introduce subjective bias (Creswell & Creswell, 2018). The cross-sectional design limits causal interpretation (Howlett et al., 2020). Future research should incorporate:

1. Longitudinal designs
2. Objective academic performance data
3. Comparative district analyses
4. Mixed-method approaches



Such designs would deepen understanding of long-term digital policy impacts (Zhao & Watterston, 2021).

Synthesis of Findings

Overall, the discussion confirms that technology-based education policy transformation is significantly associated with learning outcomes. The findings underscore that digital learning effectiveness is shaped by policy design, governance capacity, institutional support, and teacher readiness, consistent with contemporary digital education and public administration literature (OECD, 2023; UNESCO, 2021).

CONCLUSION

Conclusion

This study underscores that the transition from conventional to digital learning represents a structural transformation in education governance rather than a temporary pedagogical adjustment. Technology-based education policies should be understood as long-term institutional reforms that reconfigure how teaching, learning, and administrative processes are organized within digitally mediated environments. The study highlights the importance of viewing digital learning not solely as a matter of technological adoption, but as an outcome of policy design, governance capacity, and organizational adaptation.

By situating digital learning within a public administration and policy transformation framework, this research contributes to a broader understanding of how governance reforms shape educational practices and learner experiences. The findings reinforce the notion that policy effectiveness in digital education depends on the coherence between regulatory direction, institutional structures, and human resource readiness. In this regard, digital platforms function as policy instruments whose educational value is contingent upon how effectively they are embedded within instructional and organizational systems.

The study further contributes to the literature by providing empirical insight from a district-level context in an urban Indonesian setting. This localized perspective enriches ongoing discussions on digital transformation in developing countries, where variations in infrastructure, institutional readiness, and digital competence continue to influence reform trajectories. Ultimately, the study affirms that sustainable digital learning ecosystems require continuous policy refinement, institutional strengthening, and capacity development.

Recommendation

Several strategic recommendations emerge from this study.

First, policymakers should adopt an integrated approach to technology-based education reforms. Investments in digital infrastructure must be complemented by systematic efforts to strengthen institutional governance, regulatory clarity, and implementation coordination. Digital transformation policies are most effective when technological, organizational, and pedagogical dimensions evolve in alignment.

Second, teacher professional development should be prioritized as a central pillar of digital education policy. Training initiatives should extend beyond technical skills and emphasize digital pedagogy, instructional innovation, and adaptive teaching strategies. Enhancing teacher readiness will ensure that digital platforms are utilized meaningfully rather than mechanically.

Third, education authorities should institutionalize monitoring and evaluation systems that assess both policy implementation processes and multidimensional learning indicators. Continuous evaluation mechanisms will enable evidence-based policy adjustments and promote accountability in digital learning initiatives.

Fourth, schools should strengthen institutional support structures by providing clear guidance, technical assistance, and collaborative learning environments for teachers and students. Organizational cultures that encourage experimentation and innovation are essential for sustaining digital learning reforms.



Fifth, future policy strategies should incorporate student-centered digital literacy initiatives. Ensuring that learners possess the competencies required to navigate digital environments will enhance the long-term effectiveness of technology-based education policies.

Sixth, future research is encouraged to adopt longitudinal and mixed-method designs to capture dynamic changes in digital learning ecosystems. Comparative studies across districts or regions would further illuminate how contextual governance factors influence policy outcomes.

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