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Perceived Digital Leadership and Teachers' Technology Integration: A PLS-SEM Analysis in Chinese Private Universities

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Abstract

This study examines the impact of perceived digital leadership on teachers' technology integration in private higher education institutions in China. A quantitative cross-sectional survey was conducted with 423 teachers, and the proposed model was tested using partial least squares structural equation modeling (PLS-SEM). The findings reveal that perceived digital leadership significantly and positively predicts technology integration, explaining a moderate proportion of its variance. Drawing on Transformational Leadership Theory and Social Cognitive Theory, this study extends existing research by conceptualizing digital leadership as an enabling organizational condition that shapes teachers' instructional practices. Specifically, digital leadership is argued to influence technology integration not only directly but also indirectly by fostering supportive institutional environments, enhancing perceived usefulness of digital tools, and strengthening teachers' readiness for pedagogical innovation. The study contributes to the literature by providing empirical evidence from the underexplored context of Chinese private universities and by offering a process-oriented explanation of technology integration. From a practical perspective, the study highlights the importance of strengthening institutional support and leadership practices to enhance effective technology integration, particularly in resource-constrained private universities.

Keywords: Perceived Digital Leadership, Technology Integration, Higher Education, PLS-SEM, Transformational Leadership Theory

Introduction

Technology integration has become a central concern in higher education, as digital technologies continue to transform teaching practices and learning environments in increasingly complex ways (Akram et al., 2022; Howard et al., 2021). In contemporary educational contexts, technology integration is no longer limited to the use of digital tools but involves the meaningful alignment of technology with pedagogy and content to enhance instructional effectiveness and student learning outcomes (Mabrouk, 2025). Despite this growing emphasis, the extent to which digital technologies are meaningfully embedded in instructional practices varies considerably across institutional contexts.

In China, private universities have played an increasingly important role in expanding access to higher education under ongoing educational reforms. Despite growing investments in digital infrastructure and policy support, effective technology integration remains uneven across institutions (Murillo-Jiménez et al., 2025). This challenge is particularly evident in private universities in China, where limited financial resources, insufficient professional development opportunities, and uneven institutional support for digital teaching often hinder sustained and meaningful integration. These constraints often result in fragmented or superficial technology use, rather than sustained and pedagogically meaningful integration (Liang, 2021).

Among the various factors identified in prior research, digital leadership has emerged as a key organizational driver of technology integration (Akhmad, 2025). Drawing on transformational leadership theory, digital leadership emphasizes leaders' roles in articulating a shared vision, fostering a supportive digital culture, and enabling innovation in teaching practices (Assefa & Mujtaba, 2025; Bass & Avolio, 1994). Empirical studies suggest that when institutional leaders actively support digital transformation, teachers are more likely to adopt and implement technology in their instructional practices (Lu & Wang, 2023; Razak et al., 2023). However, existing research has predominantly examined leadership in general contexts, with limited empirical evidence in Chinese private universities.

Building on this perspective, perceived digital leadership has emerged as a particularly relevant construct for understanding technology integration in educational settings. Digital leaders are expected to articulate a clear vision for technology use, support teachers' professional development, and cultivate a school culture that encourages innovation and collaboration (Alajmi, 2022). Prior studies have shown that when teachers perceive their leaders as digitally competent and supportive, they are more likely to engage with and effectively use digital technologies in their teaching (Mehmood, 2023a; Tanniru & Peral, 2021). However, much of the existing evidence has been generated in contexts such as K–12 education or higher education systems outside China, leaving questions about how these dynamics operate in Chinese private universities.

Empirical research has provided initial support for the role of digital leadership in promoting technology integration. For example, studies conducted in Kuwait, the United States, and other contexts have found that leadership practices such as vision building, professional support, and resource provision are positively associated with teachers' use of technology (Alajmi, 2022; Tanniru & Peral, 2021). Nevertheless, these studies have largely focused on general educational settings, with limited attention to resource-constrained private universities, where institutional conditions may amplify the importance of leadership.

Against this backdrop, this study examines the impact of teachers' perceived digital leadership on technology integration in private higher education institutions in Shandong Province, China. Adopting a quantitative research design and using partial least squares structural equation modeling (PLS-SEM), this study collected data from in-service teachers at private universities and analyzed the direct relationship and explanatory power between digital leadership (DL) and technology integration (TI). The findings aim to enrich the academic literature on technology integration in private higher education and offer empirical

insights for policymakers, institutional leaders, and practitioners committed to enhancing digital teaching capacity.

This study supports the critical role of teachers' perceived digital leadership in technology integration and expands the literature on digitalization in China's private higher education sector, particularly in the understudied context of Shandong Province. The results provide practical recommendations for policymakers and university leaders to strengthen teachers' digital competencies and improve facility systems, thereby supporting more balanced digital development in higher education institutions.

More specifically, this study offers new empirical evidence on how perceived digital leadership operates in resource-constrained private universities, a context that remains underexamined in the existing literature. It also provides a more nuanced understanding of how leadership influences teachers' technology integration through organizational and behavioral mechanisms.

Research Objectives

i) To describe the current status of teachers' digital leadership and the level of digital technology application in teaching among faculty in private universities in Shandong Province, China.
ii) To investigate the relationship between teachers' digital leadership and their level of technology integration in teaching practices.
iii) To examine the influence of teachers' digital leadership on technology integration in instructional activities.

Research Questions

i) What are the levels of digital leadership and technology integration among teachers in private universities in China?
ii) What is the relationship between digital leadership and technology integration among teachers in private universities in China?
iii) How does digital leadership influence technology integration among teachers in private universities in China?

Research Hypothesis

Technology integration in higher education is shaped not only by individual capability but also by organizational conditions. Digital leadership plays a crucial role in promoting the effective use of digital technologies in educational settings. Drawing on transformational leadership theory, leaders can influence instructional practices by articulating a shared vision, fostering a supportive environment, and encouraging innovation (Bass & Avolio, 1994). Empirical studies indicate that leadership support enhances teachers' willingness and ability to integrate technology into teaching (Pettersson, 2021; Schmitz et al., 2023).
H1: Digital leadership has a significant positive effect on technology integration.

Literature Review

Technology Integration

In educational research, technology integration generally refers to the purposeful use of digital tools and technical resources in teaching activities to enrich the teaching process and

improve learning outcomes (Akram et al., 2022; Ertmer et al., 2012; Jadhav et al., 2022). Early understandings of technology integration focused on technology access and frequency of use, while contemporary academic research emphasizes pedagogical compatibility and teaching transformation rather than merely the superficial application of tools (Becker, 2000; Inan & Lowther, 2010). In this study, teachers' technology integration (TI) is defined as the deliberate application of digital technology in the teaching process to support student learning and achieve instructional objectives.

The Technological Pedagogical Content Knowledge (TPACK) framework underpins the construction of the Technology Integration (TI) concept in this study, highlighting that effective integration requires the dynamic coordination of technological, pedagogical and content knowledge in real classroom contexts (Ndebele & Mbodila, 2022). Therefore, technology integration is a multifaceted practice involving curriculum design, instructional implementation and assessment, rather than a simple technical operation. Empirical studies have demonstrated that technology integration can enhance student engagement and instructional innovation capacity, yet its implementation remains unbalanced due to inconsistent institutional support, limited resources and disparities in teachers' professional competencies (Ranbir, 2024; Safidon, 2024).

Existing literature has explored individual and technological factors affecting technology integration (TI), yet pays insufficient attention to organizational driving factors such as digital leadership, especially in private higher education institutions with limited resources in China. To ensure measurement rigor, this study operationalizes technology integration through four dimensions derived from the Teacher Technology Integration Survey (TTIS): Risk-taking behavior and comfort with technological (RC), perceived benefits in using technology in the classroom (PB), beliefs and behaviors about classroom technology use (BB), and technology support and access (TSA) (Vannatta & Banister, 2009). These dimensions reflect teachers' willingness to innovate, confidence in digital application, perceived instructional value, and access to institutional support (Karakis, 2022; Njiku et al., 2019).

Digital Leadership

Perceived digital leadership (DL) generally refers to teachers' perceptions of leadership behaviors that establish the vision, culture, and systemic conditions necessary for meaningful technology integration in educational institutions (AlAjmi, 2022). Early studies framed educational leadership mainly as instructional or transformational governance, with core focuses on vision construction, instructional assistance and teacher professional development (Leithwood & Jantzi, 2000). In contrast, recent scholarship has redefined digital leadership as an upgraded leadership practice tailored to digital transformation, which concentrates on assisting educators in rational adoption and optimal utilization of diverse digital resources (Leithwood & Sun, 2018). In this study, perceived digital leadership (DL) is defined as teachers' perception of school leaders' digital leadership practices, including articulating digital visions, establishing technology-supportive cultures, and promoting continuous improvement in technology-enhanced education.

The transformational leadership theory underpins the construction of the perceived digital leadership (DL) concept in this study, highlighting that effective DL requires leaders to inspire, motivate, and support organizational change in the digital context (Bass & Avolio,

1994; Shrestha, 2020). This theory is operationalized through the Technology Leadership Assessment (TLA) framework, which adapts transformational leadership principles to digital scenarios by focusing on three core interrelated dimensions: Visionary Leadership, Digital-Age Learning Culture, and Systemic Improvement (AlAjmi, 2022). Therefore, DL is a multifaceted practice involving vision formulation, culture building, and systemic support, rather than merely technical infrastructure management. Empirical studies have demonstrated that DL positively correlates with teachers' technology integration practices, professional development engagement, and innovation willingness, yet its effectiveness is constrained by insufficient sustained cultural and systemic support, narrow operationalization, and common method bias in measurement (Dexter & Richardson, 2020; Ng, 2015).

Existing literature has explored the positive impact of DL on teachers' technology integration, yet pays insufficient attention to its contextual adaptation in specific settings, especially in Chinese private higher education institutions with distinct leadership structures and limited resources. To ensure measurement rigor, this study operationalizes perceived digital leadership (DL) through three dimensions derived from the Technology Leadership Assessment (TLA) developed by AlAjmi (2022): Visionary Leadership, Digital-Age Learning Culture, and Systemic Improvement. These dimensions reflect leaders' capacity to formulate digital strategies, build technology-friendly environments, and promote continuous growth, which are closely related to teachers' attitudes toward digital education and technology integration practices (Byungura, 2019; Karwan et al., 2021).

While this study is primarily grounded in Transformational Leadership Theory, which explains how leaders shape organizational vision, culture, and support systems, it also draws on Social Cognitive Theory (SCT) to further explain how these organizational conditions translate into individual instructional behavior.

From the perspective of SCT, human behavior is influenced by the dynamic interaction between environmental factors, personal cognition, and behavioral outcomes (Bandura, 1986). In this study, perceived digital leadership represents an important environmental determinant that shapes teachers’ perceptions, confidence, and readiness to use digital technologies in teaching. Although individual cognitive variables are not explicitly modeled, they are implicitly embedded in the process through which leadership influences behavior.

By integrating Transformational Leadership Theory with Social Cognitive Theory, this study provides a more comprehensive explanation of how organizational leadership is translated into teachers’ technology integration practices.

Materials and Methods

Research Design

This research adopts a quantitative cross-sectional survey design to explore the relationship between teachers' digital literacy and technology integration. The study collects data from teachers employed at private universities across Shandong Province, China. A structured questionnaire is used to measure research-related variables. The dataset was subsequently analyzed to determine how teachers' digital leadership affects the integration of technological tools within instructional settings.

Conceptual Framework

Figure 1 illustrates the conceptual framework and the relationships among the variables in this research. Conceptual framework shows the relationship between specific variables in the study. Teachers' perceived digital leadership functions as the independent variable and teachers' technology integration as the dependent variable. Perceived digital leadership comprises three dimensions. While technology integration is reflected through four dimensions. This research aims to explore the impact of perceived digital leadership on teachers' technology integration in private universities in Shandong province of China.

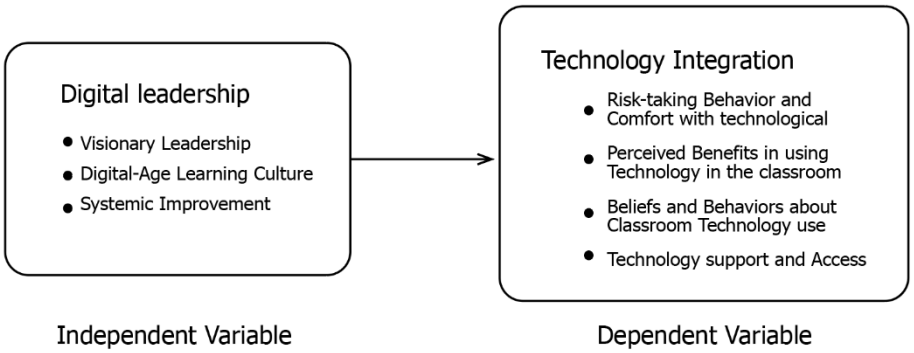

Figure 1: Conceptual framework of Study

Measurement Instruments

The questionnaire for this study was adapted from three established instruments: the Technology Leadership Assessment (TLA) (AlAjmi, 2022), and the Teacher's Technology Integration Survey (TTIS) (Vannatta & Banister, 2009). The TLA was used to measure teachers' perceived digital leadership across three dimensions: visionary leadership, digital-age learning culture and systemic improvement. The TTIS assessed teachers' technology integration in instructional practices. Minor modifications were made to ensure contextual relevance to private universities in China, while preserving the original structure and intent of the scales. The questionnaire survey consisted of 35 items in total, consist 15 items measuring digital leadership and 20 items measuring technology integration. All questionnaire items were assessed on a five-point Likert-type scale, with response options spanning from strong disagreement to strong agreement. A summary of the study variables and instruments is presented in Table 1.

Table 1
Description of Variables

Construct	Instrument	Number of Items	Scale Used
Perceived Digital Leadership	Technology Leadership Assessment (TLA) (AlAjmi, 2022)	15	5-point Likert Scale
Technology Integration	Teacher's Technology Integration Survey (TTIS) (Vannatta & Banister, 2009)	20	

Section A: Digital Leadership

The scale in this section includes 15 items adapted from the Technology Leadership Assessment (TLA) developed by AlAjmi (2022) to measure teachers' perceived digital leadership. The construct was assessed across three dimensions: Visionary Leadership (VL), Digital-Age Learning Culture (DLC), and Systematic Improvement (SI), reflecting leaders' ability to establish a strategic vision for digital transformation, foster technology-rich learning environments, and support continuous improvement through institutional policies and resources.

Section B: Technology Integration

The final section was adapted from the TTIS by Vannatta and Banister (2009) to measure teachers' technology integration in instructional contexts. This construct includes 20 items divided into four subscales: Risk-taking Behaviors and comfort with technology, Perceived Benefits in using Technology in the Classroom, Beliefs and Behaviors about Classroom Technology use, Technology support and Access.

Population and Sample

Shandong Province is a key region for higher education in China and hosts a large number of private universities. Teachers employed in private universities across Shandong Province, China, formed the population for this study. This study focuses on investigating the relationships among digital leadership and technology integration among them.

Participants were selected through a multi-stage sampling approach. Qingdao, Jinan and Weifang were initially selected as three representative cities in Shandong Province to reflect diverse regional conditions. Eight private universities in these cities were then chosen as research sites. Teaching staff from selected universities were invited to participate in the survey through random sampling.

Statistical data from the Shandong Provincial Department of Education (2023) show about 35,429 teachers employed in private higher education institutions across Shandong Province. According to the sample size table developed by Krejcie and Morgan (1970), a minimum sample of 380 respondents was considered adequate. Data were collected via the Wenjuanxing online survey platform, yielding 453 questionnaires. After screening the returned questionnaires, 423 valid questionnaires were included in subsequent statistical analysis.

Data Analysis

The collected data were analyzed using IBM SPSS Statistics 27 and Smart PLS 4 (Hair Jr et al., 2021). Prior to the main analysis, the data set was screened for completeness, accuracy, and consistency, and invalid responses were removed. A total of 423 valid questionnaires were retained for further analysis. Descriptive statistics were conducted using SPSS, which provided an overview of teachers' levels of digital leadership and their use of technology in teaching practices. To investigate the relationships among the study variables, Partial Least Squares Structural Equation Modeling (PLS-SEM) was subsequently performed using Smart PLS. The approach is suitable for analyzing relationships among latent variables and for evaluating complex research models. In addition, PLS-SEM is widely used in educational and

social science research because it allows researchers to test theoretical relationships and evaluate proposed hypotheses simultaneously.

Results

Descriptive Statistics

The survey administered through the Wenjuanxing platform generated 453 responses. After checking the responses for completeness and removing invalid entries, 423 questionnaires were retained for further analysis. This corresponds to an effective response rate of approximately 93%, which is considered satisfactory for survey-based studies in social science research.

Table 2 presents descriptive statistics for the core variables in this study, including digital leadership and technology integration. The mean scores for all variables range from 3.25 to 3.27, indicating that all constructs are at a moderate level of development. Specifically, digital leadership recorded the highest mean value (M = 3.27, SD = 0.70), followed by technology integration (M = 3.25, SD = 0.66). These results suggest that teachers in private universities demonstrate moderate levels of digital leadership and technology integration in their instructional practices.

Furthermore, skewness values ranged from 0.463 to 0.478 and kurtosis values ranged from −0.569 to −0.524, both within acceptable thresholds (Hair et al., 2019), indicating no substantial deviation from normality and supporting the suitability of the data for further analysis.

Table 2
Descriptive Statistics

Construct	N	Mean	Std. Deviation	Skewness	Kurtosis
Digital Leadership	423	3.27	0.70	0.463	-0.524
Technology Integration	423	3.25	0.66	0.478	-0.569

Correlation Analysis

Pearson correlation analysis was conducted to examine the relationship between perceived digital leadership (DL) and teachers' technology integration (TI). The results presented in Table 3 revealed a significant positive correlation between the two variables, $r = .619$, $p < .001$, $N = 423$. This finding implies that a moderate to strong linear relationship, providing preliminary support for the hypothesized association between digital leadership and technology integration.

Furthermore, the relatively high correlation coefficient reflects a notable connection between these constructs. This suggests that digital leadership may play an important role in shaping teachers' technology integration behavior. This result provides preliminary empirical evidence supporting the proposed relationship and justifies further examination through regression analysis.

Table 3
Correlation between DL and TI

Variable	Digital Leadership	Technology Integration
Digital Leadership	1	
Technology Integration	.619**	1

Note: DL = Digital Leadership; TI = Technology Integration. ** Correlation is significant at the 0.01 level (2-tailed).

Measurement Model Assessment

Before hypothesis testing, the measurement model was evaluated by examining indicator reliability, internal consistency reliability, and convergent validity to ensure the adequacy of the measurement instruments. The results are presented in Tables 4 and 5.

First, indicator reliability was assessed through outer loadings. All item loadings exceeded the recommended threshold of 0.70, indicating that all indicators adequately represent their respective constructs.

Second, internal consistency reliability was evaluated using Cronbach's alpha and composite reliability (CR). The Cronbach's alpha values ranged from 0.88 to 0.894, while CR values ranged from 0.794 to 0.800. All values exceeded the recommended threshold of 0.70, demonstrating satisfactory internal consistency.

Third, convergent validity was assessed using the average variance extracted (AVE). The AVE values ranged from 0.500 to 0.562, all exceeding the recommended threshold of 0.50, indicating adequate convergent validity.

These results indicate that the measurement model meets the required standards of reliability and convergent validity. And the measurement items used in this study are suitable for representing the theoretical constructs in the context of technology integration among teachers in private universities.

Table 4
Measurement Model Results

Construct	Dimension	CITC Rang	Cronbach's α of Dimension	Cronbach's α of Construct	CR	AVE
DL	VL	0.671-0.736	.869	0.880	0.794	0.562
	DLC		.874			
	SI		.879			
TI	RC	0.673-0.723	.849	0.894	0.800	0.500
	PB		.874			
	BB		.881			
	TSA		.876			

Note: Cronbach's α = internal consistency reliability; CR = composite reliability; AVE = average variance extracted.

Table 5
Outer Loadings of Measurement Items

Construct	Dimention	Item	Outer Loading
DL	VL	VL1	0.806
		VL2	0.799
		VL3	0.804
		VL4	0.829
		VL5	0.814
	DLC	DLC1	0.815
		DLC2	0.806
		DLC3	0.821
		DLC4	0.811
		DLC5	0.824
	SI	SI1	0.784
		SI2	0.821
		SI3	0.845
		SI4	0.822
		SI5	0.834
TI	RC	RC1	0.834
		RC2	0.821
		RC3	0.842
		RC4	0.821
	PB	PB1	0.835
		PB2	0.817
		PB3	0.806
		PB4	0.811
		PB5	0.807
	BB	BB1	0.788
		BB2	0.783
		BB3	0.795
		BB4	0.809
		BB5	0.799
		BB6	0.778
	TSA	TSA1	0.824
		TSA2	0.836
		TSA3	0.822
		TSA4	0.817
		TSA5	0.788

Discriminant validity was further assessed using the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio to test construct distinctiveness.

For the three dimensions of perceived digital leadership (DL): Visionary Leadership (VL), Digital-Age Learning Culture (DLC), and Systemic Improvement (SI). The Fornell-Larcker results (see Table 6) showed that the square roots of the average variance extracted (AVE) for each dimension (ranging from 0.810 to 0.821) were all greater than their respective inter-dimensional correlations (0.324–0.355), satisfying the Fornell-Larcker criterion. Meanwhile, the HTMT values (see Table 7) for all dimension pairs (0.348–0.406) were well below the recommended threshold of 0.85, confirming adequate discriminant validity among the DL dimensions.

Similarly, for the four dimensions of technology integration (TI): Beliefs and Behaviors about Classroom Technology in the Classroom (BB), Perceived Benefits in using Technology in the Classroom (PB), Risk-taking Behaviors and comfort with technology (RC), and Technology support and Access (TSA). The Fornell-Larcker results (see Table 8) indicated that the square roots of the AVE values (ranging from 0.792 to 0.830) exceeded all cross-dimensional correlations (0.281–0.383). The corresponding HTMT results (see Table 9) showed that the values (0.318–0.443) were also far below the 0.85 cutoff.

Overall, the results from both criteria consistently demonstrated that all sub-dimensions of DL and TI exhibited satisfactory discriminant validity, confirming that each dimension captured a distinct and unique construct.

Table 6
Fornell–Larcker Criterion for Digital Leadership Dimensions

Construct	DLC	SI	VL
DLC	**0.816**		
SI	0.349	**0.821**	
VL	0.355	0.324	**0.810**

Table 7
HTMT Results for Digital Leadership Dimensions

Construct	DLC	SI	VL
DLC	—		
SI	0.348	—	
VL	0.406	0.375	—

Table 8
Fornell–Larcker Criterion for Technology Integration Dimensions

Construct	BB	PB	RC	TSA
BB	**0.792**			
PB	0.364	**0.815**		
RC	0.306	0.383	**0.830**	
TSA	0.369	0.281	0.31	**0.817**

Table 9
HTMT Results for Technology Integration Dimensions

Construct	BB	PB	RC	TSA
BB	—			
PB	0.413	—		
RC	0.352	0.443	—	
TSA	0.419	0.318	0.357	—

Note: DL = Digital Leadership; DE = Digital Engagement; TI = Technology Integration. HTMT values below 0.85 indicate satisfactory discriminant validity.

Structural Model Assessment

Structural model assessment was performed after the measurement model had met the required reliability and validity criteria. The purpose of this analysis was to examine how the proposed framework explains the relationship between digital leadership and technology integration.

As shown in Table 10, the coefficient of determination (R^2) for technology integration reached 0.401. This indicates that the predictors included in the model account for 40.1% of the variance in teachers' technology integration behavior. In educational and social science research, this level of explained variance is generally interpreted as moderate.

Taken together, the findings indicate that the proposed model provides a meaningful explanation of teachers' technology integration practices in private universities in Shandong Province. The results also imply that the selected predictors capture important factors shaping teachers' adoption and use of technology in teaching activities.

Hypothesis Testing

To test the proposed hypothesis (H1), partial least squares structural equation modeling (PLS-SEM) was conducted to examine the effect of perceived digital leadership (DL) on teachers' technology integration (TI).

As shown in Table 10, the results reveal a statistically significant positive relationship between the two constructs ($\beta = 0.633$, $t = 24.195$, $p < 0.001$). The path coefficient of 0.633 indicates a strong positive effect, suggesting that higher levels of perceived digital leadership are associated with higher levels of teachers' technology integration. Additionally, the model explained 40.1% of the variance in TI ($R^2 = 0.401$), demonstrating substantial explanatory power.

Table 10
Hypothesis Testing Path Coefficients of the Structural Model

Path	Original sample (O)	Sample mean (M)	STDEV	t	p	R^2
DL → TI	0.633	0.640	0.026	24.195	0.000	0.401

Discussion

This study examined the relationships among digital leadership and technology integration in private higher education institutions in China. The findings provide clear empirical support for the proposed hypothesis, indicating that digital leadership exerts a significant and positive influence on teachers' use of technology in instructional practices. Beyond confirming the direct relationship, the results offer further insight into how leadership operates as a key organizational factor shaping technology-related teaching behaviors.

First, the significant positive effect of digital leadership on technology integration reinforces the central assumptions of Transformational Leadership Theory (Bass & Avolio, 1994). This theoretical perspective suggests that leaders influence followers' behaviors by articulating a shared vision, fostering motivation, and creating supportive organizational environments. In the context of digital education, the findings imply that when institutional leaders actively promote digital transformation, provide strategic direction, and encourage innovation, teachers are more inclined to incorporate digital tools into their teaching. This influence extends beyond the provision of technological resources and reflects a deeper process in which leadership shapes teachers' confidence, willingness, and readiness to engage in technology-enhanced instruction.

Although this study is primarily grounded in Transformational Leadership Theory to explain how leadership shapes organizational conditions, the findings can also be interpreted from a broader technology adoption perspective. In particular, digital leadership may contribute to shaping teachers' perceptions of the usefulness of technology, their sense of institutional support, and their preparedness to adopt new teaching practices. These elements are widely recognized as important determinants of technology use in education (Davis, 1989; Venkatesh et al., 2003). From this perspective, leadership does not directly determine behavior but creates conditions that make technology integration more meaningful, feasible, and sustainable in everyday teaching practice.

Second, the findings contribute to existing research by emphasizing the importance of organizational context in understanding technology integration. Much of the prior literature has focused on individual-level factors, such as digital competence or personal attitudes, to explain teachers' use of technology. While these factors are undoubtedly important, the present study highlights that technology integration is also shaped by institutional conditions (Ertmer & Ottenbreit-Leftwich, 2013). Leadership-driven initiatives, including the development of a shared digital vision, the provision of ongoing professional support, and the cultivation of a collaborative and innovation-oriented culture, appear to play a critical role in enabling teachers to translate technological possibilities into actual

instructional practices. This suggests that technology integration should be understood as a context-dependent process rather than solely an individual choice.

Third, this study provides context-specific insights by focusing on private higher education institutions in China. Compared with public universities, private institutions often face structural constraints (Wang, 2021), such as limited financial resources, uneven infrastructure, and restricted access to professional development opportunities. Within such environments, leadership becomes particularly important as a coordinating and enabling force. The results suggest that effective digital leadership can partially mitigate these constraints by optimizing available resources, strengthening institutional coherence, and encouraging adaptive teaching practices. This highlights the contextual sensitivity of leadership effects and suggests that the impact of digital leadership may be more pronounced in settings where formal support systems are less developed.

Furthermore, the explanatory power of the model indicates that digital leadership accounts for a meaningful proportion of variance in technology integration. This finding underscores the importance of leadership as a central factor in shaping teachers' instructional use of technology. At the same time, it also implies that technology integration is influenced by multiple dimensions, including individual capabilities, motivational factors, and technological infrastructure. Future research may therefore benefit from incorporating additional variables to provide a more comprehensive understanding of the mechanisms underlying technology integration in higher education.

In practical terms, the findings suggest that efforts to enhance technology integration should not be limited to increasing access to digital tools. Institutional leaders should place greater emphasis on developing clear digital strategies, supporting continuous professional learning, and fostering an environment that encourages experimentation and innovation in teaching. Such leadership practices are particularly important in private higher education institutions, where internal organizational dynamics play a crucial role in compensating for external resource limitations.

Conclusion

This study examined the impact of teachers' perceived digital leadership on technology integration in private universities in Shandong Province, China. The findings indicate that both digital leadership and technology integration are at moderate levels, suggesting that while progress has been made in digital transformation, further development is still needed. More importantly, digital leadership was found to be a significant and positive predictor of teachers' technology integration, highlighting the critical role of leadership in shaping instructional practices in digital contexts. These findings underscore the importance of strengthening leadership practices to support effective technology use in higher education, particularly in resource-constrained private institutions. By fostering a clear digital vision, providing institutional support, and encouraging innovation, leaders can create conditions that facilitate more meaningful and sustained integration of technology in teaching. There are also several limitations in this study. The cross-sectional design and the focus on a single regional context may limit the generalization of the findings. In addition, the model does not consider potential moderating variables that may influence the observed relationships. Future research could adopt longitudinal and multi-site designs, incorporate moderating factors, and

combine quantitative and qualitative approaches to provide a more comprehensive understanding of technology integration.

Data availability statement

The datasets used in this study are available from the authors upon reasonable request.

Ethics Statement

Informed consent was obtained from all respondents who were assured of their anonymity and the confidentiality of their responses. Participants were informed that they could withdraw from the study at any time without negative consequences.

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Conflict of Interest

The authors declare no conflict of Interest.

Reference

Akhmad, A. (2025). Digital leadership practices in educational management: A narrative literature review on trends and challenges. *International Journal of Learning, Teaching and Educational Research, 24*(8), 112–135. https://doi.org/10.26803/ijlter.24.8.6

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, Article 920317. https://doi.org/10.3389/fpsyg.2022.920317

AlAjmi, M. K. (2022). The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait. *International Journal of Educational Research, 112*, Article 101928. https://doi.org/10.1016/j.ijer.2022.101928

Assefa, E. A., & Mujtaba, B. G. (2025). Exploring transformational leadership in education by leveraging diversity and technology for inclusive practices. *International Journal of Public Leadership, 21*(4), 356–375.

Bass, B. M., & Avolio, B. J. (1994). *Improving organizational effectiveness through transformational leadership*. Sage.

Becker, H. J. (2000). Findings from the Teaching, Learning, and Computing Survey. *Education Policy Analysis Archives, 8*, Article 51. https://doi.org/10.14507/epaa.v8n51.2000

Byungura, J. C. (2019). *Improving IT integration for higher education institutional performance: Towards a contextualised IT-institutional alignment model* (Doctoral dissertation, Stockholm University).

Davis, F. D. (1989). Technology acceptance model: TAM. In M. N. Al-Suqri & A. S. Al-Aufi (Eds.), *Information seeking behavior and technology adoption* (pp. 205–219). https://quod.lib.umich.edu/b/busadwp/images/b/1/4/b1409190.0001.001.pdf

Dexter, S., & Richardson, J. W. (2020). What does technology integration research tell us about the leadership of technology? *Journal of Research on Technology in Education, 52*(1), 17–36. https://doi.org/10.1080/15391523.2019.1668316

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64*, 175–182. https://doi.org/10.1016/j.compedu.2012.10.008

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423–435. https://doi.org/10.1016/j.compedu.2012.02.001

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). An introduction to structural equation modeling. In *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook* (pp. 1–29). Springer. https://doi.org/10.1007/978-3-030-80519-7_1

Howard, J. L., Bureau, J. S., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student motivation and associated outcomes: A meta-analysis from self-determination theory. *Perspectives on Psychological Science, 16*(6), 1300–1323. https://doi.org/10.1177/1745691620966789

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K–12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137–154. https://doi.org/10.1007/s11423-009-9132-y

Jadhav, P., Gaikwad, H., & Patil, K. (2022). Teaching and learning with technology: Effectiveness of ICT integration in schools. *ASEAN Journal for Science Education, 1*(1), 33–40. http://ejournal.bumipublikasinusantara.id/index.php/ajsed/article/view/33

Karakis, Ö. (2022). Factors affecting the behaviors of teachers towards technology integration teaching via distance education during COVID-19 pandemic: A path analysis. *International Journal of Curriculum and Instruction, 14*(1), 814–843.

Karwan, D. H., Hariri, H., & Ridwan, R. (2021). Visionary leadership: What, why, and how.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607–610. https://doi.org/10.1177/001316447003000308

Leithwood, K., & Jantzi, D. (2000). The effects of transformational leadership on organizational conditions and student engagement with school. *Journal of Educational Administration, 38*(2), 112–129. https://doi.org/10.1108/09578230010320064

Leithwood, K., & Sun, J. (2018). Academic culture: A promising mediator of school leaders' influence on student learning. *Journal of Educational Administration, 56*(3), 350–363. https://doi.org/10.1108/JEA-01-2017-0009

Liang, W. (2021). University teachers' technology integration in teaching English as a foreign language: Evidence from a case study in mainland China. *SN Social Sciences, 1*(8), Article 219. https://doi.org/10.1007/s43545-021-00223-5

Lu, H.-P., & Wang, J.-C. (2023). Exploring the effects of sudden institutional coercive pressure on digital transformation in colleges from teachers' perspective. *Education and Information Technologies, 28*(12), 15991–16015. https://doi.org/10.1007/s10639-023-11781-x

Mabrouk, S. H. (2025). *Integrating educational technology and pedagogical foundations to enhance university learning outcomes.*

Murillo-Jiménez, H., Centeno-Alarcón, M., Buele, J., & Yumbla, F. (2025). Analyzing barriers to the effective implementation of technological tools in inclusive education: A scoping review. *Frontiers in Education.* https://doi.org/10.3389/feduc.2025.1687664

Ndebele, C., & Mbodila, M. (2022). Examining technology acceptance in learning and teaching at a historically disadvantaged university in South Africa through the technology

acceptance model. *Education Sciences, 12*(1), Article 54. https://doi.org/10.3390/educsci12010054

Ng, W. (2015). *New digital technology in education*. Springer. https://doi.org/10.1007/978-3-319-05822-1

Njiku, J., Maniraho, J. F., & Mutarutinya, V. (2019). Understanding teachers' attitude towards computer technology integration in education: A review of literature. *Education and Information Technologies, 24*, 3041–3052. https://doi.org/10.1007/s10639-019-09917-z

Pettersson, F. (2021). Understanding digitalization and educational change in school by means of activity theory and the levels of learning concept. *Education and Information Technologies, 26*(1), 187–204. https://doi.org/10.1007/s10639-020-10239-8

Ranbir, D. (2024). Educational technology integration: Challenges and opportunities. *Innovative Research Thoughts, 10*(2), 75–79. https://doi.org/10.36676/irt.v10.i2.1406

Razak, N. A., Rasli, R. M., Subhan, S., Ahmad, N. A., & Malik, S. (2023). Systematic review on digital transformation among teachers in public schools. *International Journal of Evaluation and Research in Education, 12*(2), 1059–1078. https://doi.org/10.11591/ijere.v12i2.24498

Safidon, J. H. (2024). Educational technology integration: Challenges and opportunities. *Innovative Research Thoughts, 10*(2), 75–79. https://doi.org/10.36676/irt.v10.i2.1406

Schmitz, M.-L., Antonietti, C., Consoli, T., Cattaneo, A., Gonon, P., & Petko, D. (2023). Transformational leadership for technology integration in schools: Empowering teachers to use technology in a more demanding way. *Computers & Education, 204*, Article 104880. https://doi.org/10.1016/j.compedu.2023.104880

Shrestha, M. (2020). Transformational leadership and its dimensions: Contributions in organizational change among schools. *BSSS Journal of Management, 11*(10), 112–131. https://doi.org/10.51767/jm1107

Tanniru, M., & Peral, J. (2021). Digital leadership in education. https://doi.org/10.1108/978-1-83982-306-020211008

Vannatta, R., & Banister, S. (2009). Validating a measure of teacher technology integration. In *Society for Information Technology & Teacher Education International Conference Proceedings*. https://www.learntechlib.org/primary/p/30757/

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Wang, C. (2021). Analysis on the differences between private schools in China and in Western countries. In *Proceedings of the 4th International Conference on Humanities Education and Social Sciences (ICHESS 2021).* https://doi.org/10.2991/assehr.k.211220.090