

PAPER

Sustainable Digital Leadership and University Teachers' Sustainable Teaching Performance: The Mediating Role of Psychological Capital and Work Engagement

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Abstract

Digital transformation has reshaped higher education and increased the need for sustainable teaching performance. This study examines the relationship between digital leadership and university teachers' sustainable teaching performance and explores the mediating roles of psychological capital and work engagement. Based on data from 376 university teachers in China, structural equation modeling with bootstrap analysis was conducted to test the proposed serial mediation model. The results showed that digital leadership significantly enhanced sustainable teaching performance. Moreover, digital leadership positively influenced psychological capital, which further promoted work engagement and improved teaching performance. Psychological capital and work engagement both served as significant mediators, while their serial mediation effect was also supported. These findings highlight the importance of integrating organizational leadership, teachers' psychological resources, and professional engagement in promoting sustainable educational development. The study contributes to sustainable educational management by revealing the psychological and motivational mechanisms underlying the influence of digital leadership on teachers' long-term teaching practices.

Keywords: Digital leadership, Sustainable teaching performance, Psychological capital, Work engagement, Higher education

Introduction

The rapid digital transformation of higher education has reshaped the ways universities organize teaching, manage academic work, support teachers, and promote institutional development [17, 16]. In recent years, digital platforms, online learning systems, artificial intelligence tools, data-driven management, and blended teaching models have become increasingly embedded in higher education institutions. These changes have created new opportunities for improving teaching quality, but they have also placed greater demands on university teachers. Teachers are now expected not only to deliver knowledge effectively, but also to continuously update teaching methods, integrate digital technologies, support students' long-term development, and respond to changing educational environments. Under these conditions, sustainable teaching performance has become an important concern in educational management.

Sustainable teaching performance refers to teachers' capacity to maintain high-quality, adaptive, innovative, and long-term-oriented teaching practices [11, 6]. It goes beyond short-term teaching effectiveness and emphasizes continuous curriculum improvement, teaching innovation, digital adaptation, and student-centered development. From the perspective of sustainable educational management, universities need to build systems that allow teaching quality to improve continuously rather than depend only on temporary policy pressure or individual teacher effort. Therefore, identifying the organizational and psychological factors that support sustainable teaching performance is important for both educational theory and university management practice.

Digital leadership may be one of the key managerial factors influencing sustainable teaching performance. Digital leadership refers to leaders' ability to develop a clear digital vision, promote technology-supported innovation, provide digital resources, and guide organizational members through digital transformation. In higher education institutions, leaders play an important role in shaping teachers' attitudes toward digital change. When university leaders communicate clear digital goals, provide professional development opportunities, encourage experimentation, and create a supportive digital culture, teachers may become more willing to adopt new teaching methods and engage in continuous teaching improvement. In this sense, digital leadership is not merely a technical capability; it is also a strategic management capacity that connects institutional digital transformation with sustainable teaching development.

However, the influence of digital leadership on sustainable teaching performance may not be purely direct. Digital transformation often brings uncertainty, pressure, workload changes, and emotional challenges for teachers. Even when institutions provide digital tools and management support, teachers may not automatically transform these resources into sustainable teaching behavior. The effectiveness of digital leadership may depend on whether teachers develop sufficient psychological resources and professional motivation. Therefore, it is necessary to examine the internal mechanisms through which digital leadership influences sustainable teaching performance.

Psychological capital provides one possible explanatory mechanism [14, 13, 5]. Psychological capital refers to an individual's positive psychological state, usually consisting of self-efficacy, hope, resilience, and optimism [12]. In the context of higher education, teachers with higher psychological

capital are more confident in solving teaching problems, more hopeful about achieving teaching goals, more resilient when facing digital challenges, and more optimistic about educational change. Digital leadership may strengthen teachers' psychological capital by providing clear direction, institutional support, and encouragement during digital transformation. When teachers perceive that their leaders support digital innovation and provide necessary resources, they may develop stronger confidence and resilience in adapting to new teaching environments.

Work engagement may serve as another important mechanism. Work engagement refers to a positive work-related state characterized by vigor, dedication, and absorption [15]. Teachers with high work engagement are more energetic, enthusiastic, and deeply involved in their teaching work. In sustainable educational management, work engagement is important because sustainable teaching performance requires continuous effort, reflection, innovation, and commitment. Teachers who are psychologically confident and resilient may become more engaged in their teaching work, and this engagement may further promote sustainable teaching performance. Therefore, work engagement may explain how teachers' psychological resources are transformed into actual teaching outcomes.

Although previous studies have examined leadership, psychological capital, work engagement, and performance separately, several research gaps remain. First, existing research on digital leadership in higher education has often focused on technology adoption, digital competence, or institutional transformation, while its relationship with sustainable teaching performance has received less attention. Second, limited studies have explained how digital leadership influences teachers' sustainable performance through psychological and motivational pathways. Third, few studies have integrated psychological capital and work engagement into a serial mediation model in the context of sustainable educational management. Addressing these gaps can provide a more complete understanding of how digital leadership contributes to sustainable teaching development in universities.

To address these gaps, this study proposes and tests a serial mediation model linking digital leadership, psychological capital, work engagement, and sustainable teaching performance. Specifically, the study examines whether digital leadership directly predicts sustainable teaching performance and whether psychological capital and work engagement mediate this relationship. The proposed model suggests that digital leadership enhances teachers' psychological capital, which further promotes work engagement and ultimately improves sustainable teaching performance.

This study makes three main contributions. First, it extends digital leadership research by linking it to sustainable teaching performance in higher education. Second, it introduces psychological capital and work engagement as key mechanisms explaining how digital leadership influences teachers' sustainable teaching outcomes. Third, it contributes to sustainable educational management by showing that institutional digital transformation should not rely only on technology or policy, but should also support teachers' psychological resources and professional engagement.

Based on these considerations, the present study aims to answer the following research questions:

- (1) Does digital leadership significantly predict sustainable teaching performance among university teachers?
- (2) Does psychological capital mediate the relationship between digital leadership and sustainable teaching performance?
- (3) Does work engagement mediate the relationship between psychological capital and sustainable teaching performance?
- (4) Do psychological capital and work engagement play a serial mediating role between digital leadership and sustainable teaching performance?

By answering these questions, this study provides empirical evidence for understanding how digital leadership can promote sustainable teaching performance and offers practical implications for university leaders seeking to build more sustainable, adaptive, and teacher-supportive educational management systems.

Theoretical Framework and Hypotheses

Theoretical Framework

This study develops a theoretical framework to explain how digital leadership contributes to sustainable teaching performance in higher education institutions. The framework integrates digital leadership theory, psychological capital theory, work engagement theory, and sustainable educational management perspectives. In the context of higher education, digital leadership refers to leaders' ability to develop a clear digital vision, support technology integration, encourage digital innovation, and create an organizational environment that enables teachers to adapt to digital transformation. Sustainable teaching performance refers to teachers' continuous capacity to improve teaching quality, adopt innovative teaching methods, support students' long-term development, and maintain adaptive teaching practices in changing educational environments.

The theoretical logic of this study is built on three core assumptions. First, digital leadership provides strategic direction and organizational support for teachers during educational digital transformation. When leaders clearly communicate digital goals, provide technological resources, and encourage teaching innovation, teachers are more likely to improve their professional performance in a sustainable way. Second, digital leadership may strengthen teachers' psychological capital, including self-efficacy, hope, resilience, and optimism. These positive psychological resources help teachers cope with uncertainty, pressure, and technological challenges in higher education. Third, psychological capital may increase teachers' work engagement, which further promotes sustainable teaching performance. Teachers with stronger psychological resources are more likely to show vigor, dedication, and absorption in their teaching work.

Therefore, this study proposes a serial mediation model. Digital leadership is regarded as the antecedent variable, psychological capital and work engagement are regarded as mediating variables, and sustainable teaching performance is regarded as the outcome variable. The proposed model suggests that digital leadership influences sustainable teaching performance both directly and indirectly through the psychological and motivational mechanisms of psychological capital and work engagement.

Digital Leadership and Sustainable Teaching Performance

Digital leadership has become increasingly important in higher education because universities are facing rapid technological change, digital transformation, and growing expectations for sustainable educational development. Unlike traditional leadership, digital leadership emphasizes the use of digital technologies, digital communication, innovation-oriented management, and strategic adaptation in technology-rich environments. Leaders with strong digital leadership can provide teachers with clear digital goals, encourage experimentation with digital tools, and create supportive conditions for teaching innovation.

Sustainable teaching performance requires more than routine teaching effectiveness. It involves teachers' continuous improvement of teaching methods, long-term curriculum development, integration of digital resources, and capacity to respond to students' changing learning needs. Digital leadership can enhance sustainable teaching performance by reducing uncertainty, improving teachers' access to digital resources, and promoting a culture of innovation. When teachers perceive that institutional leaders support digital transformation, they are more likely to engage in innovative teaching practices and continuously improve their teaching quality.

Thus, digital leadership can be understood as an important managerial factor that supports sustainable educational performance. It provides the organizational direction and resource support necessary for teachers to develop sustainable teaching practices.

H1: Digital leadership positively predicts sustainable teaching performance.

Digital Leadership and Psychological Capital

Psychological capital refers to an individual's positive psychological state of development, commonly represented by four dimensions: self-efficacy, hope, resilience, and optimism. In higher education, teachers with high psychological capital are more confident in solving teaching problems, more hopeful about achieving professional goals, more resilient when facing setbacks, and more optimistic about educational change.

Digital transformation may create pressure for teachers, especially when they need to use new technologies, redesign teaching activities, or adapt to online and blended learning environments. Under such circumstances, digital leadership can play an important role in developing teachers' psychological capital. Leaders who provide clear digital guidance and technical support can enhance teachers' confidence in using digital tools. Leaders who encourage innovation and tolerate temporary failure can strengthen teachers' resilience. In addition, a positive digital vision can help teachers develop hope and optimism toward educational change.

Therefore, digital leadership is not only a structural or technological support factor but also a psychological resource-building factor. By creating a supportive digital environment, leaders may help teachers develop stronger psychological resources for sustainable professional development.

H2: Digital leadership positively predicts psychological capital.

Psychological Capital and Work Engagement

Work engagement refers to a positive and fulfilling work-related state characterized by vigor, dedication, and absorption. Vigor reflects high levels of energy and persistence at work. Dedication refers to a strong sense of enthusiasm, significance, and pride. Absorption reflects deep concentration and involvement in work.

Psychological capital can be an important antecedent of work engagement. Teachers with high self-efficacy are more likely to believe that they can successfully complete teaching tasks and solve instructional problems. Teachers with hope are more likely to set professional goals and identify pathways to achieve them. Resilient teachers are better able to recover from difficulties in teaching and digital transformation. Optimistic teachers tend to interpret challenges as opportunities for growth rather than threats. These psychological resources can increase teachers' willingness to invest energy and attention in their teaching work.

In higher education, work engagement is especially important because teaching innovation and sustainable performance require continuous motivation. If teachers lack psychological resources, they may experience fatigue, resistance, or low participation during digital transformation. In contrast, teachers with strong psychological capital are more likely to remain engaged and proactive in their teaching roles.

H3: Psychological capital positively predicts work engagement.

Work Engagement and Sustainable Teaching Performance

Work engagement is closely related to teachers' teaching performance. Highly engaged teachers are more energetic, dedicated, and focused on their teaching activities. They are more likely to prepare lessons carefully, interact actively with students, improve course design, and adopt innovative teaching methods. These behaviors are essential for sustainable teaching performance.

Sustainable teaching performance emphasizes continuous improvement rather than short-term teaching achievement. Teachers who are highly engaged tend to invest more time and effort in long-term curriculum development, teaching reflection, and student-centered learning. They are also more likely to integrate digital technologies meaningfully rather than use them superficially. Therefore, work engagement serves as a behavioral mechanism through which teachers transform psychological resources into sustainable professional outcomes.

In this sense, work engagement can be regarded as a bridge between internal motivation and external teaching performance. When teachers are more engaged, they are more likely to demonstrate sustainable teaching

behaviors that contribute to the long-term development of students and institutions.

H4: Work engagement positively predicts sustainable teaching performance.

The Mediating Role of Psychological Capital

Digital leadership may influence sustainable teaching performance through psychological capital. Although digital leadership can directly improve teaching conditions, its effect on teaching performance may also depend on whether teachers develop sufficient psychological resources. Teachers who perceive stronger digital leadership may feel more confident, hopeful, resilient, and optimistic about digital transformation and teaching innovation. These psychological resources may then encourage them to improve teaching practices and maintain sustainable performance.

Psychological capital is especially important in sustainable educational management because long-term teaching improvement requires more than external resources. Teachers need internal psychological strength to deal with pressure, uncertainty, and continuous change. Digital leadership may provide the conditions for such psychological development. Therefore, psychological capital may explain how leadership support is transformed into sustainable teaching outcomes.

H5: Psychological capital mediates the relationship between digital leadership and sustainable teaching performance.

The Mediating Role of Work Engagement

Work engagement may also mediate the relationship between psychological capital and sustainable teaching performance. Psychological capital provides teachers with positive internal resources, but these resources need to be translated into active work behavior. Work engagement represents this process of behavioral activation. Teachers with stronger psychological capital are more likely to become engaged in their teaching work, and engaged teachers are more likely to demonstrate sustainable teaching performance.

This mediating mechanism is important because psychological resources alone may not automatically lead to performance improvement. Only when teachers invest energy, dedication, and attention in their work can these psychological resources be transformed into actual teaching outcomes. Therefore, work engagement can explain how psychological capital contributes to sustainable teaching performance.

H6: Work engagement mediates the relationship between psychological capital and sustainable teaching performance.

The Serial Mediating Role of Psychological Capital and Work Engagement

This study further proposes a serial mediation mechanism among digital leadership, psychological capital, work engagement, and sustainable teaching performance. Digital leadership may first strengthen teachers' psychological capital by providing digital vision, support, and encouragement. Psychological capital may then enhance teachers' work engagement by increasing their confidence, resilience, hope, and optimism. Finally, work engagement may promote sustainable teaching performance by encouraging teachers to continuously improve their teaching practices.

This serial mediation model provides a more complete explanation of the relationship between digital leadership and sustainable teaching performance. It suggests that digital leadership influences sustainable teaching performance not only through direct management practices but also through a chain of psychological and behavioral mechanisms. In other words, digital leadership builds teachers' psychological resources, psychological resources stimulate work engagement, and work engagement leads to sustainable teaching outcomes.

Such a model is particularly suitable for sustainable educational management because it highlights both institutional leadership and teacher agency. Sustainable transformation in higher education depends not only on

leaders' digital strategies but also on teachers' psychological readiness and active professional participation.

H7: Psychological capital and work engagement serially mediate the relationship between digital leadership and sustainable teaching performance.

Methodology

Research Design

This study adopted a quantitative cross-sectional research design to examine the structural relationships among digital leadership, psychological capital, work engagement, and sustainable teaching performance in higher education institutions. Structural equation modeling (SEM) was employed to test both direct and indirect effects, following the approach recommended for complex mediation models [10]. A bootstrap method with 5,000 resamples was used to examine the significance of mediating effects.

Participants and Sampling

The sample consisted of university teachers from higher education institutions in China. A stratified convenience sampling method was used to ensure variation in institutional types (e.g., public universities, applied universities, and research-oriented institutions).

A total of 412 questionnaires were distributed, and 376 valid responses were retained after data screening, yielding a valid response rate of 91.3%. Participants included both male and female faculty members across different academic ranks (lecturer, associate professor, and professor). The average teaching experience was 8.72 years ($SD = 5.34$).

Participation was voluntary, and informed consent was obtained from all respondents. Ethical principles followed the Declaration of Helsinki (World Medical Association, 2013).

Measures

All constructs were measured using previously validated Likert-scale instruments (1 = strongly disagree to 5 = strongly agree). All scales were adapted to the context of higher education teaching and were reviewed by three experts in educational management to ensure content validity.

Digital Leadership

Digital leadership was measured using a modified version of the E-leadership scale developed by [3]. The scale includes four dimensions: digital vision, digital communication, technology integration support, and innovation encouragement. The instrument consists of 12 items (e.g., "My institution's leadership effectively promotes digital transformation in teaching and learning").

In this study, Cronbach's alpha was 0.91, indicating high internal consistency.

Psychological Capital

Psychological capital was measured using the Psychological Capital Questionnaire (PCQ-24) developed by [12]. The scale assesses four dimensions: self-efficacy, hope, resilience, and optimism.

Example item: "I feel confident in my ability to handle difficult teaching problems."

Cronbach's alpha for this study was 0.93.

Work Engagement

Work engagement was assessed using the Utrecht Work Engagement Scale (UWES-9) developed by [15]. The scale includes three dimensions: vigor, dedication, and absorption.

Example item: "I am enthusiastic about my teaching work."

Cronbach's alpha was 0.92 in this study.

Sustainable Teaching Performance

Sustainable teaching performance was measured using a modified teaching performance scale based on B[4] and [9], adapted for sustainability-oriented teaching contexts. The scale includes three dimensions: teaching effectiveness, innovation in teaching, and long-term curriculum development.

Example item: "I continuously improve my teaching methods to ensure long-term student development."

Cronbach's alpha was 0.90.

Data Collection Procedure

Data were collected through an online questionnaire platform. The survey link was distributed via institutional email systems and academic networks. Respondents were informed about the purpose of the study, confidentiality of responses, and their right to withdraw at any time.

Data collection lasted approximately four weeks. To reduce common method bias, procedural remedies were applied, including anonymity assurance and item randomization.

Data Analysis

Data analysis was conducted in three stages. First, SPSS 26.0 was used for descriptive statistics, reliability analysis (Cronbach's alpha), and Pearson correlation analysis.

Second, confirmatory factor analysis (CFA) was conducted using AMOS 24.0 to evaluate construct validity. Model fit was assessed using multiple indices, including the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and χ^2/df .

Third, structural equation modeling (SEM) was used to test hypothesized relationships among variables. Mediation effects were examined using a bootstrap procedure with 5,000 resamples and 95% confidence intervals [7]. Model fit criteria followed established thresholds: $CFI > 0.90$, $TLI > 0.90$, $RMSEA < 0.08$, and $\chi^2/df < 5$ [10].

Results

Descriptive Statistics and Correlations

Table 1 presents the means, standard deviations, Cronbach's alpha coefficients, and Pearson correlation coefficients for the main study variables. The results showed that digital leadership was positively correlated with psychological capital, work engagement, and sustainable teaching performance. Psychological capital was also positively associated with work engagement and sustainable teaching performance. In addition, work engagement showed a significant positive correlation with sustainable teaching performance.

The reliability coefficients of all constructs ranged from 0.88 to 0.94, exceeding the recommended threshold of 0.70, indicating acceptable internal consistency. Overall, the correlation results provided preliminary support for the hypothesized relationships among digital leadership, psychological capital, work engagement, and sustainable teaching performance.

Measurement Model

Confirmatory factor analysis was conducted to examine the validity of the four-factor measurement model, including digital leadership, psychological capital, work engagement, and sustainable teaching performance. The results indicated that the four-factor model showed an acceptable fit to the data: $\chi^2/df = 2.41$, $CFI = 0.943$, $TLI = 0.936$, $IFI = 0.944$, $RMSEA = 0.061$, and $SRMR = 0.048$.

All standardized factor loadings were significant and ranged from 0.71 to 0.89, exceeding the recommended threshold of 0.50. The composite reliability values ranged from 0.88 to 0.94, and the average variance extracted values ranged from 0.56 to 0.68. These results indicated that the measurement model had acceptable convergent validity.

Table 1. descriptive Statistics, Reliability, and Correlations among Variables

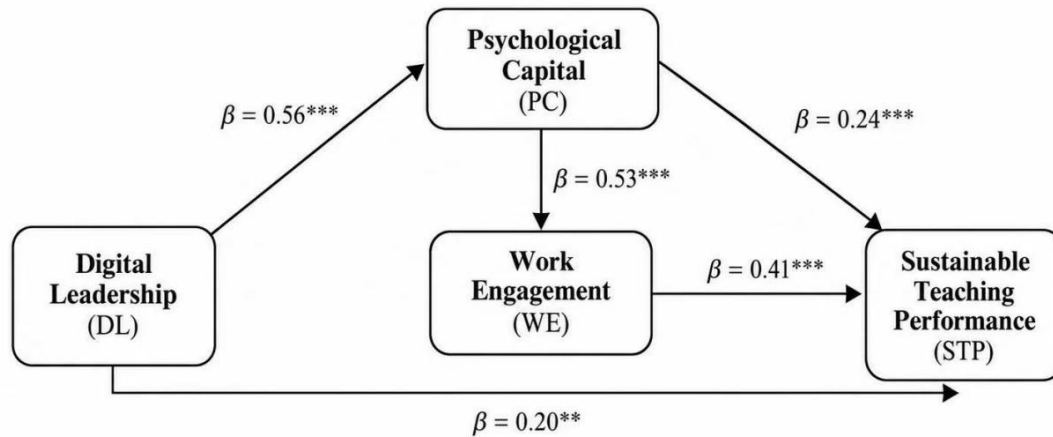
Variable	Mean	SD	Cronbach's α	1	2	3	4
1. Digital leadership	3.82	0.71	0.91	1			
2. Psychological capital	3.76	0.68	0.94	0.56***	1		
3. Work engagement	3.69	0.73	0.92	0.49***	0.61***	1	
4. Sustainable teaching performance	3.88	0.66	0.9	0.52***	0.58***	0.64***	1

Note. N = 376. ***p < .001.

Table 2. onfirmatory Factor Analysis Results

Construct	Number of items	Factor loading range	CR	AVE
Digital leadership	12	0.72–0.88	0.91	0.57
Psychological capital	24	0.71–0.89	0.94	0.6
Work engagement	9	0.75–0.88	0.92	0.66
Sustainable teaching performance	12	0.73–0.87	0.9	0.56

Note. CR = composite reliability; AVE = average variance extracted.



Note. DL = digital leadership; PC = psychological capital; WE = work engagement; STP = sustainable teaching performance. Model fit: $\chi^2/df = 2.53$, CFI = 0.936, TLI = 0.928, IFI = 0.937, RMSEA = 0.064, SRMR = 0.052. **p < .01, ***p < .001.

Fig. 1. tructural equation modeling results.

To further assess discriminant validity, the square root of AVE for each construct was compared with its correlations with other constructs. The square root values of AVE were greater than the inter-construct correlations, suggesting acceptable discriminant validity.

Structural Equation Modeling Results

Structural equation modeling was used to test the hypothesized relationships among digital leadership, psychological capital, work engagement, and sustainable teaching performance. The structural model demonstrated an acceptable fit: $\chi^2/df = 2.53$, CFI = 0.936, TLI = 0.928, IFI = 0.937, RMSEA = 0.064, and SRMR = 0.052. The standardized path coefficients are presented in Figure 2.

The path analysis results showed that digital leadership had a significant positive effect on psychological capital ($\beta = 0.56$, $p < .001$), supporting H2. Psychological capital had a significant positive effect on work engagement ($\beta = 0.53$, $p < .001$), supporting H3. Work engagement significantly predicted sustainable teaching performance ($\beta = 0.41$, $p < .001$), supporting H4.

Digital leadership also had a significant direct effect on sustainable teaching performance ($\beta = 0.20$, $p < .01$), supporting H1. In addition, psychological capital positively predicted sustainable teaching performance ($\beta = 0.24$, $p < .001$), indicating that university teachers with higher levels of confidence, hope, resilience, and optimism tended to report stronger sustainable teaching performance.

These findings suggested that digital leadership not only directly contributed to sustainable teaching performance but also indirectly influenced teachers' performance through psychological and motivational mechanisms.

Mediation Analysis

A bootstrap procedure with 5,000 resamples was conducted to examine the mediating effects of psychological capital and work engagement. The results are presented in Table 4. The indirect effect of digital leadership on sustainable teaching performance through psychological capital was significant ($\beta = 0.134$, 95% CI [0.072, 0.213]), supporting H5.

Table 3. tructural Path Results

Hypothesis	Path	β	SE	t-value	Result
H1	Digital leadership → Sustainable teaching performance	0.20**	0.07	2.86	Supported
H2	Digital leadership → Psychological capital	0.56***	0.05	11.2	Supported
H3	Psychological capital → Work engagement	0.53***	0.06	8.83	Supported
H4	Work engagement → Sustainable teaching performance	0.41***	0.07	5.86	Supported
—	Psychological capital → Sustainable teaching performance	0.24***	0.06	4	Supported

Note. **p < .01. ***p < .001.

Table 4. ootstrap Mediation Effects

Effect type	Path	β	95% CI Lower	95% CI Upper	Result
Direct effect	Digital leadership → Sustainable teaching performance	0.2	0.061	0.337	Significant
Indirect effect	Digital leadership → Psychological capital → Sustainable teaching performance	0.134	0.072	0.213	Significant
Indirect effect	Digital leadership → Work engagement → Sustainable teaching performance	0.087	0.034	0.158	Significant
Serial indirect effect	Digital leadership → Psychological capital → Work engagement → Sustainable teaching performance	0.122	0.067	0.194	Significant
Total indirect effect	Digital leadership → Mediators → Sustainable teaching performance	0.343	0.231	0.472	Significant
Total effect	Digital leadership → Sustainable teaching performance	0.543	0.421	0.661	Significant

Note. Bootstrap samples = 5,000. CI = confidence interval.

Table 5. ummary of Hypothesis Testing

Hypothesis	Statement	Result
H1	Digital leadership positively predicts sustainable teaching performance.	Supported
H2	Digital leadership positively predicts psychological capital.	Supported
H3	Psychological capital positively predicts work engagement.	Supported
H4	Work engagement positively predicts sustainable teaching performance.	Supported
H5	Psychological capital mediates the relationship between digital leadership and sustainable teaching performance.	Supported
H6	Work engagement mediates the relationship between psychological capital and sustainable teaching performance.	Supported
H7	Psychological capital and work engagement serially mediate the relationship between digital leadership and sustainable teaching performance.	Supported

The indirect effect of psychological capital on sustainable teaching performance through work engagement was also significant ($\beta = 0.217$, 95% CI [0.128, 0.326]), supporting H6.

More importantly, the serial mediation effect of digital leadership on sustainable teaching performance through psychological capital and work engagement was significant ($\beta = 0.122$, 95% CI [0.067, 0.194]), supporting H7. Since the confidence interval did not include zero, the serial mediation pathway was statistically significant.

The mediation results indicated that psychological capital and work engagement served as important mechanisms linking digital leadership and sustainable teaching performance. Specifically, digital leadership enhanced teachers' psychological capital, which further increased their work engagement and ultimately improved sustainable teaching performance.

Summary of Hypothesis Testing

The results of hypothesis testing are summarized in Table 5. All seven hypotheses were supported. Digital leadership directly predicted sustainable teaching performance and indirectly influenced it through psychological capital and work engagement. The serial mediation pathway was also significant, suggesting that leadership-driven digital transformation may promote sustainable educational outcomes by strengthening teachers' psychological resources and professional engagement.

Discussion

This study aimed to examine how digital leadership contributes to sustainable teaching performance in higher education institutions. Specifically, it investigated the mediating roles of psychological capital and work

engagement in the relationship between digital leadership and sustainable teaching performance. The results showed that digital leadership had a significant positive effect on sustainable teaching performance. In addition, digital leadership significantly predicted teachers' psychological capital, psychological capital significantly predicted work engagement, and work engagement further enhanced sustainable teaching performance. The bootstrap mediation analysis also confirmed that psychological capital and work engagement played both independent and serial mediating roles in this relationship. These findings suggest that digital leadership improves sustainable teaching performance not only through direct managerial support but also through psychological and motivational mechanisms.

Digital Leadership and Sustainable Teaching Performance

The findings indicate that digital leadership positively predicts sustainable teaching performance among university teachers. This result suggests that when institutional leaders provide a clear digital vision, encourage technology-supported innovation, and create a supportive environment for digital transformation, teachers are more likely to improve their teaching practices in a sustainable manner. In higher education, sustainable teaching performance does not only refer to short-term teaching effectiveness. It also includes teachers' ability to continuously update teaching methods, integrate digital tools, support students' long-term development, and adapt to changing educational environments.

This finding is consistent with the concept of e-leadership, which emphasizes that leaders can influence organizational members through digital communication, technology-mediated support, and strategic digital transformation [3]. In the context of higher education, digital leadership may reduce teachers' uncertainty during digital transformation by providing clear

direction, professional development opportunities, and institutional support. As a result, teachers may become more willing to engage in innovative teaching and sustainable curriculum development.

From a sustainable management perspective, this finding highlights that digital leadership should not be understood merely as the use of technology in management. Rather, it should be viewed as a strategic leadership capability that helps educational institutions build long-term resilience, teaching innovation, and adaptive capacity. Therefore, sustainable educational management requires leaders who can connect digital transformation with teaching quality, teacher development, and institutional sustainability.

Digital Leadership and Psychological Capital

The results also show that digital leadership has a significant positive effect on psychological capital. This means that teachers who perceive stronger digital leadership tend to report higher levels of self-efficacy, hope, resilience, and optimism. This finding is theoretically meaningful because digital transformation in higher education often brings uncertainty, workload pressure, and changes in teaching routines. Under such conditions, teachers need positive psychological resources to cope with new demands.

According to psychological capital theory, self-efficacy, hope, resilience, and optimism are important positive psychological resources that help individuals deal with challenges and pursue work-related goals [12]. Digital leadership may strengthen these resources in several ways. First, a clear digital vision can enhance teachers' confidence in institutional transformation. Second, technical and professional support can improve teachers' self-efficacy in using digital tools. Third, encouragement from leaders can help teachers remain optimistic when facing technological difficulties. Finally, a supportive digital culture may improve teachers' resilience when they encounter setbacks in digital teaching.

This result suggests that leadership is not only an external management factor but also an important source of psychological resource development. In other words, effective digital leadership can transform institutional digital strategies into teachers' internal psychological readiness. This is especially important in sustainable educational management because teachers' psychological resources determine whether digital transformation can be maintained over time.

Psychological Capital and Work Engagement

The findings further reveal that psychological capital positively predicts work engagement. Teachers with higher psychological capital are more likely to show vigor, dedication, and absorption in their teaching work. This result is consistent with the view that positive psychological resources can promote stronger motivation and deeper work involvement.

Teachers with high self-efficacy are more confident in solving teaching problems and using innovative methods. Teachers with hope are more likely to set teaching goals and identify alternative pathways to achieve them. Resilient teachers can recover more quickly from difficulties, such as failed digital teaching attempts or student disengagement. Optimistic teachers are more likely to interpret educational change as an opportunity rather than a threat. Together, these psychological resources can increase teachers' willingness to invest energy and attention in teaching.

This finding is also consistent with the Conservation of Resources theory, which argues that individuals with more psychological resources are more capable of investing themselves in work and generating further positive outcomes [8]. In the context of higher education, psychological capital can be understood as a key internal resource that helps teachers maintain engagement during digital and organizational change.

Work Engagement and Sustainable Teaching Performance

The results demonstrate that work engagement significantly predicts sustainable teaching performance. This finding indicates that teachers who are more energetic, dedicated, and absorbed in their work are more likely to show

better teaching effectiveness, teaching innovation, and long-term curriculum development.

Work engagement is an important motivational state that connects teachers' internal psychological resources with actual teaching behavior. When teachers are highly engaged, they are more likely to invest time in improving course design, adopting digital tools, responding to student needs, and reflecting on teaching outcomes. These behaviors are central to sustainable teaching performance because they support continuous improvement rather than one-time teaching achievement.

This result also suggests that sustainable teaching performance depends not only on institutional policies or digital infrastructure but also on teachers' active participation. Even when universities provide digital platforms and management support, sustainable teaching improvement may not occur unless teachers are genuinely engaged in their work. Therefore, work engagement functions as an important behavioral pathway through which leadership and psychological resources are translated into sustainable educational outcomes.

The Mediating Role of Psychological Capital and Work Engagement

One of the most important findings of this study is that psychological capital and work engagement mediate the relationship between digital leadership and sustainable teaching performance. The serial mediation result shows that digital leadership first enhances teachers' psychological capital, which then strengthens their work engagement and ultimately improves sustainable teaching performance.

This finding provides a deeper explanation of how digital leadership works in higher education management. Digital leadership does not automatically produce sustainable teaching performance. Instead, its influence depends on whether teachers develop sufficient psychological resources and whether these resources are transformed into active work engagement. In this sense, psychological capital represents the "resource-building mechanism," while work engagement represents the "behavioral activation mechanism."

This mechanism is important for sustainable management research. Many studies on digital leadership focus mainly on organizational strategy, digital tools, or performance outcomes. However, the present model suggests that teachers' psychological and motivational processes are essential for understanding sustainable educational change. Digital leadership can provide direction and support, but teachers' psychological capital and engagement determine whether this support becomes sustainable teaching behavior.

Therefore, this study extends the understanding of digital leadership by showing that its effect on sustainable teaching performance is both direct and indirect. It also provides empirical support for integrating leadership theory, psychological capital theory, and work engagement theory in the context of sustainable higher education management.

Theoretical Contributions

This study makes several theoretical contributions. First, it extends digital leadership research into the field of sustainable educational management. Previous research has often discussed digital leadership in relation to technology adoption, online teaching, or organizational change. This study connects digital leadership with sustainable teaching performance, thereby highlighting its long-term value for educational sustainability.

Second, this study introduces psychological capital as a key psychological mechanism linking digital leadership and teaching performance. This contributes to the literature by showing that digital leadership influences not only external teaching conditions but also teachers' internal psychological resources.

Third, this study identifies work engagement as a behavioral mechanism through which psychological capital is translated into sustainable teaching performance. This helps explain why some teachers are able to transform institutional support into continuous teaching improvement, while others may not.

Fourth, by testing a serial mediation model, this study provides a more integrated explanation of sustainable teaching performance. The model shows that sustainable teaching outcomes are shaped by a chain of leadership support, psychological resources, motivational engagement, and professional behavior.

Practical Implications

The findings offer several practical implications for university managers and educational leaders.

First, universities should strengthen digital leadership capacity among administrators and department leaders. Leaders need to provide a clear digital vision, communicate digital strategies effectively, and create supportive conditions for teachers to experiment with new teaching methods.

Second, institutions should pay attention to teachers' psychological capital during digital transformation. Professional development programs should not only teach technical skills but also enhance teachers' confidence, resilience, hope, and optimism. For example, universities can provide mentoring, peer support, digital teaching workshops, and recognition systems for innovative teaching practices.

Third, higher education institutions should improve teachers' work engagement by reducing unnecessary administrative burdens and creating a more supportive teaching environment. Sustainable teaching performance requires teachers to have sufficient time, energy, and motivation to improve teaching quality continuously.

Fourth, digital transformation should be integrated with sustainable development goals in education. Universities should avoid treating digitalization as a short-term technical project. Instead, digital leadership should be connected with long-term curriculum innovation, teacher development, student learning quality, and institutional resilience.

Limitations and Future Research

Although this study provides useful insights, several limitations should be acknowledged.

First, this study used a cross-sectional design, which limits the ability to make strong causal claims. Future studies could adopt longitudinal designs to examine how digital leadership, psychological capital, work engagement, and sustainable teaching performance change over time.

Second, the data were collected through self-reported questionnaires. Although anonymity and procedural controls were used to reduce common method bias, future research could include multiple data sources, such as student evaluations, peer observations, teaching portfolios, or institutional performance records.

Third, the sample was limited to university teachers in China. Future studies could examine whether the model applies to other educational levels, such as primary schools, secondary schools, vocational colleges, or international higher education contexts.

Fourth, this study focused on psychological capital and work engagement as mediators. Future research could include other potential mechanisms, such as digital competence, organizational trust, teacher well-being, innovation climate, or perceived organizational support. In addition, future studies may test moderating variables, such as institutional type, leadership style, teacher age, academic rank, or digital teaching experience.

Conclusion

This study demonstrates that digital leadership is an important driver of sustainable teaching performance in higher education. The findings show that digital leadership directly improves sustainable teaching performance and indirectly influences it through psychological capital and work engagement. Specifically, digital leadership strengthens teachers' positive psychological resources, which further enhance their work engagement and ultimately promote sustainable teaching practices.

Overall, the study suggests that sustainable educational management should not focus only on technology, policy, or institutional infrastructure. It should also emphasize teachers' psychological resources and professional engagement. By developing digital leadership, supporting teacher psychological capital, and promoting work engagement, higher education institutions can build a more sustainable and adaptive teaching system.

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