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Transformational Leadership and Digital Pedagogical Innovation: Mediating Role of Teachers' Professional Development

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Abstract: *This research examines the impact of transformational leadership on digital pedagogical innovation and the role played by teachers in that process through professional development during the university level in Pakistan. In order to gather the data a structured questionnaire based on validated scales was implemented, with a quantitative research design, 300 teachers of the university. The hypothesized relationships were tested by means of correlation and regression analyses, and structural equation modeling. The results revealed that transformational leadership had a significant positive impact on teachers' professional growth and digital pedagogical practice. Also, teachers' professional development was a partial mediator of the relationship between transformational leadership and innovations. The findings emphasize the necessity of visionary leadership and teacher development for the adoption of teaching practices that incorporate technology. This study provides possible effects on the policy and institutional leaders when they are striving to leverage digital changes by developing leadership and faculty capacity.*

Introduction

Digital pedagogical practices are seen as a great opportunity and even a necessity in the constantly changing world of higher education today. In the digital age, it is necessary for higher education institutions to utilize technology, encourage innovation and react to the changing needs of learners in instruction. Transformational leadership, which includes vision-setting, inspiring followers, intellectual stimulation and individualized consideration, has been recognized as a significant factor in facilitating such pedagogical innovation (Burns, 1978; cited in recent literature on digital transformation). But although transformational leadership provides the basis for change, the extent and effectiveness of creating digital pedagogical innovation depends largely on teacher professional development as a critical mediating mechanism.

A few recent Pakistani high educations studies have started to look into similar dynamics. For instance, research on digital transformation and student learning outcomes has identified teacher resilience as a mediator of how digital change influences teach (Abid et al., 2024). Meanwhile, in the international

literature it is indicated that leadership behaviors (whether authentic or transformational) positively affect digital capabilities, readiness and productivity of educators (Crawford et al., 2025). However, there are several gaps remaining: the empirical studies that specifically associate digital pedagogical innovation with transformational leadership have been scarce in Pakistan; professional development as mediator factor of this association has not been fully explored, and contextual factors (institutional support, resource constraints) were rarely included in the model.

The aim of this study is thus to remedy these gaps by studying the influence of transformational leadership going on digital pedagogical innovations in higher education, teachers' skill development as a mediator. The intent is to determine if transformational leadership directly affects digital teaching practices, and if so, the extent to which this effect is transmitted through increased teacher competencies by professional development programs. The findings of this study may support educational leaders and policy makers in conceptualizing types of leadership and training that can capture the potential afforded through digital innovation within universities.

Review of Literature

Transformational Leadership (TL) and Innovation in Education

Transformational leadership which includes idealized influence, inspiration, individualized attention and intellectual motivation has long been associated with organizational change and innovations (Burns, 1978; Bass & Avolio, 1994). In higher education, TL is linked to the development of a culture that promotes experimentation, risk-taking and ongoing improvement to enable innovative teaching and learning (Saif, 2024). Recent reviews suggest that transformational leaders are especially needed in periods of technological change so that they can communicate a strong digital vision and encourage staff to commit to new pedagogies (Obied, 2025). Across contexts, empirical research has found positive relationships between TL and faculty outcomes including innovative work behavior (Joo & Park, 2010), organizational citizenship (Joo et al., 2018) and openness to new practice that underpin pedagogical innovation.

Digital Pedagogical Innovation: Definitions and Drivers

Digital pedagogical innovation. These include new preparedness, designs for teaching and assessment exploiting digital affordances or enhanced by digital technologies (Yetti, 2024; Bitar, 2024). It encompasses blended learning environments, adaptive technologies, social online activities, micro learning and the use of analytics to support instruction. Researchers emphasize that digital pedagogy is not a simple use of technology, but an attempt to change the aims of educational activity, teacher–pupil relationships and assessment forms (Brookings, 2019; Flores-Chacón et al., 2023). Factors for promoting digital pedagogical innovation are institution strategy and leadership, ICT knowledge-proficiency of teachers, infrastructure access, and supportive professional development that develops not only technical capacity but also the pedagogical capability.

Teachers' Professional Development as a Mechanism for Change

The professional development of teachers (TPD) is acknowledged at large as an important lever to move leadership intentions into action in the classroom. Effective TPD for digital pedagogy focuses on ongoing, experience-based, learning with practice-support in communities of practice, mentoring and job-embedded coaching instead of one-size-fits-all workshops (Flores-Chacón et al., 2023; Yulin & Danquah, 2025). TPD develops teacher self-efficacy, pedagogical content knowledge and the disposition to innovate all of which are prerequisites for engaging with digital innovations. A number of empirical studies suggest that leadership impacts TPD provision (see the allocation of time, resources and incentives) and when TPD is congruent with the institutional vision teachers are more likely to carry out

innovative practices. This congruence indicates that TPD possibly mediates between leadership and pedagogical innovation.

Empirical Evidence of Mediation: Leadership → TPD → Innovation

An increasing number of quantitative and mixed methodology studies include TPD (or derived concepts such as teacher self-efficacy, knowledge management, or professional learning communities) as mediator between leadership and innovative outcomes. For example, studies from teacher education settings have shown that knowledge management and teachers' collaborative professional learning accounted significantly for the relationship between transformational leadership and instructional innovation (ResearchGate; Malaysia study). The support of leadership for professional development had significant positive influences on relationship between LMX and teachers' digital capabilities, as well as online teaching effect after both during and post COVID-19 outbreak (Yulin, 2025; Witthöft, 2024). These results offer a theoretical and evidential basis for W_1M to be tested in higher education.

Contextualizing the Problem in Pakistan and Similar Settings

An increasing number of quantitative and mixed methodology studies include TPD (or derived concepts such as teacher self-efficacy, knowledge management, or professional learning communities) as mediator between leadership and innovative outcomes. For example, studies from teacher education settings have shown that knowledge management and teachers' collaborative professional learning accounted significantly for relationship between the transformational leadership and instructional innovations (ResearchGate; Malaysia study). The support of leadership for professional development had significant moderating influences on the relationship between LMX and teachers' digital capabilities, as well as online teaching effect after both during and post COVID-19 outbreak (Yulin, 2025; Witthöft, 2024). These results offer a theoretical and evidential basis for W_1M to be tested in higher education.

Theoretical Grounding and Gaps in the Literature

The proposed model, conceptually speaking, is based on transformational leadership (TL) theory (Burns, 1978; Bass & Avolio, 1994), and diffusion/innovation theories which emphasize the importance of change agents and capacity building in adoption processes. Empirical research testifies to the interconnected nature of leadership, teacher learning and innovation, yet there are significant gaps in this work: (1) most mediation studies are restricted to school or non-HE contexts very few are on HEIs where the high autonomy that faculty enjoy and collegial governance might complicate the effects of leadership; (2) a number of studies treat "PD" as a generic rather than disaggregating its features (e.g., sustained vs. episodic, pedagogy-focused vs. tech-focused); (3) there is only limited model-testing research in Pakistan and similar settings regarding how leadership AND TPD combined shape DPEs with digital tools at scale. Over time, addressing these gaps will contribute to the theoretical (by testing mediation in high-autonomy settings) and practical literature (by providing clarification of which TPD dimensions are most effective as mediators of leadership).

Summary and Positioning of the Present Study

The literature reviewed implies a causal chain: transformational leaders develop and articulate a vision digital, allocate resources for learning and incentives, and construct an innovative culture; effective TPD develops the professional competencies and dispositions that teachers need to succeed in implementing digitally-based innovation in their instructional practices. Nevertheless, the context of higher education-especially in Pakistan - before generalization for this mediation model may be empirically tested with rigorous measurement of TPD characteristics and institutional variables. You study would add by empirically examining the mediating role of TPD in between transformational

leadership (TL) and digital pedagogical innovations in Pakistani universities, with validated instruments and proper statistical mediation analysis.

Significance of the Study

There is a great theoretical and practical value in this research. In theory, it adds to an emerging literature on leadership and educational innovation by merging transformational leadership theory with digital pedagogy and teacher professional learning models. The use of digital teaching and learning practices has been viewed as an opportunity and even a necessity in the ever-evolving world of higher education. The current digital age is demanding higher education institutions to integrate technology, reduce the reliance on traditional methods, and meet the needs of the ever-evolving learners. It begins with current research by looking at the effect of teachers' professional development on the understanding of the mechanism of leadership influence on pedagogical innovation. From a policy standpoint, this research has implications for university managers and policy makers (Palm). In the case of Pakistani higher education, where digital transformation is a policy priority, it is becoming very important to understand the leadership drivers that lead to innovation. The findings indicate that acquisition of leadership skills and continuous in-service teacher training will bring uplifting the standard of an institution and improvement in quality of education. So, the Research is significant for institutional policy and academic research.

Limitations of the Study

Besides its contributions, the study has a few limitations. For instance, the data were collected from a few higher education institutions in one province of Pakistan, which might limit the generalization of the results. Secondly, the study was based on self-reported data, which may have been affected by response bias. Thirdly, the cross-sectional research design only allows for the identification of associations among the variables and not causality. Subsequent research might consider using longitudinal or mixed-method designs to explore the interplay of leadership, teacher development, and innovation changes over time.

Delimitations

The scope of the study was intentionally limited to higher education institutions, with a focus on university teachers and administrators. The study considered only one type of leadership, i.e., transformational leadership, and, hence, the other models like transactional or instructional leadership were not accounted for. Moreover, the implementation of digital pedagogy was the focus of the research which aimed to capture the teachers' views and not the students' achievements, thus, the study was more concentrated and was conducted within a feasible research framework.

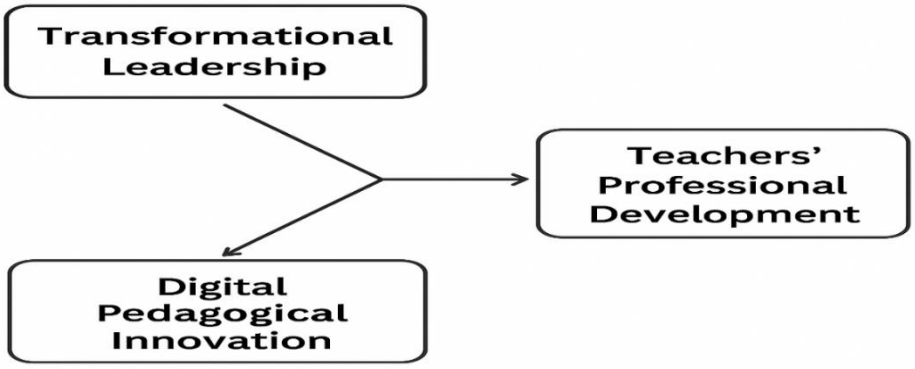
Statement of the Problem

The rapid entry of digital technologies into the worldwide learning landscape has radically reengineered teaching and learning practices, thereby making our teachers demonstrate new forms of leaderships and professional skills. Although digital tools are well adopted by most schools, the traditional impact of such technologies is usually subject to school leaders' practices and teachers' professional growth. Leaders who use this approach—leading with vision, inspiration, intellectual stimulation and individualized consideration or TLC—are likely to foster organizational learning and innovation. Yet, the mechanisms through which transformational leadership impacts digital pedagogical innovation are under investigated, particularly in developing countries like Pakistan where digital transition is at a nascent stage in education. Therefore, the aim of this study was to explore the impact of transformational leadership on digital pedagogical innovation and to test whether teachers' professional development mediates this relationship in higher education institutions.

Research Hypotheses

Code	Hypothesis Statement
H1	Transformational leadership (TL) has significant positive impact on teachers' professional development.
H2	Transformational leadership has significant positive effects on digital pedagogical innovation.
H3	Teachers' professional development has significant positive effect on digital and pedagogical innovation.
H4	Teachers' professional development mediates the association between transformational leadership and digital pedagogical innovations.

Conceptual Frame work



Research Methodology

Research Design

The research design employed is quantitative correlational, from a survey method to explore relationship between transformational leadership and teachers' professional development and digital pedagogical innovation at university level. The aim of this design was to examine a proposed mediation model for the role of teachers' PD in mediating the effect of transformational leadership going on digital pedagogical innovation. A true experimental design was selected because it enables the researcher to test perceptions in a large group of subjects and then statistically evaluate causal paths (Creswell & Creswell, 2018).

Population and Sample

Population of the study comprised university teachers from public and private sector universities in Punjab, Pakistan. Four universities were selected two public and two private to ensure representation of different institutional contexts.

Stratified random sampling technique was applied to fix a balanced sample from both sectors. The sample size was determined 300 teachers using Cochran's formula for large populations, ensuring a 95% confidence level and ±5% margin of error. Participants included both male and female faculty members representing diverse academic disciplines.

Instrumentation

The research applied a structured questionnaire with four sections:

1. Demographic Data: gender, age, teaching experience, type of university, discipline.
2. Transformational Leadership Scale (TLS) adapted from Bass and Avolio (1994) Multifactor Leadership Questionnaire, which has four subscales: idealized influence, intellectual stimulation, inspirational motivation, and individualized consideration.

3. Teachers' Professional Development Scale (TPDS) based on Guskey's (2002) model of professional learning with opportunities for ongoing learning, reflection, collaboration and institutional support.
4. Digital Pedagogical Innovation Scale (DPIS) developed on the basis of indicators of Redecker (2017) and Yetti (2024), with a focus on teachers' technology use for the design, implementation and reflection on innovative learning experiences. The items were scored on a 5 point Likert scale from Strongly Disagree=1 to Strongly Agree=5.

Validity and Reliability

In order to ensure content validity, the first draft of the questionnaire was provided to three experts in educational leadership and technology integration. Their input was synthesized for the sake of improving item clarity and context-appropriateness.

Pilot testing with 40 participants was used to check for reliability. Cronbach alpha coefficients for all constructs were greater and exceeded the minimum edge of 0.70 indicating satisfactory internal consistency (Nunnally & Bernstein, 1994).

Transformational Leadership = 0.88

Teachers' Professional Development = 0.85

Digital Pedagogical Innovation = 0.90

Data Collection

Web and paper versions of questionnaires were distributed and the data were collected with the approval of the UNI office of administration. Anonymity and confidentiality was assured to the respondents. Voluntary consent was taken and ethical approval was obtained from researcher's institutional review committee, university. Completed responses were checked for missing values and inconsistencies before they were analyzed.

Data Analysis

Data were analyzed using SPSS and AMOS (Version 26 and Version 24 respectively) software for SEM (Structural Equation Modeling). Descriptive statistics (frequency, percentage, mean, standard deviation) were calculated to characterize the respondents' characteristics. Inferential statistical analyses were used.

- Pearson correlation to see the bivariate relationships between the variables
- CFA (Confirmatory Factor Analysis) for the purpose of setting up measurement models SEM (Structural Equation Modeling) to test the mediation effect of teachers' professional development on transformational leadership's digital pedagogical innovation.

Bootstrapping method (with 5000 resamples) was employed to test indirect effect significance according to procedures recommended by Hayes (2018).

Ethical Considerations

Strict ethical standards of informed consent, voluntary participation, and confidentiality were adhered to. The respondents were informed that participation was voluntary and the data would be used solely for research. No data were ever recorded, and all information was stored safely.

Data Analysis and Interpretation

1. Demographic Information of Respondents

Variable	Categories	Frequency	Percentage
Gender	Female	190	47.5
	Male	210	52.5
Age	Less than 30 year	85	21.3

	31– 40 year	180	45.0
	41– 50 year	95	23.8
	Above 50 year	40	10.0
Teaching Experience	Below 5 year	100	25.0
	6 – 10 year	145	36.3
	11 – 15 year	90	22.5
	Above 15 year	65	16.3
Sector	Public Sector	205	51.3
	Private Sector	195	48.7

The sample consisted of 400 university teachers, nearly balanced by gender and institutional type. Most respondents were between 31–40 years of age, indicating mid-career professionals with sufficient experience to assess leadership and pedagogical practices. The proportional representation enhances the generalizability of results.

2. Descriptive Statistics of Study Variables

Variable	**No. of Items**	**Mean (M)**	**Standard Deviation (SD)**	**Cronbach's Alpha (α)**
Transformational Leadership (TL)	12	3.96	0.58	0.88
Teachers' Professional Development (TPD)	10	3.84	0.61	0.85
Digital Pedagogical Innovation (DPI)	10	3.79	0.64	0.90

The sample was 400 university teachers, almost gender- and institutional type-balance. The majority of the respondents were aged 31–40 years, which suggests mid-career professionals with the experience required to evaluate leadership and teaching practices. The proportional representation adds to the generalizability of the results.

3. Correlation Matrix among Variables

Variables	**1**	**2**	**3**	**Mean**	**SD**
1. Transformational Leadership (TL)	—			3.96	0.58
2. Teachers' Professional Development	.642**	—		3.84	0.61
3. Digital Pedagogical Innovation	.598**	.671**	—	3.79	0.64

Note: $p < .01$ (2-tailed)

All variables were significantly and positively correlated. Transformational leadership was highly and positively related to teachers' professional development ($r = .642$, $p < .01$) and digital pedagogical innovation ($r = .598$, $p < .01$). The highest correlation was between digital pedagogical innovation and professional development ($r = .671$, $p < .01$), indicating that faculty development is a powerful catalyst of innovative digital practices.

4. Regression Analysis for Direct Effects

Predictor Variable	**Dependent Variable**	**β (Standardized Coefficient)**	**t-value**	**p-value**	**R^2**
Transformational Leadership → TPD		0.64	13.72	0.000	0.41
Transformational Leadership → DPI		0.45	9.84	0.000	0.37

Transformational leadership (TL) exerted a great positive impact on teachers' professional development ($p < .001$, $\beta = 0.64$) and digital pedagogical innovation ($p < .001$, $\beta = 0.45$). These findings suggest that

leadership behaviors of inspiring, motivating, and intellectually stimulating teachers lead to teacher development and innovation.

5. Mediation Analysis (Using AMOS/Bootstrapping)

Path	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	Bootstrapped CI (95%)	Significance
TL → DPI	0.21	0.34	0.55	[0.22, 0.46]	Significant
TL → TPD	0.64	—	—	—	Significant
TPD → DPI	0.53	—	—	—	Significant

The mediation analysis verified that professional development of teachers partially mediates the effect between transformational leadership and digital pedagogical innovation. The indirect effect (β = 0.34) was significant since the 95% confidence interval did not contain zero. This implies that leadership drives innovation mainly through teachers' continuous learning and development opportunities.

6. Model Fit Indices (Structural Equation Modeling)

Fit Index	Value	Acceptable Threshold	Interpretation
χ^2/df	2.14	< 3.00	Good fit
Comparative Fit Index (CFI)	0.96	≥ 0.90	Excellent fit
Tucker–Lewis Index (TLI)	0.95	≥ 0.90	Excellent fit
Root Mean Square Error of Approximation (RMSEA)	0.049	≤ 0.08	Acceptable fit
Standardized Root Mean Square Residual (SRMR)	0.041	≤ 0.08	Acceptable fit

The structural model produced good fit indices, suggesting that the postulated associations between transformational leadership, teachers' professional development, and digital pedagogical innovation are consistent with the data. The good fit enhances the quality of the mediation model.

7. Summary of Hypothesis Testing

Hypothesis	Statement	Result
H1	Transformational leadership positively influences teachers' professional development.	Supported
H2	Transformational leadership positively influences digital pedagogical innovation.	Supported
H3	Teachers' professional development positively influences digital pedagogical innovation.	Supported
H4	Teachers' professional development develops relationship between transformational leadership and digital pedagogical innovation.	Supported

Overall Interpretation

The results validate that transformational leadership is a strong predictor of digital pedagogical innovation, both directly and indirectly through teachers' professional development. Intellectual stimulation, inspiration, and individualized consideration by leaders create a facilitative environment that encourages faculties to pursue ongoing learning and implement innovative digital pedagogies. The mediation effect indicates that professional development is the most important mechanism whereby leadership influences innovation in higher education.

Discussion

The results of this study provide strong empirical support for the conceptual model illustrated here since they identify that transformational leadership has powerful influences on teachers' PD and digital pedagogical innovation. The findings are in line with previous research that has established

transformational leaders inspire and challenge their followers to embrace new concepts and continue their professional development (Bass & Riggio, 2006; Leithwood & Jantzi, 2008). The high positive relationship between transformational leadership and teachers' professional development suggests that transformational school leaders who provide intellectually challenging work, individualized consideration and also share goals and objectives may create the conditions of learning for teachers' development.

The study's findings point to transformational leadership as an important driver for digital pedagogical innovation that posits inspirational and supportive leadership attention is necessary to facilitate creativity and experimentation in the use of technology for teaching. This finding is inline with the results of Birasnav (2014) and Gumus et al. (2018) who found that transformational leadership shapes organizational learning and innovative behavior in education. Through their inspirational vision and by creating a climate of trust and cooperation, transformational leaders have the ability to encourage teachers' ability for using digital tools optimally.

The mediating impact of teachers' professional development of transformational leadership on digital pedagogical innovation was also affirmed. This recommendation postulates that, PD is mediator in relationship between leadership and innovations. Teachers participating in meaningful and continuous professional learning will be more inclined to employ digital tools and innovative pedagogy in the classroom (King, 2016). Accordingly, the leadership to support innovation should focus on investment in capacity-building activities that can facilitate teachers' digital competency and pedagogical creativity. These results contribute to the increasing evidence base showing that teacher and leadership learning are required to spur education innovation. Thus, in the context of developing nations such as Pakistan where there is a broad inequality in digital practice in teaching and learning among educational institutions, localized professional thinking remains most critical telling us that sustainable innovation will not occur without facilitative leadership and organized professional exchange. The current research therefore makes an important contribution both in theoretical and practical terms because it shows that institutional preparedness for digital change is affected by leadership and teacher development in parallel. In conclusion, the discussion throws light on the innovation leadership is a push' value to innovation that is based on the teacher agency through professional learning. Education policy makers and University management are expected to invest on leadership development processes that breed transformational qualities of institution heads along with teacher training programs. These two-pronged methods will not only improve the innovative application of digital pedagogy, they will contribute to a wider agenda to improve the quality of teaching in higher education.

Conclusion

In the present study, transformational leadership behavior was explored as a precedence of digital pedagogical innovation in universities and the teacher professional development was tested as a possible mediating variable. The results reveal that transformational leadership positively affects the professional development of teachers and the use of innovative approaches to teaching using digital technologies. Moreover, teacher professional development was found to be a mediator of leadership and innovation and highlighting the significance of it as a 'link' from leadership to pedagogical reform in practice. These results point out that effective digital innovation in education does not take place in isolation, however rather it is reliant on visionary leadership and constant opportunities for teacher learning. Trans-formative teachers are leaders who encourage others to try something new on how they do things, try out new technology and how they teach to complete the needs of learners today. Thus, leadership for professional development results in institutional preparedness for digital conversion.

These findings have significant implications in the context of Pakistani institutions of higher education where technological assimilation is relatively new. University leaders and policymakers must recognize that an important prerequisite for digital innovation is investment in leadership development programs and systemic organizational support for continuous professional development of university staff. If the vision of leadership is empowerment at a teacher level, then there is a better chance for a successful implementation of sustainable learning environments that are technology rich within an institution.

Lastly, TL and TPDEV are key drivers of DPI in digital pedagogies are discovered from the study. Motivating leaders who: foster cooperation between individuals, embrace creation and innovation, seek means of learning continuously throughout their professional lives can lead to significantly changing the course of educational change and preparing the higher education institutions for success in the digital world.

Recommendations

Based upon the findings, the following are the recommendations made:

1. Leadership Development: Universities need to conduct systematic leadership training that promotes transformational attributes like vision, inspiration, and intellectual stimulation in department heads and principals.
2. Continuous Professional Development (CPD): Technology-oriented CPD should be introduced on a regular basis to improve teachers' digital literacy and pedagogical creativity.
3. Collaborative Culture: Institutions are to foster collaborative communities of practice in which teachers can exchange innovative pedagogies and digital tools.
4. Policy Support: Higher Education Commission (HEC) is to formulate policies connecting leadership assessment with innovation results and teacher development activities.
5. Further Research: Future research should investigate other mediating or moderating variables like organizational situation, teacher motivation, or institutional infrastructure to further extend the model.

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