Assessment and Practice in Educational Sciences

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Providing a Causal Model of Digital Leadership Factors in the Formation of an Innovative Organizational Culture in Universities of Mazandaran Province

ABSTRACT

The purpose of the present study was to provide a causal model of digital leadership factors in the formation of an innovative organizational culture in the universities of Mazandaran Province. The research method was applied in terms of purpose and descriptive–survey in nature. The statistical population included all employees of Islamic Azad University branches in the cities of Sari, Babol, Tonekabon, Chalous, Neka, and Behshahr in Mazandaran Province (1,030 individuals). The sampling method was proportional cluster random sampling based on university units, and the sample size was determined to be 280 individuals using Cochran's formula. A researcher-made questionnaire was used to collect data for the two variables of digital leadership and innovative organizational culture. The face, content, and construct validity of the instrument were examined and confirmed by academic supervisors, advisors, and subject-matter experts. In descriptive statistics, the mean, standard deviation, frequency distribution tables, and charts were presented for each variable, and this process was performed using SPSS software. In inferential statistics, the Kolmogorov–Smirnov test was used to examine the normality of data distribution, and to address the research questions, single-sample and independent t-tests, correlation coefficients, exploratory factor analysis, and structural equation modeling (including exploratory and confirmatory factor analysis) were employed. In the inferential section, the research hypotheses were tested using SPSS as well as AMOS. The results obtained from AMOS software were interpreted using the structural equation modeling approach. Path analysis results indicated that digital leadership has a positive, direct, and significant effect on innovative organizational culture.

Keywords: Digital leadership, innovative organizational culture, university administrators

Introduction

The acceleration of digital transformation in recent years has profoundly reshaped organizational structures, operational models, and managerial expectations across sectors worldwide. Digitalization has evolved from a supporting function to a strategic imperative that determines the long-term competitiveness, adaptability, and sustainability of organizations in turbulent environments (1). As organizations transition from traditional architectures to digitally enabled ecosystems, leadership capability emerges as one of the central determinants of successful transformation. The shift toward digital leadership reflects the necessity for managers to adopt new competencies, mindsets, and communication models capable of steering organizations

through complex technological and cultural transitions (2). This transformation is not merely technical but fundamentally organizational and behavioral, involving new expectations of agility, innovation, and knowledge-centered decision-making (3).

Digital leadership, as a theoretical construct, has gained increasing scholarly attention, representing a multidimensional capability that integrates digital literacy, strategic foresight, change management, and innovation facilitation. Scholars have identified digital leadership as a critical catalyst in organizational digital maturity, enabling institutions to respond to emerging technologies, big data analytics, artificial intelligence, and platform-based communication systems (4). In this regard, digital leaders must bridge the gap between technological potential and organizational readiness, guiding employees toward new ways of working, learning, and collaborating (5). Traditional leadership theories, while still relevant, fall short in addressing the nuances of the digital era, necessitating a re-conceptualization of leadership models that accommodate distributed structures, virtual interactions, and rapid technological innovation (6).

One of the defining features of digital leadership is its emphasis on dynamic organizational capabilities. Research suggests that organizations equipped with strong digital leadership competencies are significantly more capable of developing flexible, innovative responses to environmental uncertainties (7). This aligns with the capability-based view, which posits that sustainable competitive advantage arises from intangible competencies such as organizational learning, digital literacy, and adaptive capacity (8). Within digital ecosystems, leaders play a key role in orchestrating these capabilities, fostering a culture that encourages experimentation, risk-taking, and continuous improvement (9). Moreover, the digital era has introduced the necessity for leaders to manage multigenerational workforces, necessitating inclusive digital strategies that promote equal access to technological resources and digital upskilling (10).

Parallel to these developments, the concept of digital culture has emerged as a fundamental mediating factor linking digital leadership to organizational outcomes. Digital culture encompasses a set of shared behaviors, norms, and values that encourage technological adoption, collaborative digital work processes, and innovation-oriented thinking (11). Studies have shown that digital leadership contributes significantly to cultivating such a culture by promoting transparency, digital communication, knowledge sharing, and team-based digital learning practices (12). Digital culture allows employees to internalize technological change as an opportunity rather than a disruption, thereby enhancing organizational readiness for digital transformation (13). In this sense, digital leadership exerts influence far beyond technological competence—it reshapes the identity of organizations, paving the way for sustainable, innovation-driven digital ecosystems (14).

In higher education institutions, the digital transformation agenda has gained unprecedented urgency. Universities worldwide, including those in developing contexts, are confronted with pressures to integrate digital technologies in teaching, learning, administration, and governance (15). As centers of knowledge creation, universities must not only adopt digital tools but also cultivate academic cultures supportive of digital innovation, interdisciplinary collaboration, and digital scholarship (16). Digital leadership within universities is therefore increasingly recognized as a critical determinant of institutional success in the digital age. Research shows that academic leaders must develop competencies in online pedagogy, digital resource management, data-driven governance, and digital ethics while simultaneously guiding faculty and staff through the cultural and pedagogical shifts required for digital transformation (4). In this context, digital leadership is both a managerial and pedagogical capability that shapes institutional identity and competitiveness.

The Iranian higher education system is no exception to these global dynamics. In recent years, significant attention has been directed toward the necessity of digital transformation within Iranian universities, particularly within the Islamic Azad University network, which is one of the largest non-governmental higher education systems in the world. Challenges such as outdated administrative systems, limited digital infrastructure, and insufficient digital literacy among staff and faculty require strong and visionary digital leadership to drive organizational renewal (17). Studies conducted in the Iranian context highlight

the importance of identifying key digital leadership competencies tailored to local institutional structures, cultural expectations, and technological readiness levels (18). Furthermore, expanding digital awareness among university managers appears to be essential for achieving digital transformation goals and creating sustainable innovation ecosystems within higher education (5).

A growing body of literature emphasizes that digital leadership in academic institutions significantly influences factors such as digital innovation, technological adoption, organizational flexibility, and digital competence development among faculty and staff (19). It also plays a vital role in promoting digital empowerment, shaping positive attitudes toward technology, and fostering a supportive climate for innovation and experimentation (20). In line with this, digital leadership has been shown to contribute to enhanced decision-making processes, the development of intelligent administrative systems, and the establishment of collaborative digital environments that improve organizational efficiency and academic performance (3). In particular, digital leadership helps align organizational strategy with technological capabilities, thereby facilitating the emergence of innovative digital solutions, including smart classrooms, virtual laboratories, and digital learning platforms (13).

Another important dimension of digital leadership is its relationship with organizational culture. Organizational culture significantly shapes employees' perceptions, motivations, and responses to digital transformation initiatives (10). Research indicates that digital leaders can effectively foster innovative organizational cultures by promoting openness to change, encouraging knowledge sharing, and supporting digital experimentation (9). Within academic institutions, such a culture is instrumental for achieving digital transformation goals, as it motivates faculty and administrative staff to adopt innovative practices and leverage digital resources in teaching, research, and institutional management (14). Scholars emphasize that without cultural readiness, technological investments alone cannot result in meaningful digital transformation (11). Thus, the cultivation of an innovative organizational culture is both a requirement and an outcome of effective digital leadership (18).

Despite the growing global and national attention to digital leadership, gaps remain in the empirical examination of its causal effects on organizational culture, particularly within the context of Iranian higher education. Previous studies have explored digital leadership competencies (17), strategic frameworks for developing digital leaders (14), and its influence on digital capabilities and innovation (7), yet limited research has focused on how digital leadership contributes specifically to the development of innovative organizational cultures in universities. Moreover, regional dynamics, institutional diversity, and variations in technological infrastructure across university campuses in Iran necessitate localized empirical investigations grounded in contextual realities (21). Addressing this gap requires a comprehensive causal model that explains how digital leadership shapes, strengthens, and operationalizes innovative cultural patterns within universities.

Given the strategic importance of digital leadership in driving digital transformation and fostering innovation in academic environments, and in response to the documented theoretical and empirical gaps in the literature, the present study seeks to analyze its causal influence on the development of an innovative organizational culture within universities.

Therefore, the aim of this study is to develop and test a causal model of digital leadership factors in shaping an innovative organizational culture in the universities of Mazandaran Province.

Methods and Materials

The research method was applied in terms of purpose and descriptive–survey in nature. The statistical population of this study included all employees of the Islamic Azad University branches in six cities of Mazandaran Province (Sari, Babol, Tonekabon, Chalous, Neka, and Behshahr) who were engaged in information technology and digital activities. According to the most recent statistics, they totaled 1,030 individuals. A proportional cluster random sampling method was used based on university units. To this end, Mazandaran Province was first divided into three geographical regions—east, central, and west. In each region, two university branches were randomly selected, and employees engaged in IT and digital activities were chosen

from each unit as the sample. The sample size was determined using Cochran's formula, resulting in 280 participants, considering the population size of 1,030.

The data collection method was based on the criteria extracted from the qualitative phase and involved designing a researcher-made questionnaire for the two variables of digital leadership and innovative organizational culture to gather the required data. Since the research questionnaire was researcher-made, the face, content, and construct validity of the instrument were examined and confirmed by academic supervisors, advisors, and subject-matter experts.

For data analysis, both descriptive and inferential statistical methods were used based on the research questions. In descriptive statistics, for the demographic variables obtained from the questionnaire, the mean, standard deviation, frequency distribution tables, and graphs were presented for each variable, and this process was performed using SPSS software. In inferential statistics, to examine the normality of the data distribution, the Kolmogorov–Smirnov test was used, and to examine the research questions, single-sample and independent t-tests, correlation coefficients, exploratory factor analysis, and structural equation modeling (exploratory and confirmatory factor analysis) were employed. In the inferential section, the research hypotheses were tested using SPSS and AMOS software. The results from the AMOS software were interpreted through the structural equation modeling approach.

Findings and Results

To answer the question, "What causal relationship exists between digital leadership and innovative organizational culture in universities of Mazandaran Province?" structural equation modeling (SEM) based on the Partial Least Squares (PLS) approach was used through SmartPLS software. The results of the path analysis showed that digital leadership has a positive, direct, and significant effect on innovative organizational culture.

Based on the findings, the path coefficient between digital leadership and innovative organizational culture was 0.928, and the t-value was 75.279. This value is considerably higher than the critical value at the 99% confidence level, indicating a highly significant relationship. Accordingly, it can be concluded that an increase in the level of digital leadership is accompanied by a significant increase in the innovative organizational culture.

Table 1. Results of Direct Path Analysis Between Digital Leadership and Innovative Organizational Culture in Universities of Mazandaran Province

Direct Path	Path Coefficient (β)	t-value	Significance Level	Result
Digital Leadership → Innovative Organizational Culture	0.928	75.279	0.000	Confirmed

The coefficient of determination (R^2) for the endogenous variable "innovative organizational culture" was calculated as 0.861. This value indicates that approximately 86.1% of the variance of innovative organizational culture in the universities of Mazandaran Province is explained by the variable "digital leadership." According to Cohen's (1988) criteria, an R^2 value above 0.67 indicates strong explanatory power; therefore, it can be concluded that digital leadership, as an independent variable, plays a decisive and strong role in explaining innovative organizational culture (Table 1).

In addition to the coefficient of determination (R^2), the Q^2 index was calculated to assess the model's predictive power regarding the endogenous variables. The Q^2 value for the variable "innovative organizational culture" was 0.575. According to the criterion proposed by Chin (1998), a Q^2 value greater than 0.35 indicates strong predictive power. This finding indicates that the research model has an appropriate predictive ability in explaining the variations related to the innovative organizational culture variable, and its performance in this regard is evaluated as acceptable (Table 2).

Table 2. Determination (R²) and Prediction (Q²) Indices for Endogenous Variables

Endogenous Variable	R²	Q²	Interpretation of R²
Innovative Organizational Culture	0.861	0.575	Strong explanation
Digital Empowerment	0.920	0.665	Very strong explanation
Technological Competence	0.879	0.636	Strong explanation
Digital Innovation	0.873	0.635	Strong explanation
Digital Networking	0.869	0.616	Strong explanation
Digital Change Management	0.831	0.548	Strong explanation
Digital Vision and Strategy	0.749	0.523	Moderate to strong explanation
Innovation Support and Encouragement	0.907	0.696	Very strong explanation
Teamwork and Collaboration	0.888	0.692	Strong explanation
Organizational Learning and Personal Development	0.896	0.668	Very strong explanation
Commitment to Quality and Continuous Improvement	0.883	0.689	Strong explanation
Flexibility and Responsiveness	0.853	0.673	Strong explanation
Innovative Values and Norms	0.848	0.671	Strong explanation

In addition to examining the direct effect of digital leadership on innovative organizational culture, the results of the structural equation model indicate that digital leadership also exerts a significant and substantial influence on other key components of the model. The table below summarizes the path coefficients, t-statistics, and significance levels of the direct relationships between the model variables:

Table 3. Results of Direct Path Analysis Between Model Variables

Direct Path	Path Coefficient	t-value	Significance	Result
Digital Leadership → Digital Employee Empowerment	0.959	119.45	0.000	Confirmed
Digital Leadership → Technological Competence of Leaders	0.938	73.364	0.000	Confirmed
Digital Leadership → Digital Innovation	0.934	76.325	0.000	Confirmed
Digital Leadership → Digital Collaboration and Networking	0.932	71.624	0.000	Confirmed
Digital Leadership → Digital Change Management	0.911	53.124	0.000	Confirmed
Digital Leadership → Digital Vision and Strategy	0.866	30.393	0.000	Confirmed
Digital Leadership → Innovative Organizational Culture in Universities	0.928	75.279	0.000	Confirmed
Innovative Organizational Culture → Innovation Support and Encouragement	0.952	96.489	0.000	Confirmed
Innovative Organizational Culture → Teamwork and Collaboration	0.942	57.385	0.000	Confirmed
Innovative Organizational Culture → Organizational Learning and Personal Development	0.947	86.362	0.000	Confirmed
Innovative Organizational Culture → Commitment to Quality and Continuous Improvement	0.939	67.068	0.000	Confirmed
Innovative Organizational Culture → Innovative Vision and Mission	0.926	58.802	0.000	Confirmed
Innovative Organizational Culture → Flexibility and Responsiveness	0.924	58.223	0.000	Confirmed
Innovative Organizational Culture → Innovative Values and Norms	0.921	48.886	0.000	Confirmed

All the relationships examined in the model were statistically confirmed at the 99% confidence level. These results indicate that digital leadership plays a fundamental and multi-dimensional role in shaping and enhancing the key components of innovative universities. Specifically, digital leadership—through strengthening employee empowerment, enhancing technological competencies, facilitating digital innovation, developing networking, and managing digital change—creates the foundation for improving innovative organizational culture in universities.

To evaluate the overall fit of the structural model, the Goodness-of-Fit (GoF) index was used. This index reflects the overall quality of the model and is calculated by combining the mean coefficient of determination (R²) and the mean Average Variance Extracted (AVE).

Three values—0.01, 0.25, and 0.36—have been introduced as weak, moderate, and strong thresholds for the GoF index. Therefore, the obtained GoF value of 0.824 indicates that the research model possesses a very strong and satisfactory overall fit.
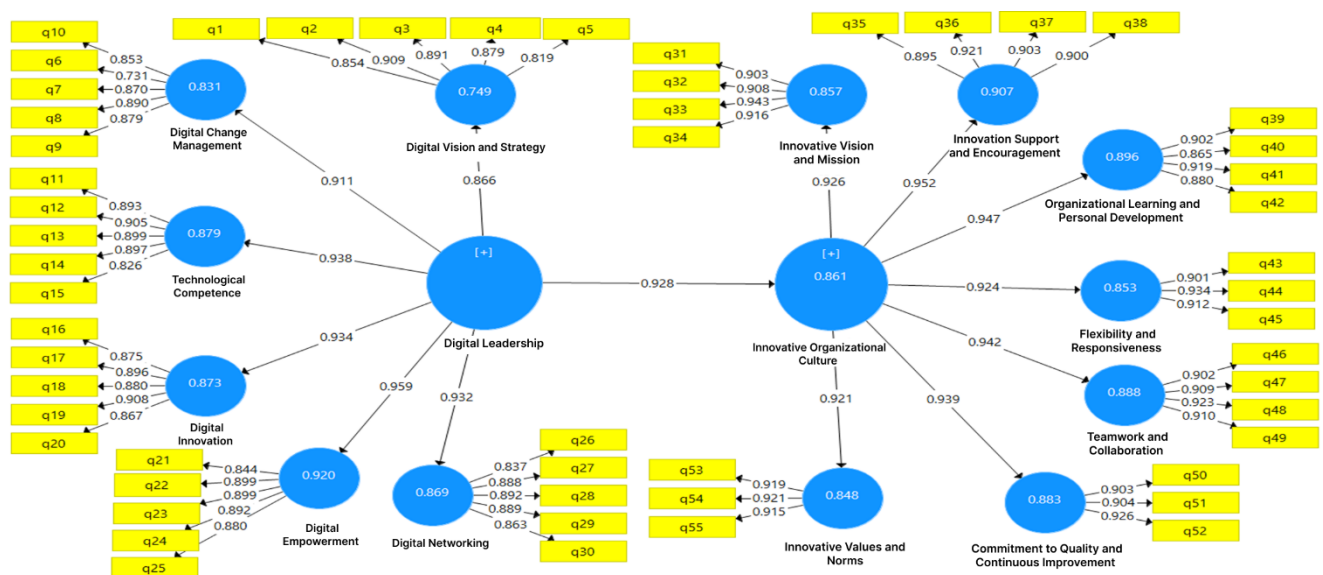
Table 4. Coefficients of Determination (R²) and Average Variance Extracted (AVE) for Model Variables

R²	AVE	Variable
0.848	0.843	Innovative Values and Norms
0.853	0.838	Flexibility and Responsiveness
0.883	0.830	Commitment to Quality and Continuous Improvement
0.920	0.780	Digital Employee Empowerment
0.907	0.818	Innovation Support and Encouragement
—	0.652	Digital Leadership
0.879	0.782	Technological Competence of Leaders
0.861	0.726	Innovative Organizational Culture
0.831	0.717	Digital Change Management
0.873	0.784	Digital Innovation
0.869	0.764	Digital Collaboration and Networking
0.749	0.759	Digital Vision and Strategy
0.857	0.842	Innovative Vision and Mission
0.888	0.830	Teamwork and Collaboration
0.896	0.796	Organizational Learning and Personal Development

The findings derived from the structural equation model analysis indicate that:

– Digital leadership has a causal, direct, positive, and very strong relationship with innovative organizational culture.

– This relationship, with a path coefficient of 0.928 and an extremely high t-value (75.279), is statistically significant and fully supported at the 99% confidence level.

– The explanatory power of this relationship, with an R² value of 0.861, is assessed as very strong.

– The Q² index value of 0.575 also indicates high predictive power of the model in explaining the innovative organizational culture variable.

– Furthermore, the Goodness-of-Fit (GoF) index value of 0.824 demonstrates that the overall fit of the model is highly desirable.

Based on this empirical and statistical evidence, it can be stated that digital leadership plays a central and strategic role in the formation and enhancement of innovative organizational culture in universities. This finding suggests that strengthening and developing digital leadership competencies at the managerial levels of universities can serve as an effective mechanism for institutionalizing organizational innovation and establishing the foundations for sustainable cultural transformation, ultimately progressing toward innovative universities.

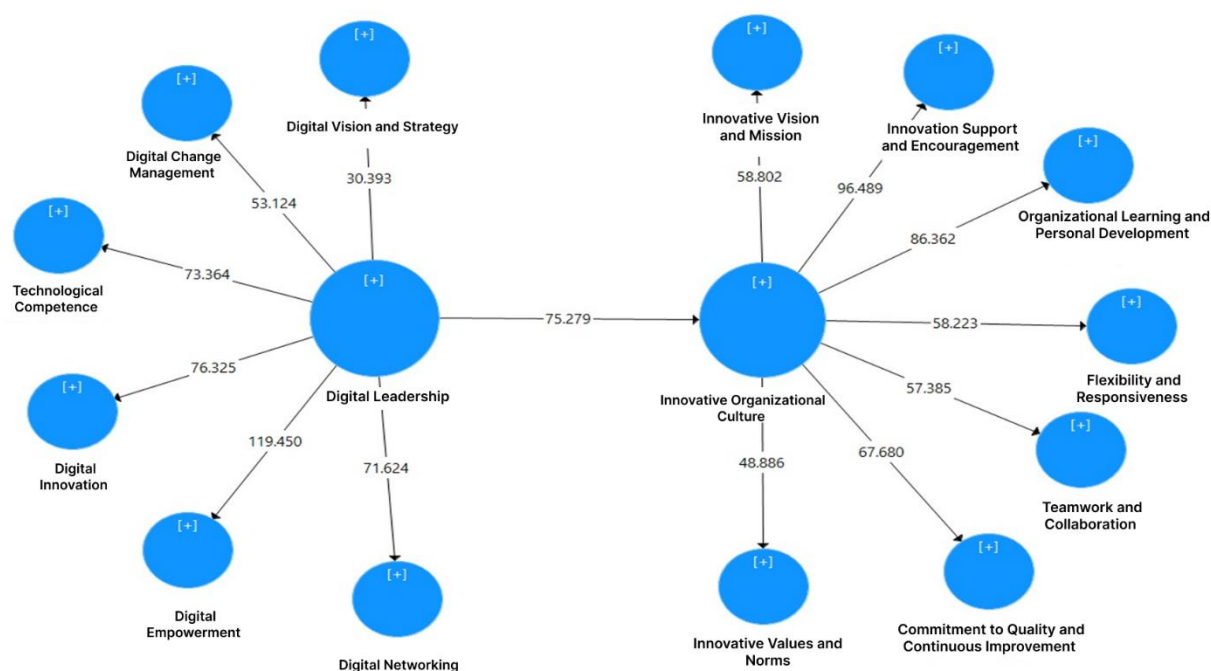**Figure 1. Estimation of Model Variable Effects Based on Standardized Coefficients**

Figure 2. Estimation of the Research Model Based on t-Statistics

Discussion and Conclusion

The findings of the present study demonstrate that digital leadership exerts a strong, direct, and statistically significant influence on the formation of an innovative organizational culture in the universities of Mazandaran Province. The path coefficient of 0.928 and an exceptionally high t-value confirm the robustness of this relationship and highlight digital leadership as a foundational driver of organizational innovation. These results align with the theoretical and empirical research suggesting that digital leadership is a critical determinant of digital transformation and organizational renewal in contemporary institutions (1). In digitalized environments, leaders play a decisive role in mobilizing technological resources, shaping cultural expectations, and guiding organizational behavior toward innovation-oriented outcomes (2). Thus, the evidence from this study strongly suggests that digital leadership represents a strategic competency essential for enabling higher education institutions to adapt to the rapid evolution of digital technologies and the shifting demands of academic, administrative, and societal stakeholders.

The empirical outcomes further show that digital leadership significantly enhances related subcomponents such as digital empowerment, technological competence, digital innovation, networking capabilities, and digital change management. These multidimensional effects confirm that digital leadership is not limited to technological proficiency but manifests as an integrated capability that shapes both structural and cultural dynamics within organizations. Previous research similarly emphasizes that digital leadership fosters dynamic capabilities such as agility, resilience, and innovation capacity by facilitating technology-enabled knowledge processes, collaborative learning mechanisms, and efficient decision-making structures (7). In the context of higher education, these findings reinforce that leaders who internalize digital competencies can guide universities toward more innovative pedagogical models, streamlined administrative systems, and digitally enriched learning environments (3).

Another important finding concerns the strong predictive power of the model, as evidenced by the R^2 and Q^2 values. The R^2 of 0.861 indicates that digital leadership explains more than 86 percent of the variance in innovative organizational culture, confirming that leadership is not merely a contributing factor but a dominant determinant of cultural transformation. This result

corresponds with prior studies showing that leadership style is among the most influential predictors of organizational culture in digitalized work environments (10). Similarly, the Q² value of 0.575 demonstrates the model's high predictive accuracy, which is consistent with studies emphasizing the central role of digital leadership in forecasting organizational readiness for technological and cultural change (11). Taken together, these metrics confirm the conceptual and empirical coherence of the proposed causal model, reinforcing the argument that digital leadership is a key mechanism shaping the internal cultural fabric of academic institutions.

The positive influence of digital leadership on innovative organizational culture aligns with prior research in both organizational and educational settings. For instance, research indicates that digital leadership enhances digital culture by fostering digital collaboration, promoting openness to experimentation, and encouraging the integration of digital tools into daily organizational practices (12). Additionally, scholars have shown that digital leadership promotes innovation through the development of strategic digital visions, the alignment of digital initiatives with institutional goals, and the reduction of resistance to technological change (18). These findings are consistent with those of the present study, wherein digital leaders were found to be instrumental in shaping norms, values, and behaviors that support creativity, continuous improvement, and proactive engagement with technological opportunities.

Furthermore, the significant relationship between digital leadership and key cultural indicators such as teamwork, continuous learning, innovative values, and mission alignment highlights the important role of leadership in constructing a learning-oriented and innovation-driven educational ecosystem. Past studies also emphasize that digital leadership strengthens organizational learning by motivating employees to acquire new digital skills, engage in cross-functional collaboration, and adopt reflective learning practices (4). Similarly, empirical evidence suggests that digital leaders encourage digital empowerment, which increases employee confidence in using digital tools and strengthens their ability to contribute to organizational innovation (20). The present study's results reinforce these observations, demonstrating that digital leadership is a strong predictor of cultural elements that collectively enhance innovation capacity within universities.

The confirmation of all hypothesized relationships in the model indicates that the components selected for measuring digital leadership and innovative organizational culture are theoretically valid and empirically supported. The high explanatory power across subcomponents such as digital empowerment, technological competence, and digital innovation shows that digital leadership functions as a multidimensional construct that affects various operational and cultural domains simultaneously. This aligns with multi-method studies demonstrating that digital leadership encompasses emotional intelligence, strategic digital knowledge, digital communication skills, and the ability to motivate followers through digital platforms (16). In university settings, such competencies are increasingly necessary for adapting to emerging educational technologies, expanding digital research infrastructures, and responding effectively to global competition in higher education (15).

Overall, the findings strongly support the argument that digital leadership is a central element of digital transformation in academic institutions. The results are consistent with conceptual frameworks developed in Iranian and international research, which highlight digital leadership as a driver of innovation, digital capability development, and technological integration within organizations (14). The present study contributes to this body of knowledge by providing empirical evidence from the context of universities in Mazandaran Province, confirming that digital leadership is a foundational determinant of innovative organizational culture and a prerequisite for sustainable digital transformation. These findings underscore the need for higher education institutions to prioritize the development of digital leadership competencies among their managers and administrative staff to ensure cultural readiness for technological advancements and to facilitate long-term institutional innovation (22).

In addition, the strong relationship between digital leadership and organizational mission, values, flexibility, and change responsiveness suggests that digital leadership plays a fundamental role in aligning organizational culture with long-term digital

strategies. This finding parallels previous research showing that successful digital transformation requires the integration of leadership-driven strategic orientation with adaptive, innovative cultural norms (6). It also resonates with studies that establish the importance of cultural readiness, open communication, and organizational trust in achieving successful digital transformation outcomes (13). By expanding empirical understanding of these dynamics, the present study adds depth to existing theories and highlights the strategic importance of digital leadership in shaping institutional behavior and long-term development trajectories.

Finally, the study contributes to the growing global discourse on the competencies required for digital leaders. The results demonstrate that digital leadership includes fostering collaborative digital networks, enhancing employee empowerment, and sustaining a culture of continuous learning—elements emphasized in prior literature on digital leadership frameworks (17). This reinforces the view that digital leadership is not merely a technical construct but a comprehensive leadership model integrating technological, cognitive, social, and cultural competencies (1). As such, institutions seeking to thrive in the digital era must invest in leadership development programs that promote these multifaceted competencies.

This study, while extensive, is limited by its reliance on self-reported data, which may introduce response biases. The sample is restricted to universities within Mazandaran Province, which may limit the generalizability of findings to other regions or institutional types. Additionally, the cross-sectional design does not allow for examination of causal changes over time or the dynamic evolution of digital leadership practices in response to emerging technologies.

Future studies should incorporate longitudinal methodologies to examine how digital leadership evolves over time and how cultural changes unfold incrementally in higher education institutions. Comparative studies across different provinces or between public and private universities could expand contextual understanding. Future research may also integrate qualitative methods, such as interviews or case studies, to explore deeper insights into leadership behaviors, cultural dynamics, and digital transformation processes.

Universities should prioritize digital leadership development through targeted training programs that enhance technological competence, innovation skills, and digital communication. Institutional policies must support the creation of digital innovation environments by providing adequate infrastructure, encouraging experimentation, and reducing bureaucratic barriers. Finally, universities can strengthen innovative organizational culture by reinforcing teamwork, transparency, and continuous learning, ensuring that digital leadership becomes embedded in daily organizational practice.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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