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The Mediating Role of Knowledge Management in the Impact of Information Technology Infrastructure on Learning and Training Optimization

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Abstract

The present study aims to investigate the mediating role of knowledge management in the impact of information technology infrastructure on the optimization of learning and training. In terms of purpose, this study is applied, and in terms of method, it is descriptive-correlational. The statistical population consists of managers and entrepreneurs of knowledge-based companies in Isfahan, among whom 93 individuals were selected using Cochran's formula and a random sampling method. To collect the required data, a researcher-made questionnaire based on a five-point Likert scale was employed. The content validity of the instrument was confirmed by experts and specialists, and Cronbach's alpha as well as composite reliability were used to assess the reliability. Upon distributing the questionnaire, the validity of the instrument was evaluated through three methods: construct validity (outer model), convergent validity (AVE), and discriminant validity. The AVE value for all variables should be greater than 0.50. To test the research hypotheses, structural equation modeling was conducted using SmartPLS 2 statistical software. The findings of the study indicate that all research hypotheses were supported. Accordingly, information generation, information networking, and provision of technical knowledge have a significant impact on knowledge management. Furthermore, knowledge management demonstrated a significant impact on the optimization of learning and training.

Keywords: Information Technology Infrastructure, Learning, Training, Knowledge Management.

1. Introduction

In today's rapidly evolving business landscape, organizations increasingly recognize the pivotal role of technology in transforming employee learning and training development. Employee training is a learning experience aimed at changing employees' skills, knowledge, attitudes, or behaviors, and is necessary to help the workforce apply modern techniques, tools, strategies, and solutions in operational tasks (Urbancová et al., 2021). On the other hand, employee learning and development generally focus on future roles within the organization, encouraging employees to acquire new or advanced skills, knowledge, and perspectives by providing learning and training opportunities and a workplace environment where these new ideas can be implemented (Noe, 2020).

Learning has long been associated with formal or informal education. However, organizational learning encompasses much more. It can be defined as "the process of learning within organizations, involving the interaction of individual and collective (group, organizational, and inter-organizational) levels of analysis, leading to the achievement of organizational goals" (Popova-Nowak & Cseh, 2015), with an emphasis on the flow of knowledge across different organizational levels (Oh, 2019). Knowledge flow, or learning flow, refers to the path through which new knowledge moves from the individual to the organizational level (i.e., forward movement) and vice versa (i.e., feedback) (Crossan et al., 1999; Crossan et al., 2011; March, 1991). The flow of learning and related processes forms the cornerstone of organizational learning activities (e.g., from physical training sessions to digital learning resources). These processes are directly linked to the psychosocial experiences of organizational members and ultimately lead to organizational change (Crossan et al., 2011). Comprehensive organizational learning is crucial as it is tied to the value creation process from the organization's intangible assets. Moreover, it integrates concepts from multiple domains, including organizational behavior, human resource management, and information technology (El Kadiri et al., 2016).

Indeed, as the workforce becomes more diverse and the pace of change accelerates, traditional learning methods face significant challenges. Here, technology emerges as a game changer, offering innovative solutions that transform how employees acquire knowledge, enhance their skills, and stay ahead (Akpoviroro, 2022). In the reengineering movement, Hammer (1990) called for the elimination of existing work processes and the creation of entirely new ones enabled by modern information technologies (Hammer, 1990). Technologies such as data warehouses, expert systems, best practice databases, and intranet/internet systems potentially include valuable components of organizational memory, while groupware and broadband communication networks may facilitate access to and utilization of that memory. Thus, information technology can be a crucial element in designing organizational learning and training by providing an infrastructure for storing, accessing, and revising elements of organizational memory (Rezaqi et al., 2023; Wang et al., 2020).

Furthermore, employee training and learning development enable human capital to showcase their competencies and ensure that organizational members acquire the knowledge and skills necessary to perform their tasks effectively through assuming new responsibilities and adapting to changing conditions (Abu Huson et al., 2024; Purwanto et al., 2020). In other words, the successful implementation of technologies that enable optimized organizational learning and training depends on the current learning capacity of the organization. Therefore, organizations that already exhibit learning capabilities should more easily expand their learning capacity, as they are more likely to experiment with new technologies. This can be managed through organizational knowledge management. Without a structured approach for storing, sharing, and applying knowledge, the high potential of information technologies to improve educational processes cannot be fully realized (Nguyen et al., 2023).

Knowledge management refers to the processes through which organizations and individuals collect, store, share, and apply existing knowledge to improve productivity and efficiency. In the organizational context, knowledge management plays a particularly crucial role as an intermediary process that connects learning and training processes to the realm of technology. This process can facilitate more effective communication and increased collaboration among individuals involved in learning and training through the use of modern information technologies (Ahmad, 2023).

In the domain of learning and training, knowledge management refers not only to the transmission of information but also to the retention and enhancement of knowledge within organizations. This process can facilitate educational procedures by creating intelligent and interactive learning environments. Additionally, information technology infrastructures such as learning management systems (LMS), online communication tools, educational databases, and digital resources can effectively support knowledge management processes, thereby optimizing learning and training (Mirzaei, 2021).

In reviewing the literature, various studies emphasize the critical role of knowledge management and information technologies in enhancing learning and organizational performance. Heidari et al. (2024) explored the role of information technology in primary education, underscoring the importance of teachers' familiarity with learning theories—such as behaviorism, cognitivism, constructivism, social learning, activity theory, connectivism, and cultural-historical theory—for successful engagement in virtual learning environments (Heidari et al., 2024). In a related study, Razaqi et al. (2023) examined how student attitudes, system quality, and knowledge management influence the use of e-learning through the mediating role of e-learning acceptance. They found significant positive causal relationships among these variables, indicating that increased

attitudes, system quality, and knowledge management lead to greater actual usage of e-learning systems (Rezaqi et al., 2023). Additionally, Razaqi et al. (2022) demonstrated that knowledge management and digital literacy positively impact job performance through the mediating effect of organizational learning, with structural equation modeling confirming the robustness of their proposed model among secondary school teachers. In a systematic literature review, Zamiri and Esmaeili (2024) highlighted diverse methods and technologies used to support knowledge sharing in learning communities, offering a comprehensive snapshot of current strategies and their implications for educators and policymakers (Zamiri & Esmaeili, 2024). Antunes and Pinheiro (2020) further emphasized the interdependence between knowledge management, organizational learning, and organizational memory, asserting that human capital is central to knowledge creation and utilization, thereby shaping the organization's intellectual capacity (Antunes & Pinheiro, 2020). Lastly, Purwanto et al. (2020) analyzed a knowledge management system (KMS) prototype designed to integrate tacit and explicit knowledge, aiming to facilitate staff recruitment and training through a web-based platform for information exchange and knowledge sharing (Purwanto et al., 2020).

This study seeks to explore how knowledge management, by facilitating the flow of knowledge among individuals and groups, can improve the performance and efficiency of information technology infrastructures in educational processes. Accordingly, the focus will be on examining how the link between knowledge management and information technology contributes to the optimization of learning and training. To address this issue, it is necessary to closely investigate the interactions between information technologies and educational processes, their positive and negative effects on learning quality, and the manner in which knowledge management can serve as a mediating tool in this area. Based on this foundation, the present study investigates the mediating role of knowledge management in the impact of information technology infrastructure on the optimization of learning and training, and the following hypotheses are proposed:

Hypothesis 1. Information generation has a significant impact on knowledge management.

Hypothesis 2. Information networking has a significant impact on knowledge management.

Hypothesis 3. Provision of technical knowledge has a significant impact on knowledge management.

Hypothesis 4. Knowledge management has a significant impact on the optimization of learning and training.

2. Methodology

This study is applied in terms of its objective and descriptive-correlational in terms of its method. The statistical population consists of 150 managers and entrepreneurs from knowledge-based companies in Isfahan, of whom 93 were selected using Cochran's formula through a random sampling method. To collect data, a researcher-made questionnaire based on a five-point Likert scale was employed. Cronbach's alpha and composite reliability (CR) tests were used to assess the reliability of the research instrument. To examine the validity of the instrument, content validity was assessed by consulting experts, and its validity was confirmed. Subsequently, following the distribution of the questionnaire, the instrument's validity was assessed using three methods: construct validity (outer model), convergent validity (AVE), and discriminant validity. The AVE value for all variables in the study must be greater than 0.50. Structural equation modeling (SEM) was used to test the research hypotheses, employing SmartPLS 2 statistical software.

3. Findings and Results

Conceptual models are systematic sets of relationships that offer a comprehensive and consistent depiction of the connections among various phenomena. Conventional models in structural equation modeling (SEM) consist of two main parts: measurement models, which explain how latent variables are defined and measured, and structural models, which depict how these latent variables are connected to one another.

In SmartPLS software, measurement models are evaluated for reliability using criteria such as factor loadings and composite reliability (CR). Convergent validity is assessed through the average variance extracted (AVE), while discriminant validity is evaluated using the Fornell-Larcker criterion.

Cronbach's alpha is a coefficient ranging from 0 to 1, where a value greater than 0.70 (Cronbach, 1951) indicates acceptable reliability. Composite reliability (CR), introduced by Werts et al. (1974), is considered superior to Cronbach's alpha because

it evaluates the reliability of constructs based on the correlations among their indicators rather than assuming equal contribution. A CR value above 0.70 for each construct indicates good internal consistency in measurement models.

Fornell and Larcker (1981) introduced the AVE criterion to assess convergent validity, stating that the critical threshold is 0.50.

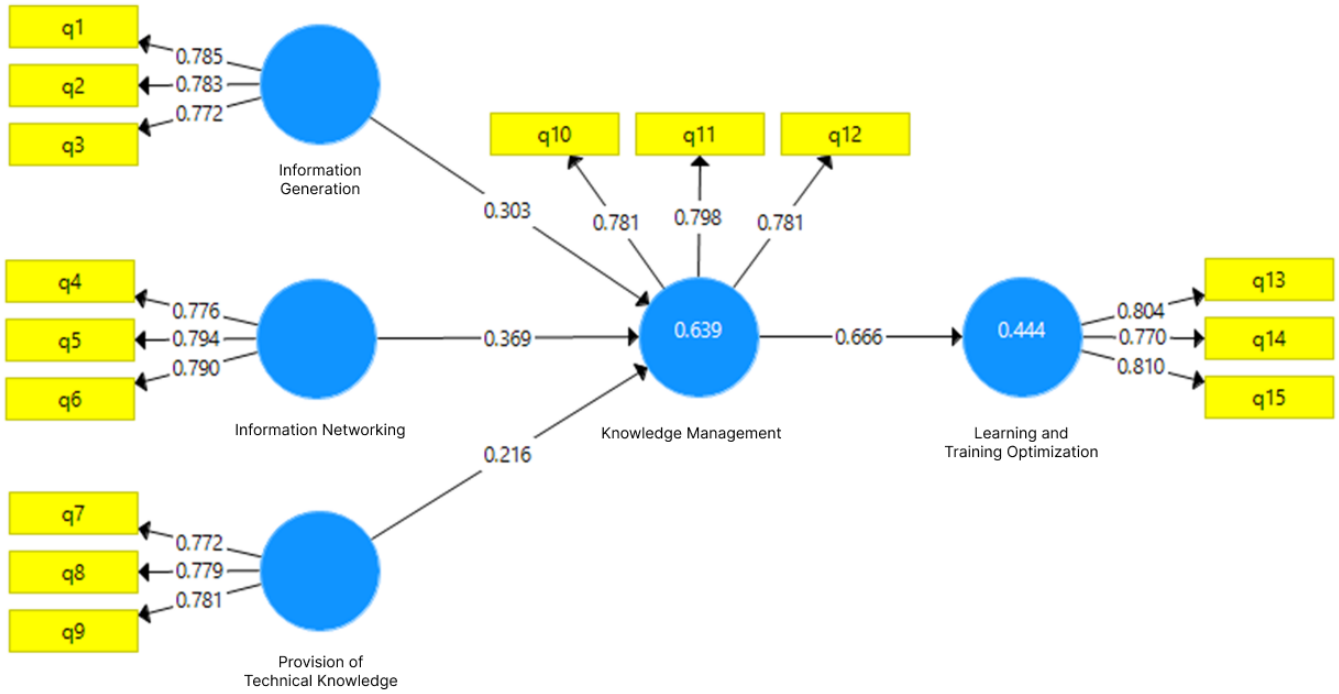

Figure 1. Model with Factor Loadings

As shown, all factor loadings are above 0.40.

Table 1. Cronbach's Alpha, Composite Reliability, and Convergent Validity

Variables	Cronbach's Alpha	Composite Reliability	AVE
Learning and Training Optimization	0.708	0.837	0.631
Information Generation	0.779	0.824	0.609
Information Networking	0.792	0.829	0.618
Provision of Technical Knowledge	0.772	0.821	0.604
Knowledge Management	0.792	0.830	0.619

As shown in Table 2, the square roots of the AVE values for the latent variables in this study—displayed in the diagonal cells of the matrix—are higher than the correlations among the variables, which appear in the lower-left off-diagonal cells. This finding indicates a good model fit in terms of discriminant validity.

Table 2. Fornell-Larcker Criterion

	Learning and Training Optimization	Information Generation	Information Networking	Provision of Technical Knowledge	Knowledge Management
Learning and Training Optimization	0.794				
Information Generation	0.699	0.780			
Information Networking	0.722	0.705	0.786		
Provision of Technical Knowledge	0.713	0.737	0.696	0.777	
Knowledge Management	0.666	0.722	0.733	0.696	0.787

Table 3. R-Square and Q^2 Values

Endogenous Variable	R^2	Q^2
Learning and Training Optimization	0.444	0.265
Knowledge Management	0.639	0.376

The R-Square coefficient (R^2) is a metric used to connect the measurement and structural components of structural equation modeling (SEM), reflecting the effect of an exogenous variable on an endogenous variable. It is important to note that R^2 values are only calculated for dependent (endogenous) constructs; for independent (exogenous) constructs, this value is zero. A higher R^2 value for endogenous constructs indicates a better model fit. Chin (1998) proposed three benchmark values—0.19, 0.33, and 0.67—for weak, moderate, and strong explanatory power of the structural model using the R^2 criterion. The R^2 values shown in Table 3 indicate that the effect of exogenous variables on endogenous ones is acceptable.

This index evaluates the model's predictive relevance. Structural models with good fit should be capable of predicting the indicators of the model's endogenous constructs. Henseler et al. (2009) introduced threshold values of 0.02, 0.15, and 0.35 to indicate low, moderate, and strong predictive relevance, respectively. The Q^2 values in Table 3 suggest that the model has suitable predictive power.

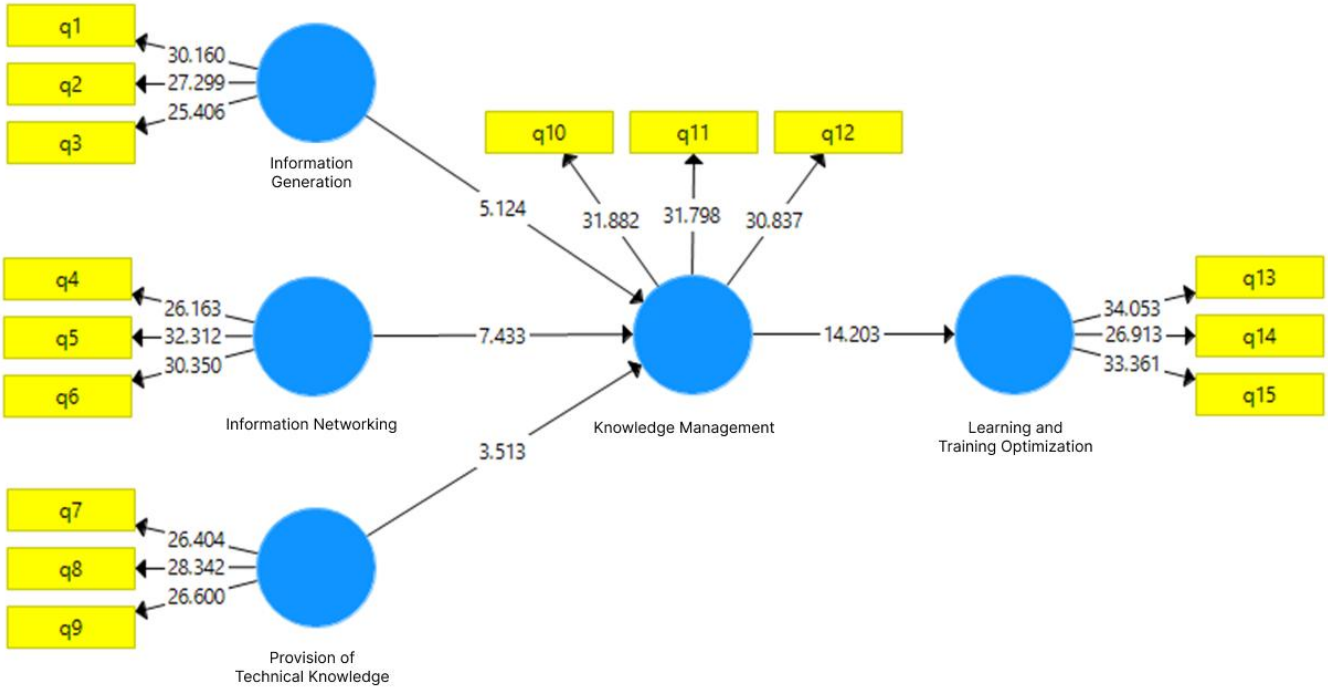

Figure 2. Structural Equation Model with Z-Values

Structural fit using t-values requires that these values exceed 1.96 to be considered statistically significant at the 0.95 confidence level. It is essential to note that t-values only indicate the statistical significance of relationships, not the strength of the associations. The path coefficients illustrate whether the impact of one variable on another is positive or negative.

Table 4. Hypothesis Testing Results

No.	Pathway	Path Coefficient	t-Statistic	p-Value	Result
1	Information Generation → Knowledge Management	0.303	5.124	0.000	Supported
2	Information Networking → Knowledge Management	0.369	7.433	0.000	Supported
3	Provision of Technical Knowledge → Knowledge Management	0.216	3.513	0.000	Supported
4	Knowledge Management → Learning and Training Optimization	0.666	14.203	0.000	Supported

Based on the results presented in Table 4, all proposed relationships in the model are statistically supported.

4. Discussion and Conclusion

The findings of the present study offer substantial empirical support for the proposed model, which investigated the mediating role of knowledge management in the relationship between information technology (IT) infrastructure and the optimization of learning and training. All four hypotheses were confirmed through structural equation modeling using SmartPLS, and the statistical indices, including path coefficients, t-values, and significance levels, all point to the robustness

of the relationships proposed in the research model. First, the results indicate that information generation significantly influences knowledge management. Second, information networking also shows a strong and statistically significant positive impact on knowledge management. Third, the provision of technical knowledge has a notable positive effect on knowledge management. Finally, the analysis reveals that knowledge management significantly affects the optimization of learning and training, supporting the core assumption that it serves as a key mediating construct in enhancing the effectiveness of IT infrastructure on learning outcomes.

These findings are aligned with a growing body of literature that emphasizes the importance of integrating technological systems with knowledge-based processes to improve organizational learning and development. For instance, the positive impact of information generation on knowledge management supports the assertions of Antunes and Pinheiro (2020), who argue that organizational learning is a dynamic process grounded in knowledge and that successful knowledge management depends on the organization's ability to generate, store, and disseminate intellectual resources. The present study's finding that information networking significantly predicts knowledge management is also consistent with the results of Zamiri and Esmaeili (2024), who, in their systematic literature review, identified various methods and technologies that facilitate knowledge sharing in learning communities. Their research affirms the critical role of effective communication infrastructures in promoting collaborative learning and organizational knowledge exchange.

Furthermore, the finding that the provision of technical knowledge contributes to enhanced knowledge management reflects the theoretical perspectives of Purwanto et al. (2020), who developed a prototype knowledge management system integrating tacit and explicit knowledge to support recruitment and training. Their model emphasized that technical knowledge, when properly codified and disseminated through knowledge systems, can enhance workforce readiness and training efficiency. In this regard, the current study reinforces the necessity of providing accessible and structured technical resources to support knowledge-intensive processes in organizational contexts.

Most notably, the study confirms the significant positive effect of knowledge management on the optimization of learning and training. This aligns directly with the findings of Razaqi et al. (2022), who established a positive and meaningful relationship between knowledge management, digital literacy, and job performance, mediated by organizational learning. Their research supports the argument that robust knowledge management systems are essential for leveraging digital tools in educational environments to enhance employee performance (Razaqi et al., 2022). Similarly, the results resonate with the work of Heidari et al. (2024), who emphasized the need for educators to internalize and apply learning theories in virtual settings—a process that requires effective knowledge management systems to facilitate the integration of theoretical knowledge into practice (Heidari et al., 2024).

The central mediating role of knowledge management in the current study also finds support in the research by Razaqi et al. (2023), who explored how knowledge management, along with student attitudes and system quality, indirectly influences e-learning usage through the mediation of learning acceptance. Their findings suggest that knowledge management acts as a vital mechanism for aligning technological capabilities with user engagement in learning systems (Rezaqi et al., 2023). The present study contributes to this literature by extending the mediating role of knowledge management beyond user attitudes and acceptance to organizational learning optimization, thus broadening the scope of inquiry into how knowledge systems enhance learning infrastructures.

In addition to theoretical alignment, the study offers practical implications for understanding how IT infrastructure components—specifically information generation, networking, and technical knowledge—can be optimized to strengthen knowledge management practices. The findings show that improvements in any of these components can positively influence knowledge management, which in turn elevates the effectiveness of learning and training programs. This insight provides organizations with a strategic pathway for enhancing training outcomes by focusing on both technological investments and knowledge management capabilities.

The study's results also contribute to a more nuanced understanding of the mechanisms through which digital environments and virtual platforms impact employee development. For example, the significance of information networking emphasizes the need for communication technologies that support not only the dissemination of information but also the formation of interactive learning communities (Zamiri & Esmaeili, 2024). The findings suggest that IT systems should not be designed

merely for content delivery but should be oriented toward knowledge co-creation and peer-to-peer exchange, both of which are fundamental to organizational learning.

Moreover, the validation of the research model using structural equation modeling with satisfactory R^2 and Q^2 values affirms the explanatory and predictive power of the model. The R^2 value for knowledge management (0.639) and for learning and training optimization (0.444) indicates a moderate to strong level of explained variance, which, according to Chin (1998), represents a well-fitted structural model. The Q^2 values further validate the model's predictive relevance, reinforcing the conclusion that knowledge management serves as an effective conduit between IT infrastructure and educational effectiveness (Chin, 1998).

In sum, this study corroborates the findings of previous research while extending the literature in a meaningful way. By empirically confirming the mediating role of knowledge management and identifying specific technological components that contribute to learning and training optimization, the study provides both theoretical depth and practical relevance. It reinforces the view that the successful implementation of IT in learning systems depends not solely on technological sophistication but equally on how well knowledge is managed, shared, and utilized within organizational ecosystems.

Despite the robust findings, the study has certain limitations that should be acknowledged. First, the research was conducted within a specific regional and organizational context—knowledge-based companies in Isfahan—which may limit the generalizability of the results to other geographical regions or sectors. Second, the use of self-reported questionnaires, while appropriate for perception-based constructs, may introduce response biases such as social desirability or overestimation of capability. Third, the cross-sectional design of the study prevents the establishment of causal relationships over time. Longitudinal data would provide a clearer understanding of the dynamic interactions between IT infrastructure, knowledge management, and learning optimization. Finally, the study did not differentiate between types of IT platforms or specific organizational roles, which may influence how knowledge management is practiced and how learning outcomes are realized.

Future studies could expand this research by exploring the model across diverse organizational settings, including public institutions, non-profit sectors, or multinational corporations, to enhance external validity. Researchers are also encouraged to conduct longitudinal studies to assess how the relationships among variables evolve over time, especially in fast-changing technological environments. Additionally, qualitative research methods such as interviews or case studies could be employed to gain deeper insights into how employees experience and engage with knowledge management systems. Future research might also examine the moderating effects of organizational culture, leadership style, or employee digital literacy on the relationship between IT infrastructure and knowledge management. Finally, experimental designs testing the effectiveness of specific IT tools on knowledge sharing and learning outcomes could provide more actionable guidance for practitioners.

Organizations aiming to enhance the effectiveness of learning and training initiatives should prioritize investments in IT infrastructure that facilitate real-time information sharing, knowledge networking, and access to technical expertise. Creating a formalized knowledge management strategy, including digital repositories and collaborative platforms, can significantly amplify the benefits of existing IT systems. Training programs should be embedded within an organizational culture that values continuous learning, where employees are encouraged to contribute to and utilize shared knowledge resources. Managers should focus on building integrative systems that connect knowledge flows with performance metrics and learning goals. By doing so, they can ensure that IT investments translate into meaningful and sustainable improvements in organizational learning capacity.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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