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RESEARCH ARTICLE

The impact of leadership style on employee voice behavior in the context of digital transformation: An exploration of the psychological mechanism based on self-determination theory

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ABSTRACT

The purpose of this research is to examine the role that ambidextrous learning, self-efficacy, and the satisfaction of basic needs play in mediating the connection between digital transformation leadership (DTL) and employee voice behavior. Also covered is how an innovation-friendly setting could act as a moderator. Organizations can utilize the findings to gain theoretical support and practical recommendations on how to increase innovation, improve decision-making quality and efficiency, and accelerate digital transformation through employee input. This study used ambidextrous theory and social cognitive theory to construct a theoretical model that examined employee voice behavior as a dependent variable. Leadership in digital transformation, ambidextrous learning, self-efficacy, meeting fundamental needs, and an environment conducive to innovation are all components of the paradigm. The mediating and moderating effects of the proposed model were experimentally tested with the help of SPSS and AMOS after 658 valid data points were collected from questionnaire surveys. First, leadership during digital transformation has a positive effect on employee voice behavior. Second, leadership during digital transformation has an effect on employee innovation behavior. Third, innovation atmosphere moderates the effect of dual learning, self-efficacy, and basic needs satisfaction on employee innovation behavior. Fourth, basic needs satisfaction, self-efficacy, and dual learning mediate the effect of digital transformation leadership on employee innovation behavior. This study's results can help companies appreciate the value of human capital activation and the urgency of creating a flexible response mechanism to deal with digital disruption and international competitiveness. Improving digital transformation leadership and fostering staff engagement in advice and innovation can help organizations enhance their decision-making efficiency and competitiveness. Previous empirical studies have established that employee enthusiasm can be increased by developing an organizational climate that fosters creativity. The current study is unique in the following contributions: (1) by extending the existing knowledge on digital transformation leadership and employee voice behavior to the ambidexterity and social cognition approaches, and (2) by exploring the intrapersonal processes that hold these relationships, including ambidextrous learning, self-efficacy, and satisfaction of basic needs.

Keywords: Digital transformation leadership; employee voice behavior; ambidextrous learning; self-efficacy; organizational commitment; innovation climate; employee innovation behavior

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1. Introduction

Artificial intelligence, cloud computing, and big data are some of the technological advances that are evolving at an unimaginable pace in the modern digital economy, and they are providing enterprises with a broad range of digital resources [1]. This has sparked off fundamental changes in business models that were in existence, and at the same time, it has also altered the way people consume and also their daily living patterns. Therefore, digital transformation can no longer be overlooked as a precondition of gaining sustainable development and maintaining competitive advantage by firms. Their ability to maneuver through the change and take advantage of the emerging opportunities would depend on effective leadership that is vital in guiding organizations through this complex change [2,3].

Can you tell me what "digital transformation" is? This systematic shift is being propelled by state-of-the-art technological means. In order to achieve digital transformation's ultimate goal of better product and service delivery, a complete organizational overhaul is required, one that makes use of cloud computing, social media platforms, big data, data analytics, mobile communication technologies, and more than just updating technology[4]. Four to six the significance of understanding that digital transformation entails adjustments to firm culture, organizational structures, and business processes in addition to altering tools all in an effort to fulfill the constantly evolving market demands brought about by digital technology[5,6].

Within the framework of digital transformation, the emphasis here is on both people and technology. For digital transformation to be effective, people and organizational competencies must take center stage. "Digital transformation" means more than just adding new tech; it also means bringing in fresh faces at the top and altering the company's culture to help it thrive in the digital age [7]. At every stage of digital transformation, strong leadership is essential.

In this information era, the demand for CEOs who can lead digital transformation within their companies is a hot subject. When it comes to complex and constantly evolving digital challenges, digital transformation leadership is more adaptable and skilled than more conventional leadership methods. Both academics and entrepreneurs are beginning to recognize digital transformation leadership as a critical skill for modern firms to have. Because of this, research into the idea, including its definition, characteristics, and interplay with elements like innovation management, market focus, and strategic alignment, has recently seen a renaissance [8]. Leadership is crucial during digital transformation, but academics have yet to fully grasp the role of digital transformation leadership (DTL) or conduct a comprehensive study on the topic [9]. To address this gap in our understanding, this project will investigate DTL's meaning and applicability in detail and put its underlying mechanisms to the test empirically. The results will then be used to enhance and develop related theoretical frameworks.

Innovation and competitiveness can be boosted by encouraging individuals to accept change and set a good example. With the help of digital transformation leaders, how can businesses accomplish this? Those at the helm of digital transformation initiatives demonstrate characteristics and take measures that help their teams adjust to the dynamic nature of the digital landscape. If a company wants to survive in today's competitive business world, every person has to do their part by contributing their unique ideas, skills, and knowledge. As the number of external concerns continues to rise, organizations are placing a greater emphasis on innovation and quick response. According to González [10], the "first step" in encouraging creativity is when employees offer constructive criticism. Workers are able to drive innovation inside the firm and adapt to changing situations with the help of voice behavior, which provides a key channel for workers to constructively convey their thoughts and ideas. Employee expertise and knowledge is another key internal factor driving organizational development in the context of company operations, as stated by Fang

Zhibin (2015) [11], a Chinese researcher. The degree of creativity shown by the employees will have a significant impact on the company's future.

The literature has clearly outlined the contribution of transformational leadership in the employee voice behavior. This study would take this further by proposing Digital Transformation Leadership (DTL) as a context-specific construct. Unlike more conventional transformational leadership models, DTL is a synthesis of digital agility, technological orientation, and strategic vision as a component of a more general theory of self-determination. The concept of ambidextrous learning and psychological capital (self-efficacy and organizational commitment) are identified as the main mediators, thus, providing a sophisticated explanatory framework of the intrapersonal processes between DTL and the voice behavior. Besides, the paper includes the moderating role of the innovation climate, which is not a common factor that is explored along with various mediators in the same structural equation modeling (SEM) model. It combines these factors to present an empirically based, theory-enriched explanation of the leadership behavior in the conditions of digital transformation and the relationship between this behavior and proactive employee engagement and communication related to innovation.

2. Theory and hypotheses

2.1. Concept of digital transformation leadership

Academic interest in leadership as it relates to digital transformation has grown in tandem with the information age. A genuine and dynamic notion, "digital leadership" represents the development and modernization of leadership in the information age. The term "digital leadership" refers to a style of management that combines technological advancements with an emphasis on the leader's character traits such as kindness, inclusion, transformative strength, and moral rectitude. Technology is not leadership in the digital era; rather, it is the complementary utilization of digital resources [12].

Based on a review of the literature, this study adopts the term Digital Transformation Leadership (DTL) to more accurately describe leadership within the context of digital transformation. According to recent research, DTL is an emerging leadership style that combines digital and transformational elements [13]. As a result, it combines the best parts of the two leadership models that inspired it. Before continuing with the research, it is crucial to clarify the connection between these concepts.

For Nyakomitta [14], a transformational leader is one who inspires their team members to think creatively and take initiative through a combination of charisma, psychological and intellectual motivation, attention to employees' needs and development, and promotion of organizational change and innovation. The team's capacity to carry out tasks efficiently is subsequently enhanced. Digital management is characterized by "the ability of leaders to impact the mindsets and actions of their organization's members through the utilization of various digital resources to facilitate digital transformation and adapt to the digital landscape" [15]. Sağbaş [16] argues that digital leadership has a significant social impact due to the fact that it promotes behavioral changes in individuals, groups, and organizations through the utilization of sophisticated information technology. To aid their companies' digital transition, executives that are skilled in digital leadership will advocate for digital transformation, create digital teams, and support the usage of digital technologies. McCarthy first used the phrase "Digital Transformation Leadership" (DTL) [17].They proposed the term "digital transformational leadership" (DTL) to describe top-level executives' comfort with and skill with digital tools and processes. These leaders craft a clear and idealized digital vision that inspires employees to reach their maximum creative potential and make proactive, meaningful enhancements so that the organization may achieve its digital goals. This kind of guidance allows companies to respond quickly to

shifting consumer preferences and seize emerging digital opportunities. The DTL specification provided by is utilized in the present study[18].

2.2. Voice behavior

2.2.1. Concept of voice behavior

Shipton [19] was the first to introduce the concept of "voice," defining it as a type of employee response to dissatisfaction in the workplace. Building on this idea, he further described voice as the act of employees expressing dissatisfaction to superiors or other authority figures, with the intention of changing or improving an undesirable situation.

Hubbart [20] views employee proposals as an optimistic endeavor that entails taking certain risks in order to promote the organization's growth. Additionally, suggestion behavior improves the organization's development status while also easing its present difficulties. This task is not part of the main role. It is both subjective and proactive [21]. Elshaer [22] argues that when workers are aware of the resource requirements set by their supervisors, they are more likely to generate ideas independently. He views suggestions as a resource that the business can use. The second school of thought sees "voice behavior" as a movement toward more open and frequent communication among employees as a means to both personal and professional development. Following Timuçin's [23] lead, most domestic studies on employee voice have defined voice behavior as an extra-role conduct when employees proactively offer constructive proposals to improve the organization's developmental status or ease present difficulties.

2.2.2. Study contribution and theoretical advancement

The previous empirical studies have proved that transformational leadership has a constructive effect on the employee voice behaviour, yet the current body of literature has failed to acknowledge the type of challenges that digital transformation poses. The current research falls into the theoretical context of Digital Transformation Leadership (DTL) as an integrative construct defined by the combination of historically transformational qualities and skills, specific to technology and media, such as adaptability, technological fluency and strategic vision.

With the help of the Self-Determination Theory, the study focuses on the role of DTL as a mediator between leadership and employee voice through ambidextrous learning, self-efficacy and organizational commitment. Additionally, the innovation climate is viewed as a moderating factor, by virtue of which it allows the research to place the employee voice in the immediate context of the organization.

The use of multiple mediators alongside a moderator in one statistical model provides a strong and context-sensitive explanation of how leadership has an impact on employee voice in the process of digital transformation.

2.3. Ambidexterity

2.3.1. Concept of ambidexterity

The ability to do two tasks simultaneously is the origin of the word "ambidexter," which is the adjective "ambidextrous" in this context. March was the first to propose the concept of ambidexterity in the field of organizational learning (1991). Looking down from this vantage point, he could make out the two halves of organizational learning, the exploratory and exploitative halves, which are mutually supportive and interconnected. Shi [24] elaborated on this idea by drawing a distinction between exploratory and exploitative learning. Exploratory learning entails bringing in new members and actively seeking out information from outside sources, while exploitative learning involves creatively recombining and altering parts of known

knowledge. This study defines exploratory learning as the act of acquiring, integrating, and using new information and technology; utilization learning as the act of thoroughly exploring and mastering one's current body of knowledge; and dual learning as the behavior of utilizing both of these learning modalities simultaneously, based on Chang's [25] definition of individual dual learning.

2.4. Self-efficacy

2.4.1. The concept of self-efficacy

The belief that one can successfully complete a task is known as "self-efficacy," a concept initially proposed by Schunk [26]. According to Bovolon, self-efficacy is the internal motivator that has the power to guide one's ideas and actions [27]. When people believe in their own abilities, it motivates them to take action, which in turn affects their thoughts, feelings, and physical and mental states. General self-efficacy is defined as an individual's average level of confidence in their capacity to handle challenges in complex circumstances [28]. The term "self-efficacy" has both wide and narrow applications in Chinese psychology. To back up his claim, Bandura [29] defined self-efficacy as the confidence in one's ability to accomplish one's objectives. This study employs the following definition: A person's self-efficacy can be defined as their belief in their own capacity to handle specific circumstances. In the context of a job, it is the extent to which an employee feels they have the skills necessary to complete a task.

2.5. Organizational belonging

2.5.1. Concept of organizational belonging

Organizational belonging (Organizational Commitment) is also translated as organizational commitment by many domestic scholars. Strawder [31] believes that organizational belonging is a deep psychological constraint that affects individual behavior. It goes beyond value identification and reflects the fit between individual values and organizational goals. It reflects the desire, need and sense of responsibility for membership. Oljemark [32] believes that employee belonging refers to the employees' approval and recognition of the organization in terms of spirit, personal emotions and inner subconsciousness, so that they voluntarily assume organizational responsibilities and obligations, and work enthusiastically with the mentality and sense of responsibility of the owner. Waller [33] argued that a sense of belonging represents the emotional connection between the individual and the organization, and reflects an individual’s proactive engagement with the organization. Zhu [34] defines organizational commitment as the degree to which employees not only believe in and strive toward the organization's stated goals, but also intend to remain with the company for the near future and contribute to its expansion. This study employs this definition.

2.6. Innovation atmosphere

2.6.1. Concept of innovation atmosphere

Zhong [35], first proposed the concept of innovation atmosphere, which is the subjective perception of individuals on the part of the environment within the organization that is innovative. Ozsoy [36] defined organizational innovation atmosphere as a set of measurable organizational characteristics in the work environment that are directly or indirectly perceived by organizational members and that affect the innovative behavior of employees, including environmental freedom, organizational support, teamwork, learning and growth, and ability development. Zhang [37] believed that organizational members' perceptual description of the degree to which their work environment supports creativity and innovation will affect the attitudes, beliefs, motivations, values and innovative behaviors of organizational members, and thus affect the innovation ability and innovation performance of the entire organization. This study adopts this definition, as it emphasizes that innovation climate is a cognitively based construct from the employee’s perspective. It

also highlights the impact of innovation climate on both the psychological and behavioral dimensions of employees, as well as its significance for the organization as a whole.

The relationship between digital transformation leadership and employee suggestion behavior

Ding [38] believes that transformational leaders provide life and emotional care based on the individual differences of employees. This personalized care is actually a communication process between leaders and subordinates. In this process, both parties can understand each other more deeply, employees' problems can be fed back and solved in a timely manner, and employees can make constructive suggestions. In the context of digital transformation in the digital age, digital transformation leaders have unique personal charm, and employees will have a strong sense of following and respect for them, enhance their sense of belonging to the organization, firmly follow the leaders, and work hard to achieve personal and organizational goals. Qalati, [39] found that transformational leaders, through their distinctive leadership style, can enhance subordinates' commitment to both the leader and the organization, thereby inspiring a willingness to follow. In such contexts, employees' sense of responsibility increases, and they perceive the achievement of organizational goals as their personal mission. This motivates them to actively express their ideas and suggestions to the organization. Transformational leaders also foster a climate of change and innovation, encouraging subordinates to develop emotions aligned with transformation—such as enthusiasm, openness to change, and a proactive mindset. These transformational emotions further promote employees' engagement in promotive voice behavior that benefits the organization [40].

Rasheed [40], demonstrated that transformational leadership has a significant positive impact on employee voice behavior. Hai [41] found that when a leader's style is more transformational, employees are more likely to have their suggestions—whether proposing new ideas or pointing out existing problems-recognized and encouraged by the leader. Drawing on Social Exchange Theory, investigated the relationship between transformational leadership and employee voice. Their findings also confirmed that transformational leadership plays a facilitative role in encouraging employees to offer suggestions. According to this theory, a principle of reciprocity exists between transformational leaders and employees. When employees perceive benefits provided by the organization, leaders are more likely to view employee suggestions as valuable contributions to both themselves and the organization. In such circumstances, the transformational leadership style encourages employees to continuously offer ideas and suggestions to help resolve internal organizational issues. By showing support and respect, transformational leaders cultivate positive relationships with employees and provide emotional, intellectual, and resource-based support to facilitate their development and help them realize their full potential.

Al-Husseini [42] studied the positive effect of transformational leadership on promoting employees to give advice to their superiors and colleagues. The results of Mubarak [43] showed that transformational leadership had a significant positive impact on employees' advice behavior. Chua [44] studied the significant positive impact of transformational leadership on employees' advice based on self-determination theory.

A good leader-subordinate relationship will encourage employees to participate in voice behavior. When leading the team to transform the enterprise, digital transformation leaders should advocate an open communication and cooperation culture and encourage employees to participate in the decision-making process. They should value employees' opinions and suggestions and consider them in decision-making. In the face of new situations, digital transformation leaders should provide employees with learning and development opportunities to help them improve their skills and knowledge. They should encourage employees to try new ideas and methods, and provide training and learning resources to stimulate employees'

creativity and innovative thinking, so that they are more capable of making suggestions and improvements. Based on this, the hypothesis is proposed:

H1: Digital transformation leaders have a positive impact on employees' voice behavior.

The relationship between digital transformation leadership and dual learning

Ilyas [45],found through empirical research that transactional or transformational leadership styles adopted by senior and middle-level managers can effectively promote exploratory learning and exploitative learning in the organization, but different leadership styles have different degrees of influence on the two learning modes. This finding echoes the research conclusion that the leadership behavior of corporate management is an important factor affecting organizational dual learning. With the deepening of digital transformation, Wang [46] explored the impact mechanism of transformational leadership on employees' digital creativity based on organizational learning theory and found that digital exploration and digital utilization play a mediating role between the two.

Makedon [47], further confirmed the importance of digital leadership in supporting corporate marketing, innovation, and invention strategies. It is worth noting that when leaders have transformational characteristics and moral leadership motivation, and these traits are widely shared among employees, they can significantly enhance organizational learning behavior. These studies together show that leadership style and leadership characteristics play a key role in the organizational learning process, especially in the context of digital transformation, and their importance is becoming more and more prominent.

In the process of digital transformation, the role of leaders is primarily reflected in two aspects: building a supportive learning environment and promoting individual ambidextrous learning. Specifically, digital transformation leaders systematically construct a supportive organizational context by providing employees with diverse learning opportunities and resources, effectively stimulating their innovative thinking and exploratory spirit. At the same time, they focus on cultivating a learning-oriented team culture. Faced with the new environment and new challenges brought by digital transformation, this type of leader can better mobilize the internal driving force of employees, and encourage employees to actively explore new knowledge and accumulate new experiences by stimulating their curiosity and thirst for knowledge. Compared with traditional leaders, digital transformation leaders need to pay more attention to establishing an open and inclusive learning environment [48], and continuously stimulate individual innovation potential and willingness to explore through institutional design and resource investment, so as to promote the overall digital transformation process of the organization. Based on this, the following hypothesis is proposed:

H2: Digital transformation leadership has a positive impact on dual learning.

The relationship between digital transformation leadership and self-efficacy

Salanova [49] research pointed out that when employees perceive more transformational leadership behaviors, their self-efficacy and self-esteem levels will increase accordingly. This finding was further verified by Yuwono [50], whose research showed that transformational leaders can positively influence subordinates' self-efficacy through their own ability demonstration and determination transmission, thereby stimulating employees' work motivation and work beliefs, and ultimately improving work performance. Njaramba [51]empirical research expanded this conclusion from the perspective of psychological capital, confirming that transformational leadership is not only positively correlated with employees' self-efficacy, but also has a significant positive correlation with other dimensions of psychological capital such as hope, optimism and resilience. Furthermore, the study by and Zhao [52] provides additional support for this perspective. They found a significant positive correlation between transformational leadership and

employees' levels of self-efficacy and followership-that is, the more transformational leadership behavior employees perceive, the higher their self-efficacy and followership levels. Collectively, these studies indicate that transformational leadership plays an important role in enhancing employees' psychological capital and job performance.

In the digital era, digital transformation leaders are more resolute and supportive in guiding enterprise transformation. They place greater emphasis on resource provision, offer necessary support, serve as role models, assign employees more challenging tasks and projects, and provide broader learning opportunities. In the context of digital technology adoption, supervisors play a critical role in influencing subordinates' intrinsic motivation and behavioral intentions toward technology use Deng [53]. When managers demonstrate idealized influence and individualized consideration, employees are more intrinsically motivated to adopt and utilize such technologies. This helps to enhance their confidence in overcoming challenges and completing specific tasks, which in turn affects their ability to use digital technology to create constructive results for problem solving. All of these can enhance employees' self-efficacy, help stimulate employees' enthusiasm and creativity, make them more willing to actively participate in digital transformation, and believe that they can successfully cope with the challenges brought by transformation. At the same time, enhanced self-efficacy can also help employees more confidently deal with difficulties and adversities in digital transformation, and improve work performance and results. Based on this, it is proposed:

H3: Digital transformation leadership has a positive impact on self-efficacy.

The relationship between digital transformation leadership and organizational belonging

Transformational leaders emphasize the importance of team goals and will sacrifice their own interests for team goals. These behaviors can win the respect and following of employees and awaken their sense of belonging. Boland [54] proved that leadership has a positive impact on organizational belonging. Transformational leaders emphasize helping subordinates build their own knowledge and abilities, thereby enhancing employees' self-confidence, which helps meet employees' competitive needs. Through transformational leadership, leaders can strengthen relationships with subordinates and subordinates and establish emotional connections. Johnstone and Kyambade [55] found that transformational leadership can fulfill employees' need for belonging in the workplace and influence their behavior by satisfying this need. Effective leaders motivate and encourage employees to work toward shared goals while demonstrating a strong sense of organizational responsibility, thereby enhancing employees' effort, productivity, and loyalty.

Becoming a digital leader is not solely about the organizational context but also about leadership style and capability. A digital leader motivates employees to innovate and supports their ideas, fostering an environment in which organizational members feel a strong desire to remain with the company due to the leader's support. An adaptive leadership style cultivates followers' commitment, and leadership is generally considered a key factor in developing a strong sense of organizational belonging. The correlation between leadership style and organizational commitment is positively correlated. Bacha [56] believes that leadership, especially in terms of encouragement, autonomy, and transformational style, tends to encourage a higher sense of belonging to the organization. Islam [57] pointed out that the ability of leaders to inspire and motivate employees is based on trust. Employees who trust their business leaders feel more loyal to the company, feel that the organization supports them, and feel that the leader will allocate resources fairly, treat others properly, and follow procedures transparently.

Digital transformation leaders can enhance employees' sense of identity and belonging to the organization through open communication, promoting teamwork, motivating employees, and providing support and resources. This positive leadership style helps to establish a healthy organizational culture,

promote employee job satisfaction and loyalty, and thus have a positive impact on organizational belonging and contribute to the development of the organization. Based on this, it is proposed that:

H4: Digital transformation leaders have a positive impact on organizational belonging.

The relationship between dual learning and employee voice behavior

Adapting to the new organizational context, identifying and resolving work-related difficulties, and proposing solutions that leverage both new and current knowledge and experience are all tasks that knowledge workers with an innate motivation to learn would excel at, according to Cai [58]. So, to close the gap between their current and ideal situations, people are more likely to express their discontent. A further advantage of learning motivation is that it can empower knowledge-based employees to voice their opinions, even if they go against the company's current practices. In the absence of intrinsic motivation, employees could be afraid to suggest new ideas for fear that management will reject them or that they do not have enough solid reasons to back them up. Conversely, risk-takers are more likely to be people who have a strong desire to succeed academically. Knowledge workers who are really committed to learning should not only work hard to improve their abilities, but also take pride in demonstrating their self-assurance by sharing the ideas and information they've gleaned from their extensive knowledge in the subject. Knowledge workers' personalities impact their level of openness to publicly sharing their opinions and suggestions, which is considered as a sign of competence [59].

H5: Ambidextrous learning has a positive impact on employee suggestion behavior.

The relationship between self-efficacy and employee voice behavior

Shakil, [60] believe that psychological capital represents the psychological potential of an individual and helps inspire employees to exhibit more organizational citizenship behaviors. Voice behavior is a challenging and innovative role-external behavior. Employees with a high sense of efficacy will choose to persist when faced with difficulties. A sense of efficacy helps to promote positive behavior among employees, who will put forward their own suggestions and ideas to the organization. Voice behavior is a challenging role-external behavior that changes the organizational environment. If voice behavior fails, it may be opposed and rejected by other team members. Therefore, given the challenging nature of voice behavior, employees need to have enough confidence in themselves.

Self-efficacy refers to the degree of confidence that an individual has in his or her ability to successfully perform tasks and required actions. To a certain extent, employees' self-efficacy reflects their confidence in whether they can make suggestions and whether their suggestions will be adopted. Staff members with high levels of self-efficacy believe in their abilities and ideas and are prepared to overcome any challenge that may come their way while offering proposals. The available literature on employee behavior in the workplace environment shows that the employees with strong self-efficacy, which can be defined as the feeling of individual capability, are more likely to make constructive suggestions. These people work with an unspoken belief that their recommendations will bring positive results. As a result, they are likely to participate in behaviour that serves the organizational interests.

In theory, the self-efficacy concept refers to a belief that an individual has about his/her ability to perform specific tasks. As far as organizational interactions are concerned, it can be conceived as the confidence of an individual in the proposed-making capacity and the probability of such suggestions being implemented. Staff members with a high rate of self-efficacy believe in their abilities and ideas and tend to address challenges and present some proposals. In addition, employees who support their competencies will tend to act positively in making recommendations as they anticipate that the proposals will have good results.

On the other hand, employees with low self-efficacy are not likely to offer solutions in the work place. Employees with high self-efficacy are more likely to make suggestions that benefit the organization. On the contrary, employees with low self-efficacy will doubt their own control and decision-making ability, and then have a strong sense of anxiety, thus reducing their suggestions. Based on this Achari[61], it is proposed:

H6: When workers believe in themselves, they are more likely to give constructive criticism.

The Relationship Between Organizational Commitment and Employee Voice Behavior

An individual's level of organizational commitment is determined by the strength of the emotional and psychological connection they develop with their organization. It follows that belonging to a group is highly prized. A highly dedicated employee is one who sees themselves as an integral component of the company's mission and who invests both intellectually and emotionally in its success. Consequently, they are more inclined to contribute positively and have an effect on the company that is good for it. Given that employees are considered insiders, their proposals are more likely to be taken seriously[62]. Employees need to feel that they are an indispensable part of the organization and are recognized and valued. Leaders can express their attention and respect for employees by providing opportunities and platforms for employees to make suggestions, so that employees feel that their voices are heard and important. This sense of belonging can stimulate employees' enthusiasm and involvement, and encourage them to participate in suggestion activities more actively. Hamza [63] used employee suggestion behavior as the outcome variable and found that normative commitment and affective commitment both have significant positive effects on suggestion behavior, and affective commitment has a greater effect. Organizational commitment reflects employees' emotional attachment to the organization. Employees with high levels of commitment tend to place greater importance on the organization's development, exhibiting fewer withdrawal behaviors and showing a stronger willingness to offer suggestions aimed at improving performance. In this sense, organizational commitment actively promotes voice behavior from another perspective. They first focused on the level of organizational belonging of employees and found that high perceived organizational investment in employee development can enhance the impact of perceived supervisor support on organizational belonging, Nur [64]. Secondly, they studied the moderating effect of work involvement and found that employees with high work involvement have a stronger role in the impact of organizational belonging on inhibitory voice. Based on this, they proposed:

H7: Organizational belonging has a positive impact on employee voice behavior.

The relationship between dual learning, digital transformation leadership and employee voice behavior

Brother Theophilus [65] Knowledge workers may be motivated to learn more through enterprise digital transformation, which could help them concentrate on gathering the complex and varied data needed to generate new ideas. When workers have access to new ideas and information, they are more inclined to publicly support digital transformation. Leaders in the sector would do well to encourage their teams to engage in lifelong learning if they want to be better prepared to face the challenges brought about by digital transformation. Workers are more inclined to engage in ambidextrous learning, which involves transferring knowledge from the classroom to real-world scenarios, thanks to this new motivation to learn. The opportunity to step beyond of one's comfort zone, test out new strategies, and ultimately discover what works motivates people to speak up. This prompts the following theory to be put forward:

Proposition 15: Ambidextrous learning mediates communication between digital transformation executives and their staff.

The relationship between self-efficacy and digital transformation leadership and employee voice behavior

A major principle of social cognition theory, self-efficacy affects people's mental health and the amount of motivation they feel inside to alter their behavior as they choose. According to studies, employees exhibit greater dedication and effort on the job when they have faith in themselves and their talents. Their ability to focus on professional responsibilities, along with their passion and excitement, gives them greater energy and enthusiasm to their work. Business owner, 66 years old. When employees have faith in their own talents, they are more likely to be competent and confident in their work. When workers have faith in their abilities, they are more likely to provide constructive feedback. When workers are valued and acknowledged for their efforts, they are more inclined to provide helpful criticism and participate in actions that promote the digital transformation of the business. Workers' level of self-assurance impacts both their level of engagement and their level of initiative. When individuals believe in their abilities, they are more likely to provide a hand with digital transformation projects. They have come to publicly support the digital transformation of the firm, reflecting their growing belief in the importance of their position. Employees' belief in their own abilities also plays a role in their resilience. When leaders in digital transformation lay out specific objectives and steer staff through major changes, they may encounter resistance from staff. Employees that believe in themselves are more likely to push through difficulties, keep going when things become tough, and eventually succeed. Contributing their expertise to the digital transformation of the organization, they keep a positive attitude, bounce back quickly from failures, and keep talking [67].

H8: Self-efficacy plays a mediating role between digital transformation leadership and employee advice behavior

The relationship between organizational belonging and digital transformation leadership and employee voice behavior

When CEOs put their own needs first, it fosters a culture of trust and loyalty among employees, which in turn encourages greater corporate citizenship efforts. Furthermore, subordinates are more likely to speak up and engage in productive dialogue with their superiors when they receive this type of attention. The research of Kuczman [68]. Employees that have trust in their superiors and the organization are more inclined to offer suggestions that align with its goals, which increases the suggestions' efficacy. Because of this, they believe their opinions will be acknowledged. Sharif [69] demonstrated that organizational commitment moderates the association between transformative leadership and employee voice behavior. Success in digital transformation can be achieved when leaders shape the company's culture, provide incentives, and offer support to employees. By fostering a sense of community, leaders can boost employee engagement and creativity during digital transition. Because of this positive impact, employees are more inclined to speak up and help bring about change and innovation in the firm. Employees' confidence in management's support increases their willingness to raise concerns, which benefits the organization's digital transformation initiatives. Because of this, the following hypothesis can be advanced:

H9: Organizational commitment mediates the relationship between digital transformation leadership and employee voice behavior**.**

Moderating effect of innovation atmosphere

By I. Georgescu [70] Team leaders can create a more innovative work environment by using specific strategic HRM practices. Members of a team are more likely to be open to new ideas, discuss and implement

them, and support one another when doing so in an environment that encourages creativity. Studies have shown that leaders play a pivotal role in creating an environment conducive to teamwork. A linear relationship exists between leaders, team cohesiveness, and verbal habits of employees. One-way leaders can influence their employees' voice behavior for the better is by creating a welcoming and equitable team environment. In an innovative setting that is willing to take risks, employees may feel less interpersonal danger when they make suggestions. Therefore, under a high level of innovation atmosphere, team members are more likely to believe that voice is safe and effectively shared. Transformational leaders stimulate exploratory and critical thinking among employees by promoting interaction between them. They encourage employees to share ideas and suggestions, providing methods that challenge traditional approaches and offer adventurous solutions to problems. The formation of a team voice climate is the result of social interaction and collective interpretation working together Wang [71]. In a high-level innovation atmosphere, team members will interact more frequently and timely, and effectively exchange new ideas, which helps to transform employees' perception of transformational leadership behavior into a common understanding and judgment among team members, and promotes the rapid formation of a team suggestion atmosphere. On the contrary, if the team's innovation atmosphere is low, the team lacks tolerance, and the interaction and communication between members are insufficient, it will hinder the sharing of information conveyed by the leader among team members, thereby weakening the impact of transformational leadership on the team suggestion atmosphere.

The trusting environment encourages employees to voice their thoughts, which in turn boosts innovation. The leaders of the digital transformation initiative are pushing for more candid communication amongst employees as a way to encourage the sharing of knowledge. This kind of team leadership encourages people to speak their minds and share their perspectives. Employees are more inclined to engage in voice behavior, which is made possible through open communication channels and discussion platforms, when leaders provide a setting where they may freely express their ideas and thoughts without worrying about punishment or criticism. I agree [72]. This leads us to propose the following theory:

H10: Innovation climate positively moderates the relationship between digital transformation leadership and employee voice behavior.

A positive learning and innovation culture is an essential precondition of an innovation climate which makes employees willing to participate in constant learning and analyze new ways and approaches to thinking. In this cultural context, staff are more willing to challenge, to offer solutions with confidence and to apply new practices thus promoting organizational innovation and growth. At the same time, an innovation climate reduces the interpersonal risks that employees face in the process of communicating suggestions and increases trust and cooperation between members of the team. As a result, staff members will become more willing to share ideas and knowledge publicly and to accept and incorporate feedback and suggestions of the peers.

The effective institutionalization of ambidextrous learning requires mutual trust and collegial support as its prerequisites. A strong innovation climate, in addition, puts emphasis on learning and development thus encouraging employees to participate in the continuous process of improvement. In such an encouraging environment, employees are willing to take on challenging tasks and to test new solutions, with their competencies gradually increasing. The resulting positive inclination to learning propagates the proactive voice behaviour where people are able to suggest new ideas and innovative solutions that eventually lead to the benefit of the organization [73].

H11: Innovation climate positively moderates the relationship between ambidextrous learning and employee voice behavior**.**

The workplace that is innovation-oriented creates the atmosphere so that the employees feel safe and trustworthy enough to make suggestions and share opinions. Such openness is strongly encouraged by digital transformation leaders who encourage employees to speak out ideas and opinions freely and in the process establish a favorable organizational culture [74]. The resulting culture of safety and trust enhances the feeling of self-efficacy in the employees and makes them more confident in the importance of their contributions. Such leaders focus on constant communication and collaboration between teams and empower employees to provide their opinions and suggestions, thus stimulating the active voice behavior and increasing the levels of self-efficacy.

Digital transformational leadership can be described as a way of leadership whereby leaders listen to employees in a methodical manner, convert their ideas into workable projects, and reward contributors who take organizational performance to a higher level. This organized feedback and incentive framework increases the faith that employees have in their skills and rewards them to positively engage in workplace conversation. The hypothesis we base on this description is:

Employers that enable positive employee feedback loop and establish positive reward systems create a culture of accountability and reciprocity throughout the organization:

H12: A supportive work environment for innovation mitigates the beneficial influence of self-efficacy on employees' propensity to speak up.

Employees are more likely to take risks, try new things, and learn from their mistakes in an innovative workplace. When organizational environment is perceived as safe, staff members tend to be more engaged in interpersonal voice; the perception, in its turn, is positively related to creativity and productivity. Creative organisational practices can spark the creativity and passion of employees and thus create a climate that encourages their voice behaviour. Voice behaviour is highly mediated by the feeling of belongingness among the employees. The case is that when the degree of organisational belonging is high, an environment that proactively encourages innovation is likely to increase voice behaviour, generate more innovative ideas and increase enthusiasm of employees towards their work. The result of such an organisational climate is therefore not only the ability of the employees to speak up but also a strong sense of intrinsic motivation to do their best work.

Therefore, we propose the corresponding hypothesis:

H13: Innovation atmosphere has a positive moderating effect on the positive impact of organizational belonging on employee voice behavior.

3. Materials and methods

3.1. Research subjects and data collection

This study uses established scales that have been extensively employed by numerous researchers and are known for their stability and accuracy. Based on the research context of digital transformation in enterprises during the digital economy era, this study will focus on Chinese companies. The primary subjects of the research will include employees from technology companies, the financial industry, and big data companies undergoing digital transformation, with data collected from these groups. Based on the research subjects selected for this study, purposive sampling was employed to choose a representative sample for the survey.

The questionnaires were distributed and collected online through the use of Wenjuanxing, with anonymous completion required.

The investigation, standardized measurement scales were used based on previous study, and this has led to structured questionnaire with initially 64 items. The six constructs to be measured by these items included Digital Transformation Leadership, Ambidextrous Learning, Self-Efficacy, Organizational Commitment, Innovation Climate and Employee Voice Behavior. This questionnaire has been published online through Wenjuanxing and has been sent to staff in the Chinese companies that have been transformed into digitalization, especially in technological, financial, and big data areas. Seven hundred and forty one responses were collected, which is classified as invalid, given the control questions and time filters used, thus leaving 658 as the valid responses (88.8 percent response rate.

The measurement instruments that were used in this research were analogous to those that were employed in well-established and validated scales that were already utilized in related literature. Namely, the scale of Digital Transformation Leadership (6 items) was taken after McCarthy (2019); the scale of Ambidextrous Learning (8 items) was directly based on March (1991) and further redesigned individually; the scale of Self-Efficacy (7 items) referred to the works by Bandura (1997) on the concept of general self-efficacy; the scale of Organizational Commitment (8 items) to the works by Meyer and Allen (1991) on the three-component approach to Fine tuning of words was done in all scales to make it fit in the digital transformation context of this study.

3.2. Sample collection and background data statistics

Based on the research background of digital transformation of enterprises in the digital economy era, the survey subjects of this study are Chinese enterprises, and mainly select employees of technology-based enterprises, financial industry, Internet big data companies and other enterprises in digital transformation as research subjects for data collection.

In the first step of screening items, 5 items were dropped due to low factor loadings leaving a final 59 items in all constructs. Through this process, 741 questionnaires were collected of which 83 were found to be invalid and therefore discarded leaving a final valid sample size of 658. Such a sample size matches the tradition of similar empirical studies and helps to make the data of the study methodologically sound and valid.

In the confirmatory factor analysis (CFA), some few items of the factors that had poor factor loading were dropped to make the measurement valid. As a result, some of the subdimensions that were originally lost or the appearance of some other subdimensions has forced the increase to 51 items under the analysis of Table 5 compared to the initial 47 (presented in Table 3). This change itself is in the best practice of structural equation modeling and enhances the soundness of the measurement model.

4. Results

Descriptive statistical analysis of demographic variables such as gender was performed using SPSS 26.0, and the results are shown in **Table 1**:

In terms of gender, the proportion of females is slightly higher than that of males, reaching 51.82%, while the age structure is mainly composed of young people aged 26-35, accounting for 34.04%. In terms of educational background, the largest number of people are undergraduates, accounting for 50.61%, and those with a master's degree or above account for 33.13%. In terms of income, the number of people in the range of 6,001 yuan to 8,000 yuan accounts for 45.14%. In terms of industry distribution, the largest number of

people are in technology-based enterprises, accounting for 34.80%, followed by traditional enterprises, Internet big data companies and the financial industry. In terms of positions, ordinary employees accounted for the highest proportion, at 37.99%. In terms of company size, companies with 20-200 employees and 201-300 employees accounted for a large proportion, at 37.39% and 34.50% respectively, while companies with more than 301 employees accounted for 28.12%.

Table 1. Background data statistics of formal test sample

Background Variable	Category	Number	Proportion
Gender	Male	317	48.18%
	Female	341	51.82%
Age	Under 25	33	5.02%
	26-35 years	224	34.04%
	36-45 years	184	27.96%
	46-55 years	124	18.84%
	Over 56	93	14.13%
Highest Education	College or below	107	16.26%
	Bachelor's degree	333	50.61%
	Master's or above	218	33.13%
Income	Below 4000 RMB	72	10.94%
	4001-6000 RMB	183	27.81%
	6001-8000 RMB	297	45.14%
	Above 8000 RMB	106	16.11%
Industry	Technology companies	229	34.80%
	Finance industry	115	17.48%
	Internet big data companies	120	18.24%
	Traditional enterprises	162	24.62%
	Others	32	4.86%
Position	Regular employee	250	37.99%
	Entry-level manager	192	29.18%
	Mid-level manager	216	32.83%
Company Size	20-200 employees	246	37.39%
	201-300 employees	227	34.50%
	Over 301 employees	185	28.12%

***Source**: Organized based on the survey questionnaire.*

4.1. Descriptive Statistics

SPSS 26.0 was used to perform descriptive statistics on the maximum, minimum, mean, and standard deviation of each variable in the formal questionnaire. The results are shown in **Table 2.** The mean of all variables is greater than 3, indicating that the target group has a high degree of digital transformation leadership, innovation atmosphere, dual learning, self-efficacy, organizational belonging, employee innovation behavior, and employee suggestion behavior, and the target group is well selected. All standard deviations are less than 1, indicating that there are no extreme values.

Table 2. Descriptive statistics

Item	Minimum Value	Maximum Value	Mean	Standard Deviation
Digital Transformation Leadership	1.00	5.00	3.008	0.784
Organizational Commitment	1.00	5.00	3.148	0.767
Ambidextrous Learning	1.00	5.00	3.080	0.618
Self-Efficacy	1.00	5.00	3.163	0.757
Innovation Climate	1.00	5.00	3.225	0.621
Employee Voice Behavior	1.00	5.00	3.260	0.900

***Source**: Organized based on the SPSS 26.0 output results.*

4.2. Reliability test

To what extent do the results of a scale's measurements stay the same over time is the definition of its reliability. Repeated measurement of the same or similar events yields more reliable survey results [77]. The reliability, consistency, and stability of the test results are indicated by a high dependability coefficient. Researchers usually use Cronbach's α coefficient as a yardstick for measuring reliability. Using reliability coefficients of 0.825, 0.914, 0.852, 0.927, and 0.917, respectively, the following factors were identified in the reliability test: innovation climate, organizational belonging, digital transformation leadership, self-efficacy, and dual learning. With Cronbach's α values greater than 0.80 for each variable, suggesting good consistency and reliability in the sample, the dependability level is sufficiently excellent to be examined in the next phase.

Table 3. Reliability test

No.	Variable/Dimension	Items	Cronbach's α
1	Digital Transformation Leadership	6	0.890
2	Ambidextrous Learning	8	0.825
3	Self-Efficacy	7	0.881
4	Organizational Commitment	8	0.903
5	Employee Voice Behavior	6	0.937
6	Innovation Climate	12	0.877

4.3. Confirmatory factor analysis

As a crucial part of structural equation modeling (SEM), the measurement model checks the validity of the researcher's theoretical premise by looking at the correlations between the visible and latent variables. Evaluations of the construct's discriminant and convergent validity have confirmed the measuring model's reliability. We say that concept indicators are all convergent when there is a high degree of correlation between them. Discriminant validity is based on the degree of similarity between two constructs. Using confirmatory factor analysis and convergent validity testing is one approach to determining the measurement model's efficacy. The confirmatory factor analysis model's validity is checked by the formal validity test in AMOS 21.0. This analysis considers the discriminant validity of the variables, how well the data fits the model, and how well the variables aggregate internally. These were the outcomes of all of the experiments:

4.3.1. Confirmatory factor analysis model fit indices

Confirmatory factor analysis was conducted on the overall questionnaire, and the results show that the fit indices are as follows: $\chi^2/df = 1.132 < 3$, RMSEA = 0.014 < 0.05, SRMR = 0.027 < 0.05, NFI = 0.929 >

0.9, RFI = 0.923 > 0.8, IFI = 0.991 > 0.9, TLI = 0.990 > 0.9, CFI = 0.991 > 0.9, GFI = 0.927 > 0.9. In summary, all fit indices of the overall model meet the analytical standard requirements, indicating a good model fit.

Table 4. Confirmatory factor analysis fit indices

Result	Value	Evaluation
χ^2/df	1.132	Satisfactory
RMSEA	0.014	Excellent
SRMR	0.027	Excellent
NFI	0.929	Excellent
RFI	0.923	Excellent
IFI	0.991	Excellent
TLI	0.990	Excellent
CFI	0.991	Excellent
GFI	0.927	Excellent

Among the several forms of measurement construct validity, convergent validity stands out as crucial. The composite reliability (CR) and average variance extracted (AVE) of the observation items are the standard ways to communicate measurement. This study elaborates on the three criteria used to evaluate convergent validity, building on the work of Cheung [78] .This model meets all three criteria: first, an AVE of more than 0.5; second, a CR of more than 0.7 for composite reliability; and third, factor loadings of all standardized types are more than 0.5.

The convergent validity test shows that all indicators have standardized factor loadings over 0.5, the Composite Reliability (CR) is greater than 0.7, and the Average Variance Extracted (AVE) is greater than 0.5. Thus, the convergent validity is good since all of the model's variables show high levels of internal consistency.

Table 5. Convergent validity test

Variable/Dimension	Item	SFL	AVE	CR
Digital Transformation Leadership	SZ1	0.764	0.587	0.895
	SZ2	0.763		
	SZ3	0.691		
	SZ4	0.863		
	SZ5	0.770		
	SZ6	0.734		
Ambidextrous Learning	TS1	0.737	0.538	0.903
	TS2	0.693		
	TS3	0.704		
	TS4	0.742		
	LY1	0.734		
	LY2	0.760		
	LY3	0.755		
	LY4	0.738		
	CX2	0.813		
	CX3	0.829		
	CX4	0.866		

Variable/Dimension	Item	SFL	AVE	CR
	CX5	0.874		
Self-Efficacy	ZW1	0.738	0.516	0.882
	ZW2	0.702		
	ZW3	0.709		
	ZW4	0.717		
	ZW5	0.693		
	ZW6	0.720		
	ZW7	0.746		
Employee Voice Behavior	JY1	0.853	0.720	0.939
	JY2	0.818		
	JY3	0.831		
	JY4	0.855		
	JY5	0.876		
	JY6	0.856		
Organizational Commitment	GS1	0.784	0.540	0.904
	GS2	0.715		
	GS3	0.732		
	GS4	0.768		
	GS5	0.698		
	GS6	0.748		
	GS7	0.747		
	GS8	0.682		
Innovation Climate	TC1	0.887	0.574	0.936
	TC2	0.834		
	TC3	0.760		
	TC4	0.699		
	ZG1	0.716		
	ZG2	0.734		
	ZG3	0.737		
	ZG4	0.706		
	ZC1	0.751		
	ZC2	0.758		
	ZC3	0.726		
	ZC4	0.731		

Table 5. (*Continued*)

Note: The difference in the number of items between table 3 (47 items) and table 5 (51 items) lies in the retention of sub-dimension and drop or redefinition of a few items during the process of confirmatory factor analysis.

We have given serious thought to the terms AVE (average variance extracted), CR (combined reliability), and SFL (standardized factor loading).

A number of standard metrics, such as the square root of the variable's AVE and the correlation coefficient between latent variables, are used to assess the discriminant validity of models. Since the

correlation coefficient is smaller than the sum of the variables, the model is able to differentiate between them if their absolute values squared are less than it is.

Table 6 provides a summary of the test parameters according to the established criteria. Table 6's remaining space displays the variables' correlation coefficients, whereas the diagonal of the same table displays the square root of the AVE. We run a test to see if it is discriminant valid. Because the square root of digital transformation leadership is 0.766, the AVE demonstrates strong discrimination, surpassing the factor correlation coefficient's maximum absolute value of 0.359. With a maximum absolute value of 0.357 for the correlation coefficient across variables and a square root of the AVE of 0.849, there is strong discriminant validity in employee innovation behavior. As the square root of the AVE (0.848) is greater than the greatest absolute value of the correlation coefficient between variables (0.359), employee suggestion behavior demonstrates good discriminant validity.

When compared to the maximum absolute value of the component correlation coefficient (0.238), Innovation Atmosphere demonstrates significant discriminant validity (AVE square root = 0.758). Good discriminant validity is shown when the absolute value of the square root of self-efficacy (AVE) is greater than the maximum factor correlation coefficient (0.260). A square root of the absolute value of the AVE for dual learning (0.733) is greater than the maximum absolute value of the correlation coefficient between variables (0.358), indicating strong discriminant validity. A square root of the organizational membership's AVE of 0.735, which is more than the greatest absolute value of the factor correlation coefficient of 0.358, indicates good discriminant validity.

Table 6. Discriminant validity test

	Digital Transformation Leadership	**Employee Voice Behavior**	**Innovation Climate**	**Self-Efficacy**	**Ambidextrous Learning**	**Organizational Commitment**
Digital Transformation Leadership	0.766					
Employee Voice Behavior	0.359**	0.848				
Innovation Climate	0.113**	0.238**	0.758			
Self-Efficacy	0.238**	0.252**	0.069	0.718		
Ambidextrous Learning	0.358**	0.348**	0.120**	0.260**	0.733	
Organizational Commitment	0.358**	0.315**	0.021	0.158**	0.298**	0.735

***Note**: * $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$; Bold values represent the square root of AVE.*

4.4. Correlation analysis

Using Pearson's correlation analysis, we looked at leadership in digital transformation, self-efficacy, dual learning, organizational belonging, employee suggestion behavior, employee innovation behavior, and innovation atmosphere. **Table 7** shows the results of the variable correlation coefficient matrix calculations. In the data table, you can see that all of the components of digital transformation leadership-self-efficacy, dual learning, organizational belonging, employee suggestion behavior, and employee innovation behavior-meet the requirements for regression analysis [79].

Table 7. Correlation Analysis

Variable	Digital Transformation Leadership	Employee Voice Behavior	Innovation Climate	Self-Efficacy	Ambidextrous Learning	Organizational Commitment
Digital Transformation Leadership	1					
Employee Voice Behavior	0.359**	1				
Innovation Climate	0.113**	0.238**	1			
Self-Efficacy	0.238**	0.252**	0.069	1		
Ambidextrous Learning	0.358**	0.348**	0.120**	0.260**	1	
Organizational Commitment	0.358**	0.315**	0.021	0.158**	0.298**	1

***Note**: ***p<0.001; **p<0.01; *p<0.05*

4.5. Hypothesis Testing

The dependent variables in this study were employees' innovation and voice behaviors; the independent variables were digital transformation leadership; the mediating variables were ambidextrous learning, self-efficacy, and organizational commitment; and the structural equation model (SEM) was constructed using AMOS 24.0 software. Common method bias, correlation analysis, reliability and validity tests, and descriptive statistics formed the basis of the model. To ensure accuracy, the model considers every conceivable connection between the variables. Leaders in digital transformation, ambidextrous learners, self-efficacy, organizational commitment, and employee innovation and voice behaviors were the variables that were tested in a multiple linear regression model developed in SPSS 26.0. As an additional moderating factor, the innovation climate was considered. After the importance of the fundamental moderating effect was confirmed, a PROCESS model was used to determine if the moderating variable's values affect the mediating path relationship. The computed and tested results for each model are displayed below.

4.5.1. Direct effect test of digital transformation leadership on employee voice behavior

A structural equation model was established with digital transformation leadership as the predictor variable and employee voice behavior as the outcome variable to test the direct effect in the overall model. The model fit indices were as follows: $\chi^2/df = 2.555 < 3$, RMSEA = 0.049 < 0.05, SRMR = 0.027 < 0.05, NFI = 0.975 > 0.9, RFI = 0.969 > 0.9, IFI = 0.985 > 0.9, TLI = 0.981 > 0.9, CFI = 0.985 > 0.9, GFI = 0.969 > 0.9. In summary, all fit indices of the main effect test model meet the analytical standard requirements, indicating good model fit and high adaptation, with strong structural fit.

Table 8. Model fit indices for the impact of digital transformation leadership on employee voice behavior

Result	Value	Evaluation
χ^2/df	2.555	Satisfactory
RMSEA	0.049	Excellent
SRMR	0.027	Excellent
NFI	0.975	Excellent
RFI	0.969	Excellent

Result	Value	Evaluation
IFI	0.985	Excellent
TLI	0.981	Excellent
CFI	0.985	Excellent
GFI	0.969	Excellent

Table 8. (*Continued*)

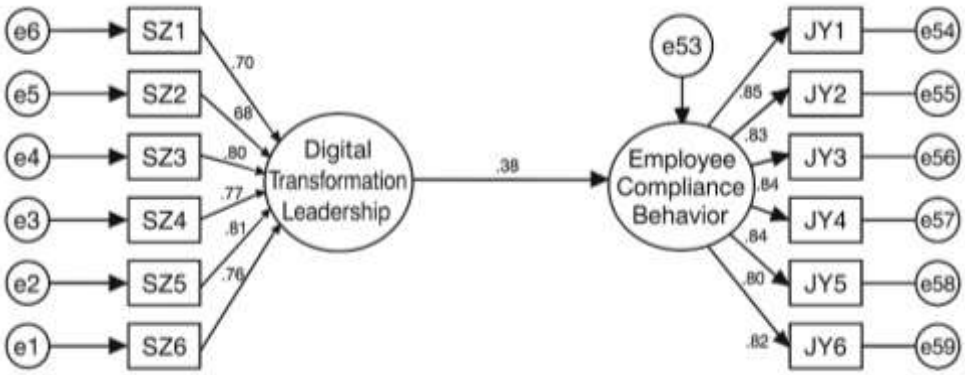

Figure 1. Path model of digital transformation leadership and employee voice behavior

The calculation of variable path coefficients and significance test results show in **Table 9**, that digital transformation leadership has a significant positive impact on employee voice behavior. The standardized path coefficient β=0.378 and the significance test result p<0.001, so the null hypothesis is established.

Table 9. Impact Analysis of Digital Transformation Leadership on Employee Voice Behavior

Path of Influence	b	β	SE	t	p
Digital Transformation Leadership → Employee Voice Behavior	0.471	0.378	0.054	8.794	<0.001

4.5.2. Mediating effects of dual learning, self-efficacy and organizational belonging

To examine the interdependent nature of the model's variables, we constructed a structural equation mediation model. The model examined the relationship between digital transformation leadership, mediating variables such as self-efficacy and organizational belonging, and the dependent variable, employee voice behavior. **Figure 1** displays the model. Concurrently, a 5,000-times bootstrap sample was used to calculate the effect size of each model.

All three variables-self-efficacy (standardized path coefficient β=0.142 and significance test result p<0.001), organizational belonging (standardized path coefficient β=0.181 and significance test result p<0.001), and dual learning (standardized path coefficient β=0.281 and significance test result p<0.001)-were positively correlated with employee voice behavior, indicating a strong direct influence relationship between the variables. The second part of the route coefficient of the mediation model and the proof of the original assumptions H6, H7, H8, H12, H13, and H14 are completed.

Table 10. analysis of direct influence relationships in the mediation model

Path of Influence	b	β	SE	t	p
Digital Transformation Leadership → Ambidextrous Learning	0.312	0.519	0.042	7.512	<0.001
Digital Transformation Leadership → Self-Efficacy	0.254	0.272	0.042	6.104	<0.001

Path of Influence	b	β	SE	t	p
Digital Transformation Leadership → Organizational Commitment	0.358	0.397	0.041	8.641	<0.001
Self-Efficacy → Employee Voice Behavior	0.187	0.142	0.054	3.490	<0.001
Organizational Commitment → Employee Voice Behavior	0.247	0.181	0.059	4.219	<0.001
Digital Transformation Leadership → Employee Voice Behavior	0.161	0.131	0.071	2.285	0.022
Ambidextrous Learning → Employee Voice Behavior	0.577	0.281	0.139	4.149	<0.001

Table 10. (*Continued*)

The results of the significance test ($p=0.003<0.01$) and the standardized path coefficient ($\beta=0.174$) show that the leadership of digital transformation significantly improves the advice behavior of employees. The significance test result was $p=0.022<0.05$, and the normalized path coefficient was $\beta=0.131$. Thus, the mediation model has a direct effect on the route coefficient and a substantial impact on the dependent and independent variables as well.

Just to review, the mediation model showed a strong mediation influence link with significant coefficients in all of the paths-direct impact, anterior, and posterior. We calculated the total effect, the direct effect, and the effect size of each indirect channel using the bootstrap method, which we repeated 5,000 times. The magnitude of each effect might then be more accurately compared.

The calculations reveal that digital transformation leadership affects employee voice behavior through dual learning with a mediating influence size of 0.180. It can be inferred that there is a mediating path link because the 95% confidence interval [0.099, 0.294] does not contain zero. With a mediating impact size of 0.048 and a 95% confidence interval [0.025, 0.079] that does not contain 0, digital transformation leadership does have an effect on employee voice behavior through self-efficacy. With a mediating impact size of 0.089 and a 95% confidence interval [0.054, 0.132] that does not contain 0, digital transformation leadership does have an effect on employee voice behavior through organizational belonging.

Table 11. Decomposition of effect sizes in the mediation model

Path of Influence	Effect Decomposition	Effect Size	SE	95% Lower Limit	95% Upper Limit	p
Digital Transformation Leadership → Ambidextrous Learning → Employee Voice Behavior	Mediating Effect	0.180	0.059	0.099	0.294	<0.001
	Direct Effect	0.161	0.078	0.027	0.284	0.052
	Total Effect	0.341	0.061	0.244	0.443	<0.001
Digital Transformation Leadership → Self-Efficacy → Employee Voice Behavior	Mediating Effect	0.048	0.017	0.025	0.079	0.001
	Direct Effect	0.161	0.078	0.027	0.284	0.052
	Total Effect	0.209	0.077	0.075	0.327	0.015
Digital Transformation Leadership → Organizational Commitment → Employee Voice Behavior	Mediating Effect	0.089	0.024	0.054	0.132	<0.001
	Direct Effect	0.161	0.078	0.027	0.284	0.052
	Total Effect	0.250	0.079	0.116	0.376	0.005

Moderators of employee voice behavior include leadership in digital transformation, organizational belonging, self-efficacy, dual learning, and

In this study, we look into how digital transformation leadership, dual learning, self-efficacy, and organizational belonging affect employee voice behavior and how that relates to the value of innovation atmosphere. The innovation atmosphere serves as a moderator, whereas these components serve as predictors and voice behavior as outcome variables. The computations, which were carried out after standardizing all variables, are shown in **Table 11.**

Model 1's digital transformation leadership β coefficient is 0.200, as shown in **Table 12**, and this value is statistically significant at the 0.001 level. A reduction in the digital transformation leadership coefficient on employee suggestion behavior to 0.184 (significant at the 0.001 level) is observed when the moderating variable is included in Model 2. The addition of the product term to Model 3 significantly improves employee suggestion behavior, as indicated by the interaction term "digital transformation leadership × innovation atmosphere" (with a path coefficient of β=0.170 and a significance test result of $p<0.001$). So, it's clear that the innovation climate is a major moderator. When the innovation atmosphere score increases and assumption H22 holds, the positive impact of digital transformation leadership on staff suggestion behavior becomes more pronounced.

Statistical significance is indicated at the 0.001 level by the β coefficient of dual learning in model 1, which is 0.193. After includes the moderating variable in model 2, the digital transformation leadership coefficient on employee suggestion behavior drops to 0.176, which is significant at the 0.001 level. The employee suggestion behavior was significantly and positively impacted by the "dual learning × innovation atmosphere" interaction term after the product term was included to model 3. A significant test result of $p<0.001$ and a path coefficient of β=0.149 provided evidence that the innovation atmosphere had a large positive moderating influence. Supporting hypothesis H23, a higher innovation atmosphere score is associated with a stronger favorable effect of dual learning on employee suggestion behavior.

There is statistical significance with a β coefficient of self-efficacy of 0.128 at the 0.001 level in this model. Statistically significant at the p0.001 level, the effect of digital transformation leadership on staff suggestion behavior is reduced to 0.122 by the moderating variable in Model 2. In Model 3, the product term shows how the interaction term between "self-efficacy × innovation atmospheres" positively affects employee suggestion behavior. A significance level below 0.001 and a path coefficient of 0.133 provide credence to the idea that an innovation-friendly environment considerably moderates in a positive way. A high innovation climate score is associated with employees' self-efficacy, which has a positive effect on their suggestion behavior (H24).

A score of 0.165 indicates that the organizational belonging β coefficient in model 1 is statistically significant at the 0.001 level. Statistically significant at the 0.001 level, Model 2's incorporation of the moderating variable raises the organizational membership coefficient on employee suggestion behavior to 0.173. A path coefficient of β=0.101, $p<0.01$ indicates that the employee suggestion behavior is highly influenced by the "organizational belonging × innovation atmosphere" interaction term after the product term is included in model 3. This provides strong evidence that the innovation climate acts as a moderator. An increase in the innovation climate score confirms hypothesis H25 and amplifies the positive influence of organizational affiliation on suggestion behavior among employees.

Model 3's greater significance and an increase in explanatory power to 12.30% (F=43.879, p0.001) provide credence to the idea that the regression model was effective.

Table 12. Moderating effect of innovation climate

Variable	Employee Voice Behavior	Model 1	Model 2	Model 3
		β	t	VIF
Digital Transformation Leadership		0.200***	5.142	1.272
Ambidextrous Learning		0.193***	5.050	1.233
Self-Efficacy		0.128***	3.528	1.103
Organizational Commitment		0.165***	4.390	1.194
Innovation Climate				
Digital Transformation Leadership × Innovation Climate				
Ambidextrous Learning × Innovation Climate				
Self-Efficacy × Innovation Climate				
Organizational Commitment × Innovation Climate				
R^2		0.223	0.256	0.379
Adjusted R^2		0.219	0.251	0.370
F		46.037***	44.945***	43.879***

***Note**: ***p<0.001; **p<0.01; *p<0.05*

In order to more clearly explain the moderating effect of innovation atmosphere on the influence of digital transformation leadership on employee suggestion behavior, this study conducted a simple slope test based on the results of linear regression and drew a simple effect analysis chart. It can be seen from the **figure 2**, that compared with the low innovation atmosphere, the digital transformation leadership in the high innovation atmosphere has a stronger predictive effect on employee suggestion behavior, indicating that the innovation atmosphere plays a significant positive moderating effect on the digital transformation leadership on employee suggestion behavior.

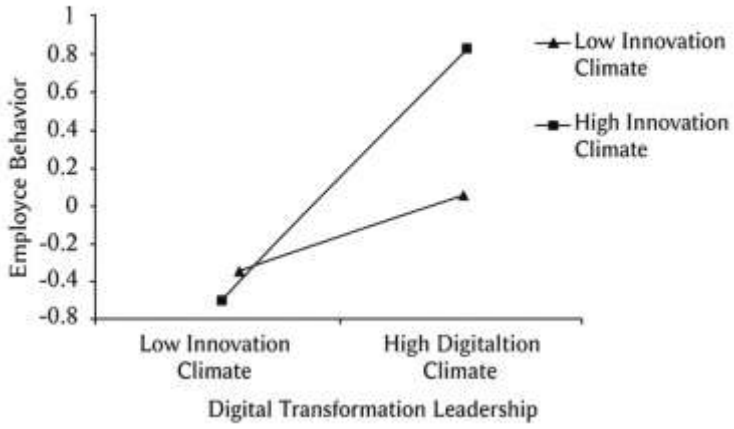

Figure 2. Moderating effect of innovation climate on digital transformation leadership and employee voice behavior

This study aimed to acquire a deeper knowledge of how innovation atmosphere modifies the effect of dual learning on employee suggestion behavior by using a basic impact analysis chart and basic slope test. The results of the linear regression formed the basis for the test. Dual learning's predictive power on staff suggestion behavior is higher in an innovative workplace (as seen in **Figure 3**) than in a less innovative one.

That the innovation environment significantly reduces the effect of dual learning on suggestion behavior is well supported by this.

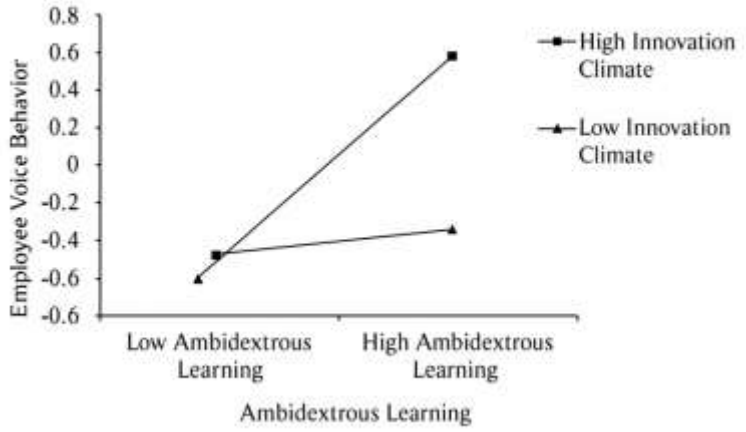

Figure 3. Moderating effect of innovation climate on ambidextrous learning and employee voice behavior

To learn more about how innovation climate moderates the effect of self-efficacy on employee suggestion behavior, this study used a simple slope test and a basic effect analysis chart. It was based on the findings of the linear regression that the test was conducted. Employee suggestion behavior is more strongly predicted by self-efficacy in a high innovation environment (**Figure 4**), as compared to a low innovation one. Accordingly, it appears that the innovation environment considerably mitigates the effect of self-efficacy on suggestion conduct.

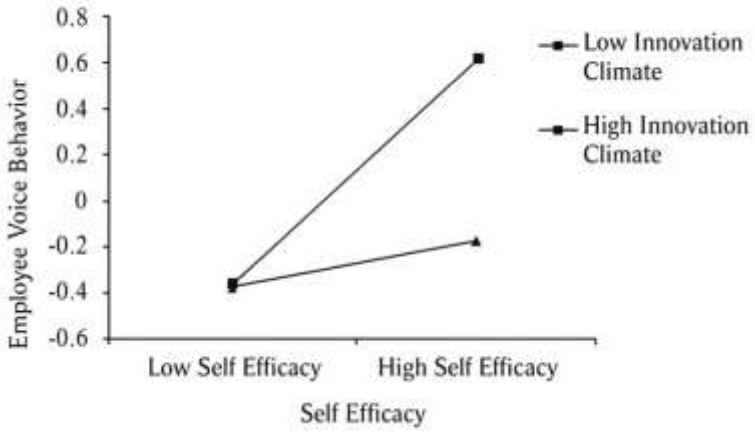

Figure 4. Moderating effect of innovation climate on self-efficacy and employee voice behavior

The impact of innovation climate on organizational belonging's moderating effect on suggestion behavior was examined in this study using a basic effect analysis chart and a basic slope test. It was based on the findings of the linear regression that the test was conducted. According to **Figure 5**, the predictive power of organizational belonging on employee suggestion behavior is higher in an innovation-rich environment compared to an innovation-poor one. This provides more evidence that the innovation climate considerably mitigates the impact of belonging to a company on suggestion behavior.

Figure 5. Moderating effect of innovation climate on organizational commitment and employee voice behavior.

4.6. Summary of research hypotheses

A total of 25 hypotheses were proposed in this study. After verification by empirical research, the specific research hypothesis conclusions are shown in **Table 13**.

Table 13. Research hypotheses and conclusions

Hypothesis Condition	Research Result
H2 Digital transformation leadership has a positive impact on employee voice behavior	Supported
H3 Digital transformation leadership has a positive impact on ambidextrous learning	Supported
H4 Digital transformation leadership has a positive impact on self-efficacy	Supported
H5 Digital transformation leadership has a positive impact on organizational commitment	Supported
H12 Ambidextrous learning has a positive impact on employee voice behavior	Supported
H13 Self-efficacy has a positive impact on employee voice behavior	Supported
H14 Basic psychological needs have a positive impact on employee voice behavior	Supported
H15 Ambidextrous learning mediates the relationship between digital transformation leadership and employee voice behavior	Supported
H16 Self-efficacy mediates the relationship between digital transformation leadership and employee voice behavior	Supported
H17 Organizational commitment mediates the relationship between digital transformation leadership and employee voice behavior	Supported
H22 Innovation climate positively moderates the relationship between digital transformation leadership and employee voice behavior	Supported
H23 Innovation climate positively moderates the relationship between ambidextrous learning and employee voice behavior	Supported
H24 Innovation climate positively moderates the relationship between self-efficacy and employee voice behavior	Supported
H25 Innovation climate positively moderates the relationship between organizational commitment and employee voice behavior	Supported

4.7. Research results

This study obtained the following results after empirical research:

1. Evidence suggests that top-down support for digital transformation greatly enhances staff participation in decision-making. Listening attentively, encouraging candid dialogue, and including employees in decision-making are characteristics of transformational leaders. This style of leadership is great for creating a workplace where people are not afraid to share their ideas and opinions. The results of Zhang's investigation are supported by this [80] .Whether employees bring forward new ideas or point out problems already present in the firm, leaders that embrace a more transformational style of leadership will appreciate and execute their suggestions. As they acclimate to the digital age, leaders in digital transformation will set more concrete objectives, become more approachable, and encourage and inspire their people to achieve these goals. When workers have their opinions heard, they are more inclined to bring up problems inside the organization and suggest ideas that could improve innovation and advancement.

2. The association between leadership in digital transformation and employee voice behavior is mediated by organizational belonging, self-efficacy, and dual learning. Dual learning, which mixes exploratory and exploitative learning, helps employees adapt to digital world and improve their innovative capacities. Those who take part in dual learning programs improve their problem-solving and adaptability skills, making them more suitable for careers in technology. This is in line with what other researchers, like Ajina, have found [81]. Knowledge workers may be motivated to learn more through enterprise digital transformation, which could help them concentrate on gathering the complex and varied data needed to generate new ideas. Knowledge workers are more likely to rally behind digital transformation efforts when they have access to updated information. When employees believe in themselves and their skills, they are more likely to give good suggestions. Because they feel their ideas will be taken seriously and put into action, they take more initiative in this area. Concerning the company's digital transition, they also have insightful comments and recommendations. In addition, they think that leadership conduct, which is a major element in employee suggestions, can often improve the satisfaction of workers' fundamental psychological requirements while they are on the job. Leaders in digital transformation should encourage their people to think creatively and find innovative solutions to problems by encouraging dual learning, building trust, and offering extra support. Positive self-perception is an important trait for digital transformation leaders to exhibit. When employees believe in themselves and their talents, they are more inclined to show initiative and persevere through difficult situations. Leaders in digital transformation can increase voice behavior by motivating people intrinsically [82].

3. It has been proven that the innovation atmosphere does, in fact, moderate. Leaders in digital transformation may have an even greater effect if they foster an innovative culture that encourages people to speak up more, try new things, and be more creative and innovative as a team. On top of that, the innovation culture helps employees be more creative and helpful by strengthening the role of organizational belonging, self-efficacy, and dual learning as mediators between leadership's digital transformation efforts and employees' actions. When managers encourage their employees to express their thoughts, learn new things, come up with original solutions to issues, collaborate on projects, provide and receive constructive criticism, and generally be creative, they create an inventive work environment and increase employee creativity. According to Badriyah [84], transformational leadership has a favorable effect on the team's innovative culture. Vo argues that transformational leadership is the best way to create a culture that encourages creativity and new ideas [85]. According to Babu's [86] empirical research, transformational leadership is linked to an environment that fosters innovation. In their quest for comprehensive capability, knowledge workers are more likely to try out new ideas and take on challenging tasks, according to Adams's [87] theory, since they have higher desires for esteem and self-actualization. Employees' fundamental psychological needs are met and their desire for social approval and validation is sated, leading to an increase in intrinsic motivation,

when they feel valued by their superiors, peers, and the organization overall. According to Al-Faouri [88], team leaders can foster an atmosphere that is more conducive to innovation by implementing specific tactics related to human resource management. Members of an inventive team are expected to not only contribute ideas often and concisely but also to back up the ideas' implementation and take on the risks that come with innovation. According to research, the relationship between transformational leadership and team voice climate can be influenced by the team innovation environment, which in turn can be positively influenced.

The innovative environment encourages open communication, promotes diversity and various viewpoints, offers feedback and awards, and strengthens the beneficial impact of digital transformation leaders on employees' voice behavior. It also creates a sense of security and trust. People are motivated to keep learning and improving since learning and progress are prioritized in the innovative atmosphere. Employees flourish in such a setting because they aren't hesitant to take risks, learn new skills, and advance in their careers. Employees that have an open mind and are eager to learn will be more empowered to raise their voices and provide original approaches to challenges. It provides autonomy, capacity support, and a feeling of belonging to the organization, which improves employees' enthusiasm and readiness to engage in voice action. The creative environment provides employees with opportunities to collaborate and interact with others. Leaders in digital transformation emphasize the value of a collaborative workforce that supports one another, shares knowledge, and works together. In this belonging context, employees' needs for belonging are fulfilled, and their enthusiasm for participating in vocal activity is encouraged.

5. Conclusion

The effect of leadership in digital transformation on employees' vocal behavior is examined in this study through the moderating roles of basic needs satisfaction, self-efficacy, and dual learning. Leadership in digital transformation significantly improves voice behavior, according to empirical research. According to the research, innovation culture mitigated the favorable influence of dual learning, self-efficacy, and fundamental needs satisfaction on employees' voice behavior. With these findings, our understanding of the link between digital transformation leadership and employee behavior is further enhanced, and we now have a clearer idea of how companies may put this theory into action to promote ethical hiring practices.

Theoretical significance

The theoretical significance of this study is mainly reflected in the following aspects:

1. Adding to the body of knowledge on digital transformation leadership: this study provides more evidence that leaders' actions within the digital transformation context impact employees' actions and supports the claim that digital transformation leadership positively impacts employees' advice behavior.

2. Enhanced understanding of the mediating role of dual learning, self-efficacy, and basic needs satisfaction: This study offers a fresh viewpoint for the advancement of related theories by being the first to incorporate these factors into the impact mechanism of digital transformation leadership on employee voice behavior. The results demonstrate the mediating role of these factors between leadership behavior and employee voice behavior.

3. According to the results, innovation atmosphere mitigates the effect of basic needs satisfaction, self-efficacy, and dual learning on employees' vocal behavior. This contributes to the body of theoretical literature on innovation climate in the field of organizational behavior. 1) The moderating effect of the innovative environment was emphasized.

Practical significance

The practical significance of this study is mainly reflected in the following aspects:

1. Improving digital transformation leadership: Organizations should attach importance to the cultivation of digital transformation leadership, improve leaders' digital skills and strategic vision, provide an open working environment, give full play to leadership charm, and stimulate employees' suggestions, thereby promoting organizational innovation and development.

2. Focus on improving dual learning, self-efficacy and basic needs: Organizations should enhance employees' dual learning capabilities through training and support systems. Digital transformation leaders should enhance employees' self-efficacy, autonomy, competence and belonging through scientific management, personality charm, and create a good working environment, and promote employees' active participation to further enhance their innovation capabilities.

3. Create a positive innovation atmosphere: Organizations should build a culture and work environment that supports innovation, which is also inseparable from the active role of leaders. So as to more effectively transform employees' innovation potential into actual innovation results.

6. Limitations of the study

Although this study has achieved certain results, it still has some limitations:

1. Sample limitations: The samples of this study mainly come from a specific industry or region, which may not fully reflect the actual situation of different industries or regions. Future research can expand the sample range to enhance the universality of the research conclusions.

2. Limitations of research methods: This study mainly uses cross-sectional data, which makes it difficult to capture the dynamic changes between digital transformation leadership and employee behavior. Future research can adopt a longitudinal research design to more comprehensively reveal the relationship between these variables.

3. Limitations of variable measurement: The self-report scale used in this study may be affected by social desirability and common method bias. Future research can use multi-source data and multi-dimensional measurement methods to improve the accuracy and reliability of the research.

In summary the study provides additional evidence to back up the assertions made and provides insight into the impact of leadership activities on innovation actions made by employees throughout digital transformation. This paves the way for future investigations into the richness and diversity of linked systems.

Conflict of interest

The authors declare no conflict of interest

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