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Article

Investigating the impact of digital leadership on innovation performance of public universities in Yunnan, China

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Abstract: In the era of rapid technological development, the integration of technology in education has become crucial (Hashim et al., 2022). The digital transformation of education requires universities to transform their traditional operational models, strategic directions, and teaching practices, re-examine their own value propositions, and promote high-quality innovative development in universities. Transformation and change bring challenges to organizational management, especially leadership. Can digital leadership positively influence the innovative behavior of university teachers? Can digital leadership improve organizational innovation performance by influencing innovation behavior? These questions urgently need to be answered through practical surveys of digital transformation in universities. From March 2024 to May 2022, we conducted a survey of 1142 participants from 12 universities in Kunming, southwestern China. Our research findings indicate that digital leadership has a positive impact on the innovation performance of university organizations; Innovation behavior plays a mediating role between digital leadership and organizational performance. These findings provide new insights into the potential mechanisms by which digital leadership influences organizational innovation in universities. The research findings emphasize that in the process of transforming traditional operational models, strategic directions, and teaching practices in higher education, in order to achieve high-quality innovative development, it is necessary to attach importance to digital leadership and continuously stimulate innovative behavior.

Keywords: digital leadership; innovative behavior; innovation performance

1. Introduction

Driven by the new generation of intelligent technology, COVID-19 epidemic and other external factors, the digital transformation of higher education ushers in rare development opportunities and challenges. On the one hand, the digital transformation of higher education relies on technology, which determines that technological innovation has become its driving force for development. On the other hand, the impact of the COVID-19 has exposed the vulnerability of the higher education system, catalyzed the demand for digital resilience construction of the higher education system, and forced the digital transformation of higher education (Zhu and Hu, 2021a). Digital transformation is a process of continuously improving the level of digitalization within an organization, which can bring challenges to organizational management, especially leadership. If there is a lack of managers who are proficient in strategy and digital thinking, it will be difficult to seize opportunities for change in the wave of digital technology, and this transformation will not be achieved smoothly. In the context of

the increasing impact of technology on leadership, the concept of digital leadership has been proposed (Klus and Muller, 2021).

At present, research on digital leadership is still in the preliminary exploration stage, and relevant literature mainly focuses on the concept and characteristics of digital leadership. In terms of the role of digital leadership, it focuses on exploring its impact on organizational level outcome variables such as innovation management, dynamic capabilities, and organizational performance found that digital leadership has a positive impact on organizational dynamic capabilities (Dearaujol et al., 2021; Mihardjo et al., 2019; Sasmoko et al., 2019; Soon et al., 2021; Wasono and Furinto, 2018). Wasono and Furinto (2018) found that digital leadership can use digital technology to revolutionize management and drive management innovation (Wasono and Furinto, 2018). Cheng Soon (2021) confirmed that digital leadership helps determine digital business strategies, thereby improving business performance (Cheng Soon and Salamzadeh, 2021). However, few scholars have explored the impact of digital leadership on creating performance. Innovation is an eternal theme for organizations, especially in the VUCA (instability, uncertainty, complexity, ambiguity) era, where innovation is a powerful tool for organizations to maintain vitality and resilience.

The term VUCA originates from a military concept that describes the complex and dynamic global environment following the conclusion of the Cold War. Throughout the 1990s, it gained widespread usage among managers in leading multinational corporations and gradually extended to diverse domains. Johansen was the first academic to study the VUCA era, and in his book Sense the Future, respond to the Present, he describes the dangers and opportunities of the VUCA era in the military, health industry, education and business Settings. But his research does not address the question of what the VUCA era is and how companies should respond. Forsythe et al. (2018) argue that the UVCA era refers to the acceleration of change (variability), the lack of predictability (uncertainty), the interconnectedness of causal forces (complexity), and the great potential for misinterpretation (ambiguity). Noda (2020) combines the COVID-19 pandemic with UVCA for the first time and gives a new interpretation of UVCA: The era of VUCA is a rapidly changing social environment that is difficult to predict the future. The two scholars only define from the era of Uka, but do not explain the four characteristics of Uka in detail.

Galen and Destiny (2009) further elaborated on the four characteristics of the VUCA era: variability represents a dynamic changing social environment, uncertainty is caused by information loss, complexity comes from multiple potentially related dimensions, and fuzziness is the existence of multiple possible interpretations of available information. Bennett and Lemoine (2014) further expand the meaning of these four characteristics: Volatility means that the world is in an unstable and changing state. Information in the world can be obtained and the state can be understood, but the changes are frequent and difficult to predict. Uncertainty is the relationship between the reasons for something and the results are understandable, but there is a lack of understanding as to whether they will have a meaningful impact or whether they will lead to significant change. Complexity is due to many interconnected parts, forming a complex network of information and procedures, in various forms and intricacies. Ambiguity refers to a lack of understanding of the “basic

rules of the game," where the causes and effects of events are not understood and no precedents can be referenced to predict what will happen in the future. How to develop and execute an effective strategy in a VUCA environment, and what skills and qualities leaders should have in a VUCA environment are very worthy of study. Therefore, exploring how digital leadership affects employee innovation behavior and improves organizational innovation performance is of great significance.

The theory of digital leadership believes that digital leadership has characteristics such as a transformational vision, strategic thinking, digital literacy, and adaptability, and leads organizations towards prosperity through the implementation of digital transformation strategies. Digital leadership utilizes digital technology to drive management change and change management processes. The application of digital technology has also transformed and improved the communication methods of organizations, enhancing their management performance. Digital transformation encourages universities to establish flexible and self managed work teams in teaching and research, empowering employees with more responsibility and greater autonomy (Gierlich-joas et al., 2020; Wang et al., 2021). This kind of authorization will enhance team members' awareness of team work efficiency and significance, thereby helping to enhance team creativity (Abbasi et al., 2021). On the one hand, digital leadership drives digital transformation within organizations, bringing new job requirements and inspiring employees to reshape their motivation; On the other hand, digital leadership focuses on cultivating employees' digital abilities, enhancing individual work abilities, and stimulating individual creativity. Therefore, this study suggests that digital leadership can have an impact on both teacher innovation behavior and organizational innovation performance.

The social identity theory holds that the role and influence of a leader over subordinates or followers is not only determined by their authority and power, but also by their ability to gain recognition and respect from subordinates or followers. If subordinates or followers cannot perceive the leader's leadership, they may not follow the leader's guidance or decisions, or even leave the organization.

Organizational members have a high recognition of digital leadership in implementing digital change, and correspondingly, digital leadership emphasizes the application of digital technology in organizational management, which is more easily perceived by employees. At the same time, in response to the work requirements put forward by digital leadership, team members are more willing to spontaneously engage in teaching and research innovation. Therefore, digital leadership enhances employee innovation behavior, thereby improving organizational innovation performance.

Integrating digital leadership theory and social identity theory, this study constructs a model of the impact of digital leadership on innovation behavior and performance (see **Figure 1**), focusing on examining the impact of digital leadership on innovation behavior and performance, exploring the mediating role of innovation behavior between digital leadership and innovation performance, and providing reference for the practice of digital transformation management in universities.

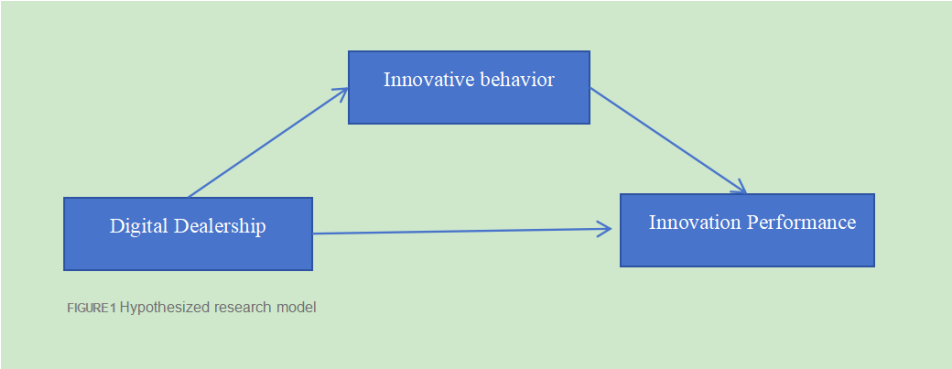

Figure 1. Hypothesized research model.

2. Literature review and theoretical assumptions

2.1. Digital leadership

Different eras require different leadership styles, and in the past few decades, technological change has been shaping new leadership. In the era of digital economy, digital transformation of enterprises presents new challenges to leaders, driving them to enhance strategic awareness, effectively respond to environmental uncertainty and complexity using digital technology, and lead organizations towards a more dynamic future. For leaders, digital technology means new forms of communication and organization, and traditional leadership styles cannot fully cope with the opportunities and challenges brought by digitization. To this end, scholars have proposed the concept of digital leadership and developed digital leadership theory. Klus et al. defined digital leadership as a new leadership style in which leaders create clear and meaningful visions for organizational digital transformation, and implement strategies to achieve digital transformation (Klus and Muller, 2021). Some scholars also believe that digital leadership, which refers to the use of organizational digital assets by leaders to achieve goals at the organizational and individual levels, is a fast, cross hierarchical, and team oriented leadership approach (Klus and Muller, 2021; Oberer et al., 2020; Zeike et al., 2019). Existing research has elaborated on the characteristics of digital leadership from multiple perspectives.Deanna believes that digital leadership has creative thinking, foresight, and insight (Deanna, 2016); Henselek believes that digital leadership has characteristics such as creativity, rich digital knowledge, strong networking and collaboration abilities; Kane believe that digital leadership requires four key skills, namely transformational vision, forward thinking perspective, digital literacy, and adaptability. Leaders with a transformational vision can more effectively predict markets and trends, make more precise business decisions, and solve challenging problems in uncertain environments (Kane, et al., 2019). Leaders with a forward-looking perspective have a clear vision, reasonable strategies, and foresight, and are able to grasp trends in the digital trend.

2.2. Digital leadership and innovation performance

Innovation performance is an evaluation of the efficiency and effectiveness of organizational or individual innovation activities. Many researchers have elucidated the importance of leadership in an organization and how it affects employee behavior

and performance (Vanblaere and Devos, 2016). Digital leadership is a complex structure whose core goal is to create a customer-centric, digitally capable, and industry-leading business model. To achieve this goal, digital leadership needs to undergo deep transformation in the following three aspects: firstly, reshaping the role, skills, and style of digital leaders. The second is to build digital organizations, establish governance systems, visions, values, structures, cultures, and decision-making processes. Finally, it is necessary to adjust personnel management, virtual teams, knowledge reserves, communication and collaboration methods, encourage employees to innovate and practice, and provide a continuous source of innovative power for the digital development of the enterprise. Digital leadership is the core competitiveness of enterprises in the digital age. But researchers have also found that a leader's leadership performance depends on the perception of employees. If employees cannot perceive a leader's digital leadership, then the leader's leadership is also difficult to play a role. According to social identity theory, it tells us the importance of leadership to followers or subordinates in China. If teachers can gain self recognition from an organization, they will feel satisfied within the organization and be willing to stay longer. They may want to follow their leaders, place more emphasis on innovation, and have more ideas, innovative behaviors, and innovative performance (Ramlawati et al., 2021). Therefore, this article proposes the following assumptions:

H1: Digital leadership has a positive impact on organizational innovation performance.

2.3. Digital leadership and innovative behavior

The digital transformation of higher education is a digital disruption in the information age. It requires the application of information technology to change thinking patterns and reconstruct digital activities that integrate learning, teaching, and organization (Ferreira et al., 2019).

The quality of teaching for teachers depends not only on their professional knowledge, teaching skills, and professional ethics, but also on their creative behavior (Amorim Neto Roque Do Carmo, 2018). It is the driving force for the professional development of teachers and an effective way to promote their creative behavior and improve the quality of university education. Innovation is one of the important capital of humanity, and innovative talents and behaviors are the key elements and core driving forces of university innovation. The innovation or creative behavior of universities is a key element of national development. The outbreak of COVID-19 has led to changes in university teaching methods and academic exchanges, but now, many innovative and creative behaviors of teachers have made significant contributions to education (Ellis et al., 2020).

In the new era of education, the construction of teacher teams is a major highlight of current education development (Antonopoulou et al., 2021). The innovative and creative behavior of teachers is an important component of people's satisfaction with education. The creativity of a teacher's work not only depends on their work attitude, but also affects the quality of education (Jabbouri et al., 2016). Currently, the major

challenge faced by principals is to stimulate teachers' positive psychological power and promote innovation or creative behavior through digital leadership transformation.

The digital age has put forward higher requirements for innovation in universities. As the organizers and implementers of teaching and research, university teachers play an important role in university innovation, and digital leadership will play a positive role in the creativity of teachers.

Leaders with digital leadership can better grasp the development direction of educational informatization and promote the process of digital construction in schools. At the same time, it can also stimulate the innovative potential of teachers and create an educational environment conducive to innovation.

Therefore, this article proposes the following assumptions:

H2: Digital leadership has a positive impact on teacher creativity.

2.4. Innovation behavior and organizational innovation performance

Original sentence: "Creativity and innovation are two closely related concepts, where creativity generally refers to the generation of novel and useful new ideas (Amabile, 1996). According to George and Zhou (2001), employee creativity is the generation of new and valuable ideas about products or services, production methods, and management processes. Compared to creativity, innovation is a more complex process with a broader meaning. Economist Schumpeter (1934) was the first scholar to introduce the term innovation, which he saw as a creative activity or behavior based on the concept of entrepreneurship. Later, Drucker and Noel (1986) defined innovation as 'the new behavior that creates wealth-generating resources for entrepreneurs, resources that turn into real wealth-creating resources.' Woodman et al. (1993) suggested that employee innovative behavior not only involves investing in work to achieve goals but also includes innovative ideas. Creativity generates new ideas while innovative behavior puts these new ideas into practice, transforming innovative ideas into work performance and productivity. Innovative behavior is based on and starts with creativity and is the implementation of creativity in practice.

Currently, academia has gradually reached a consensus on creativity and innovation where creativity is the generation of novel and useful ideas proposed by individuals; it represents the beginning stage of innovation (Mumford and Hunter, 2005). Innovation involves proposing novel and useful ideas then implementing them to achieve those ideas (Kanter, 2009; Van de Ven, 1986). Innovation includes not only idea generation but also the process of putting those ideas into action (Kanter, 2009). As innovation is non-continuous conceptually speaking (Li, 2008), subsequent scholars view innovation as multi-stage process (Xie and Wu, 2000); each stage representing different activities/behaviors (Kleysen and Street, 2001a).

Anderson et al. (2014) provide an integrated definition for workplace creativity/innovation primarily referring to attempting development/introduction of improved/new work methods/processes/products. The stage mainly involving generating new idea being referred as Creativity whereas implementing those same idea being referred as Innovation."

Innovation is a complex and broad concept, according to Barreguet et al. (2009) pointed out that innovation is an interdisciplinary concept, and different disciplines

have different views on innovation. This study focuses on individual level innovative behavior. Innovative employees can bring new ideas to the organization, improve work efficiency, promote teamwork, and thus drive the organization forward. Therefore, understanding and innovating individual innovative behavior is particularly important. Based on a comprehensive analysis of previous research, combined with the background and specific needs of this study, this study defines employee innovative behavior as the process of teachers generating, promoting, and implementing innovative ideas in relevant organizational activities, as well as putting them into practice.

The transaction cost theory explains the relationship between innovation behavior and innovation performance. On the one hand, innovative behavior can bring higher performance, as universities can gain unique competitive advantages and improve research and teaching capabilities through innovation. On the other hand, innovative behavior also means that universities need to bear certain transaction costs, which may lead to a short-term decline in performance. The transaction cost theory reveals three key stages of innovative behavior: initial, mid-term, and later stages. Universities investing innovation resources, conducting research and development activities, and cultivating talents in the early stages may lead to lower innovation performance. In the mid-term, universities begin to reap innovative results, and innovation performance gradually becomes apparent. In the later stage, the innovative achievements and methods of universities are widely applied, and the innovation performance reaches its peak. However, with the continuous updating of knowledge, research, and education, universities need to invest new innovative resources and start a new cycle of innovation.

The universities selected for this study are the top ranked comprehensive universities in Southwest China. Through years of digital transformation and reform, the reform has achieved initial results. Combining the background of digital reform and transaction cost theory of the research object.

Therefore, this article proposes the following assumptions:

H3: Positive impact of innovative behavior on organizational innovation performance

2.5. The mediating role of innovative behavior between digital leadership and innovation performance

According to social identity theory, employees will examine the digital strategy being implemented, form corresponding cognition, and take certain actions (Hogg, 2001). If employees believe that the benefits brought by digital transformation outweigh the threats, they tend to form positive expectations and positive self reactive impacts. This helps to stimulate employees' intrinsic innovation vitality, thereby improving organizational innovation performance. On the contrary, if employees have the perception that "technology is the knife, I am the fish and meat", it will generate negative expectations and reactions, ultimately not conducive to improving the innovation performance of the enterprise. Therefore, investigating the innovative behavior of employees after their understanding of the results of digital transformation

is an important link in the process of the impact of digital transformation on innovation performance.

Under the influence of digital leadership, the digital transformation of universities places employees in a digital work environment, requiring them to possess certain digital literacy to better apply digital technology. Digital leadership, through leadership demonstrations and relevant training, cultivates employees' positive awareness of digital transformation and enhances their ability to apply technology, creating a competitive advantage for the organization. If digital leadership plays a role in optimizing employees' digital personal cognition, their acceptance of digital transformation will increase, and they will actively apply digital technology to innovate work practices, form organizational innovation capabilities, and improve organizational innovation performance.

Innovative behavior refers to the behavior of individuals who are brave enough to try and constantly break through in the face of challenges and opportunities. By cultivating innovative behavior, teachers can continuously improve their educational and teaching level, thereby enhancing innovation performance. Research participants with higher levels of innovative behavior are more likely to participate in problem-solving, risk-taking, and collaborative activities, which are crucial for promoting innovation. Studies have shown that universities with strong digital leadership are more likely to encourage and support innovative behavior among faculty and staff. Therefore, this article proposes the following assumptions:

H4: Innovation behavior plays a mediating role between digital leadership and innovation performance.

3. Method

3.1. Participant

We recruited participants from 12 universities in southern Yunnan, China and conducted a survey of randomly selected managers and teachers from each university from March to May 2024.

We distributed 1200 questionnaires and received 1180. After excluding incomplete and invalid questionnaires, we obtained 1142 valid research samples (97.5% response rate). Among them, 55.9% are males and 44.1% are females, aged between 23 and 60 years (average age = 41.5 years).

3.2. Measures

To ensure the consistency of the scale in this study, we translated the validated original scale into Chinese. The questionnaire is distributed online and offline. With the help of alumni resources, it extensively contacts local universities in Yunnan and surveys college teachers in selected universities. The survey subjects need to meet the following characteristics: (1) The department of the selected teacher is undergoing digital transformation; (2) The selected teachers are using digital tools for innovation in teaching and research; (3) The selected teacher should have at least three years of work experience, whether in a management or teaching position.

All projects were rated using a five level Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2.1. Digital leadership

Digital leadership was measured using Karakose's (2009) three-dimensional measurement table. The sample items included "Leaders encourage the use of digital technology" and "Leaders have in-depth knowledge in their professional field and can continuously learn." and "Leaders focus on efficiency and use scientific methods to evaluate work performance." The Cronbach alpha of this scale is 0.959.

3.2.2. Innovative behavior

Innovation behavior was measured using a four-dimensional scale developed by Karakose et al., with 7 items designed in this study. The Cronbach's alpha value of the scale was 0.881.

3.2.3. Innovation performance

The innovation performance was measured using a two dimensional scale developed by Jabbouri et al., with a total of 11 items designed. In this study, the reliability coefficient of the scale was 0.913.

3.3. Data analysis

We first conducted descriptive statistics and correlation analysis using SPSS version 27. Based on Hayes and Preacher's (2014) suggestion, we tested the mediating and moderating effects by running the SPSS Process macro (version 3.0) (Model 14). Use bias corrected bootstrap method to analyze the direct and indirect effects of digital leadership and innovation.

In addition, to investigate whether individual characteristics affect innovation performance, this study selected demographic variables such as gender, age, education level, and years of work as control variables at the individual level.

4. Results

4.1. Descriptive statistics and correlation

Table 1 presents the descriptive, correlation, and reliability results with respect to the variables of interest. Digital leadership was positively associated with innovation performance (r = 0.872, p < 0.01). Digital leadership was positively associated with innovative behavior (r = 0.872, p < 0.01). Innovative behavior was positively correlated with innovation performance (r = −0.875, p < 0.01).

Table 1. Means, standard deviations and correlations among variables.

Variables	1	2	3	4	5	6	7
(1) Gender	1						
(2) Age	0.001	1					
(3) Education	0.019	−0.004	1				
(4) Years of work	−0.007	−0.034	0.910**	1			
(5) DL	−0.003	0.026	−0.729**	−0.719**	1		

Table 1. (*Continued*).

Variables	1	2	3	4	5	6	7
6.IB	0.012	0.012	−0.716**	−0.713**	0.964**	1	
7.IP	−0.007	0.018	−0.729**	−0.724**	0.971**	0.961**	1
Mean	1.5	2.34	2.53	2.89	2.33	2.33	2.33
SD	0.5	1.00	0.69	1.42	1.11	1.14	1.13

N = 1142. Boldface values indicate Cronbach's alpha. DL, digital leadership; IB, innovative behavior; IP, innovation performance. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

4.2. Hypothesis testing

Table 2 shows that digital leadership positively affected innovation performance ($B = 0.946$, $p < 0.001$), supporting Hypothesis 1. The table also indicates that digital leadership was significantly related to innovative behavior ($B = 0.960$, $p < 0.001$) and that innovative behavior was significantly related to innovation performance ($B = 0.346$, $p < 0.001$). Therefore, hypotheses 2 and 3 have been validated. Moreover, the bootstrap-derived indirect impact of digital leadership on innovation performance were significant ($B = 0.332$, 95% confidence interval [CI]: [0.289, 0.373]). Thus, innovative behavior partially mediated the positive association between digital leadership and innovation performance, supporting Hypothesis 4.

Table 2. Results of mediating hypotheses.

Variables	Innovative Behavior	Innovation Performance	
	Model 1	Model 2	Model 3
1) Gender	0.343*	−0.009	−0.021
2) Age	0.006	−0.005	−0.007
3) Education	−0.023	−0.014	−0.006
4) Years of work	−0.035	−0.398*	−0.028*
5) Digital Leadership DL	0.960***	0.946***	0.615***
6) Innovative Behavior IB			0.346***
Total effect [95% CI]		0.946 [0.928, 0.965]	
Direct effect [95% CI]		0.615 [0.571, 0.659]	
Indirect effect [95% CI]		0.332 [0.289, 0.373]	
R^2	0.930***	0.944***	0.952***

Bootstrap size = 5000. CI, confidence interval. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

5. Discussion and conclusion

This study investigated the relationship between digital leadership and innovation performance, as well as the potential mechanisms that influence this relationship. Our research findings are summarized as follows. Firstly, our research findings indicate that digital leadership has a significant positive impact on innovation performance. That is to say, universities with high digital leadership are more likely to achieve innovative performance. This finding is consistent with previous empirical research (Alenezi, 2023; Bresciani et al., 2021; Ramlawati et al., 2021; Vanblaere and Devos, 2016), Most of these studies have confirmed a positive relationship between digital

leadership and innovation performance, and the implementation of digital leadership promotes the improvement of innovation performance in universities. Therefore, our study adds empirical evidence of the positive impact of digital leadership on innovation performance.

Second, our research indicates that innovative behavior to some extent mediates the relationship between digital leadership and innovation performance. Consistent with previous research (Amorim Neto Roque Do Carmo, 2018; Ellis et al., 2020; Ferreira et al.,2019). The current work confirms the mediating role of innovation behavior in the relationship between digital leadership and innovation performance in the context of China. On this basis, this study strengthens the empirical research on the partial mediating role of innovation behavior between digital leadership and innovation performance in Chinese universities.

Third, according to Foy et al. (2019), the innovative behavior implemented by employees based on their digital abilities typically depends on their perception of the leadership of the board of directors. Social identity theory reminds us that leaders need to pay attention to the role of social identity in their leadership (Raskovic,2021). Leaders can use social identity theory as a tool to understand the needs and expectations of subordinates or followers, and try to meet their needs and expectations through their leadership behavior. By doing so, leaders can enhance their leadership effectiveness and promote the development of the organization.

5.1. Theoretical implications

This study has made certain theoretical contributions to the research on digital transformation and digital leadership in universities. Firstly, our research findings confirm the positive impact of digital leadership on the innovation performance of Chinese universities. The emergence of the concept of transformative digital leadership has promoted the digital transformation process of universities (Ainuaimi et al., 2022). However, there is still a gap in research on transformational digital leadership, and the specific mechanism by which transformational digital leadership affects the digital transformation of universities is not yet clear. Exploring the specific pathways through which transformational digital leadership affects innovation performance can undoubtedly greatly enrich the existing research results of this emerging concept and to some extent supplement the research gap in digital transformation driven innovation performance.

Secondly, this study reveals the mediating mechanism between digital leadership and innovation performance. So far, there has been a wealth of research on digital transformation and innovation behavior in the business sector, especially in the IT industry. (Yücel, 2021) Only a few empirical studies have focused on the significant impact of innovative behavior on leadership and organizational innovation performance. In the post pandemic era, Chinese universities have utilized digital technology to make institutional operations more streamlined, automated, and intelligent. The impact mechanism of organizational innovation performance in achieving better quality development is not clear (Benavides et al.,2023). Our research extends existing efforts by proposing innovative behavior as a mediator.

Thirdly, this study provides new insights into the aforementioned relationships using social cognitive theory. This study expands the application scope of social cognitive theory by emphasizing the important role of employees' perception and identification with digital leadership in leadership. Although previous studies have also focused on the interrelationships between leaders and their subordinates (Alonderiene and Goldfarb,2008; Belette, 2018; Long et al., 2014), This study is the first to explore the mediating role of innovative behavior in the relationship between leadership and organizational performance in Chinese universities. By doing so, our research has extended the application and promotion of social cognitive theory to the Chinese context.

5.2. Actual impact

Our research also provides some practical insights for Chinese university administrators and government education departments.

Firstly, given the significant impact of digital leadership on the innovation performance of Chinese universities, digital leadership can be seen as a key factor in improving university innovation performance. In the process of deepening digital transformation, improving the level of education and ranking of influence in Chinese universities, it is necessary to attach importance to the digital management ability of university presidents and department managers. University leaders not only engage in in-depth learning, possess global thinking, critical thinking, and creative abilities, but also actively plan and pursue the mission and vision of universities, leading organizational change and innovation. Treat every employee equally in practical work, encourage them to participate in decision-making, focus on work efficiency, and be able to use digital technology to track and scientifically evaluate various aspects of the school's work.

Secondly, managers should also be aware of the importance of taking effective measures to enhance innovative behavior. Changing the organizational structure of universities to make them more flexible than before. The innovation in implementing job design has made it more diverse than before. Continuously utilizing innovation to improve the quality and speed of scientific research in universities. As far as university teachers are concerned, they should be keenly aware that recognizing the management changes of managers, being able to identify problems in teaching and research work, actively come up with solutions, and strive to implement innovation. These innovative behaviors can enhance their own abilities and increase organizational performance.

Finally, our research findings emphasize the positive role that teachers perceive digital leadership in promoting innovative behavior and increasing innovation performance. University leaders should actively care for their employees and guide them to pursue the vision and goals of the university. University leaders should enhance the knowledge and digital technology application ability of employees through training and other learning methods. University teachers should also actively identify with the development goals of universities, actively participate in departmental decision-making, and actively implement digital innovation. More importantly, mutual recognition and active interaction between managers and employees can achieve effective management and service for both parties,

continuously improving process innovation performance and result innovation performance through effective innovative behavior.

5.3. Limitations and future research directions

Our research is subject to several limitations. Firstly, the cross-sectional study design makes it difficult for us to clarify the causal relationships between variables. Although our research findings reveal a significant impact of digital leadership on innovation performance in Chinese universities, caution should be exercised in interpreting the results. Given that our findings based on cross-sectional design may change and become uncertain over time, researchers should use experimental designs, longitudinal data, or panel data to test future causal relationships. Secondly, we collected self-reported data from respondents, which may lead to common methodological biases and artificially exaggerated correlations (Crampton and Wagner, 1994). Therefore, other researchers should collect data through different types of surveys. For example, conducting qualitative analysis of our research questions through interviews and other surveys; Enriching research materials through statistical analysis of teaching and research achievements in universities. Thirdly, this study was conducted in a region in southwestern China, in order to prevent this discovery from being extended to universities in other regions, especially in developed coastal areas in the east. Therefore, future exploration should focus on the factors that influence the digital transformation of universities in other regions of China.

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