

Research Article

How Digital Transformational Leadership Promotes Digital Creativity: A Dual-path Mediation Model

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Abstract

This study explores the dual-path mechanisms for the influence of digital transformational leadership on employees' digital creativity. A questionnaire survey of 300 knowledge-based employees in several Chinese firms was conducted, and 219 valid questionnaires were obtained. We conducted structural equation modeling using Mplus to analyze our data. The results show that digital transformational leadership has a significant positive effect on digital creativity. Openness to change and change self-efficacy mediates the relationship between digital transformational leadership and digital creativity. Importantly, openness to change and change self-efficacy play a chain mediating role in the effect of digital transformational leadership on digital creativity—that is, digital transformational leadership increases their openness to change and change self-efficacy, which in turn contributes to their digital creativity. By enriching research in the field of creativity, this study is also instructive for guiding and promoting employees' digital creativity.

Keywords

Digital Transformational Leadership, Digital Creativity, Openness to Change, Change Self-efficacy

1. Introduction

With the rapid development of digital technologies such as big data, artificial intelligence, the advent of Industry 4.0 era has promoted the transformation of business practices and business models. Enterprises urgently need to leverage digital transformation to survive and develop. As digital transformation deepens, digital creativity has become an important factor promoting industrial innovation and competitiveness [1, 2]. Digital creativity is defined as “all forms of creativity driven by digital technologies” [3, 4]. For example, it promotes innovation in production processes, business models, and products through the application of various digital technologies [5, 6]. Although previous studies on employee crea-

tivity are abundant [7, 8], we know very little about how to cultivate and enhance digital creativity among employees [9].

In the context of the digital economy, scholars have proposed the concept of digital transformational leadership, which is described as a leadership style that combines transformational leadership with the use of digital technology [10]. Prior research has confirmed that different leadership styles, such as transformational leadership [11], empowering leadership [12], are crucial factors driving digital creativity. However, there is still a dearth of research on the relationship between digital transformational leadership and employees' digital creativity. Hence, this study posed the following re-

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search questions: Does digital transformational leadership contribute to increasing employees' digital creativity? If so, *why* and *how* digital transformational leadership influence digital creativity?

Integrating social information processing theory and social cognitive theory, this study argues that digital transformational leadership can be viewed as a major source of information and a role model at work for employees. Digital transformational leadership involves vision communication, behavioral modeling, and interactive feedback, which together promote employees' openness and self-efficacy to digital transformation, thus enhancing their digital creativity. This study clarifies the dual-path mechanisms for the influence of digital transformational leadership on digital creativity by constructing a theoretically grounded model. Specifically, we propose openness to change and change self-efficacy as two pathways through which digital transformational leadership affects digital creativity. The findings will enrich the research on the antecedent variables for digital creativity and provide practical insights for organizational management undergoing digital transformation.

2. Theory and Hypotheses Development

2.1. Digital Transformational Leadership and Digital Creativity

Digital transformational leadership is a product of integrating leaders' digital mindsets with traditional transformational leadership in the context of digital economy [10, 13]. Leaders can help companies succeed in the digital age in three ways: (1) following emerging technology trends; (2) determining the direction of the digital change and investment strategy; and (3) leading the team to change quickly and precisely [14]. The extant literature indicates that digital transformational leadership facilitates employees' creativity and innovation [15-17].

Digital transformational leadership is expected to promote employees' digital creativity for two reasons. First, digital transformational leaders usually set clearer digital goals and development strategies, which lead employees to use emerging digital technologies to solve problems [18, 19]. As such, leaders as important role models for their employees can guide and motivate employees to use digital technologies to promote innovation [20]. Second, digital transformational leadership create a digital workplace by improving and encouraging digital knowledge sharing and digital learning [15]. Thus, leader behaviors sends a positive signal to guide employees to digital creativity. Based on above, we hypothesized that:

Hypothesis 1: Digital transformational leadership is positively related to employees' digital creativity.

2.2. Mediating Effects of Openness to Change

Social information processing theory emphasizes that individuals form their attitudes and behaviors by processing and interpreting information from others in the social environment [21]. In the digital era, leaders are an important source of information for employees and can thus significantly influence employee attitudes toward change and their subsequent behaviors [22].

Openness to change refers to employees' willingness to support and actively participate in digital transformation [23, 24]. According to Miller et al. [25], employees' openness to change is formed of two main aspects: (1) employees' willingness to support change and (2) employees' expectation of the potential consequences of change. According to social information processing theory, the digital thinking and support for digital transformation demonstrated by transformational leadership signal a positive attitude toward change to employees, thus also shaping employees' willingness to support change. Digital transformational leadership also delivers information about change and clear strategic goals to employees through digital platforms, ensuring that employees have a clear understanding of the goals, processes, and expected results of change [18]. This awareness results in their expectations of positive outcomes, which enhance employees' openness to change.

On the other hand, employees who are more open to change are more willing to share their thoughts and creative ideas about organizational digital transformation. This atmosphere can facilitate the generation and implementation of new ideas driven by digital technologies [26]. Employees with more openness to change are also usually less fettered by old conventions and thus more flexible in their thinking, which results in more creativity [26, 27]. The following hypothesis is thus proposed:

Hypothesis 2: Openness to change mediates the relationship between digital transformational leadership and digital creativity.

2.3. Mediating Effects of Change Self-efficacy

The concept of change self-efficacy is rooted in the notion of self-efficacy, which solidifies and enriches self-efficacy in a particular domain. Ng and Lucianetti [28] define change self-efficacy as the extent to which an individual is confident in achieving the goals of change in a change situation. According to social cognitive theory, individuals promote their self-efficacy by observing the behavioral outcomes of significant others and positive feedback from the outside world [29]. Self-efficacy then affects the individual's cognitive processes, behavioral choices, affective processes, and motivational efforts [30].

According to social cognitive theory, the behavior of digital transformational leaders is an indirect experience that enhances followers' confidence in the success of digital transformation, thereby increasing their change self-efficacy.

Furthermore, digital transformational leaders also give positive feedback, encouragement, and support to employees who use digital technology to solve their work problems, which leads those employees to believe in their ability to accomplish digital goals, thus further increasing their change self-efficacy.

Research has shown that individuals with a high sense of self-efficacy are usually more confident in their ability to perform specific tasks and thus have more creativity [31]. Change self-efficacy is a domain-specific form of self-efficacy, and in a digital environment, this positive belief in change promotes employees' innovative activities in the use of digital technology, which in turn enhances their own digital creativity.

Hypothesis 3: Change self-efficacy mediates the relationship between digital transformational leadership and digital creativity.

2.4. Chain Mediation of Openness to Change and Change Self-efficacy

To sum up, drawing upon social information processing and social cognition theory, this study proposes that employees' perception and interpretation of social information (e.g., digital transformational leadership) will influence their attitude (i.e., openness to change) and indirectly shape their perception of self-competence in similar situations (i.e., change self-efficacy), which in turn affects individual behavior (digital creativity). Therefore, a chain mediation model is constructed to further reveal the mechanism by which digital transformational leadership influences digital creativity. Figure 1 presents our hypothesized theoretical model.

Hypothesis 4: Openness to change and change self-efficacy have a chain mediation effect on the relationship between digital transformational leadership and digital creativity.

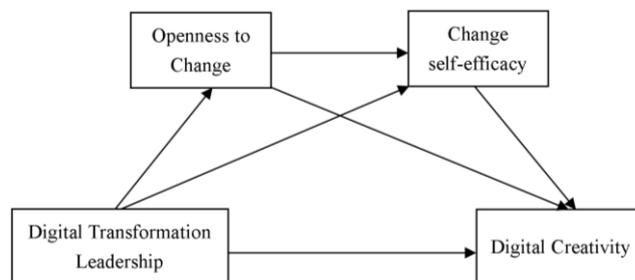


Figure 1. Research model.

3. Methodology

3.1. Participants and Procedure

This study adopts the questionnaire survey method to select a total of 300 knowledge-based employees in Internet or private enterprises, and the questionnaires are mainly distributed by relying on online channels to carry out anonymous research. After preliminary screening, a total of 219 valid questionnaires were obtained, with an effective recovery rate of 73%. Among the 219 employees, 39.7% are male and 60.3% are female, with an age range of 20-60 years old; average job tenure is 5.80 years (SD = 4.61); average Organizational tenure is 3.05 years, (SD = 2.10). Table 1 shows the basic profile of the sample.

Table 1. Sample characteristics (n = 219).

Demographic Variables	Characteristics	Frequency	Percentage (%)
Gender	Male	87	39.7
	Female	132	60.3
Age	20-25	63	28.8
	26-30	66	30.1
	31-40	54	24.7
	41-50	25	11.4
	51-60	11	5.0
	High school	27	12.3
Education	College	45	20.5
	Bachelor	107	48.9
	Master	29	13.2
Tenure	PHD	11	5.0
	1-5 (years)	115	52.5

Demographic Variables	Characteristics	Frequency	Percentage (%)
	6-10 (years)	80	36.52
	11-20 (years)	20	9.14
	20 and above	4	1.84
Organizational tenure	1-5 (years)	197	89.9
	6-10 (years)	21	9.6
	11 and above	1	0.5
Total		219	100

3.2. Measurements

3.2.1. Digital Transformational Leadership

Digital transformational leadership was measured using a scale developed by AlNuaimi et al. [10], which consists of a total of six items on a 6-point Likert scale rating from “1 = strongly disagree” to “6 = strongly agree”. Higher scores represent higher levels of digital transformational leadership. Specific questions include “My leader provides employees with a clear vision for digital transformation”, “My leader inspires all employees with our organization's digital transformation plan,” and so on. The Cronbach alpha for this scale is 0.91.

3.2.2. Digital Creativity

Digital Creativity is measured using a scale developed by Lee and Chen [4], which consists of three items. A sample item is “I am able to come up with new ideas at work through the use of digital technology”. A 6-point Likert scale (ranging from “1=strongly disagree” to “6 = strongly agree”) is used to evaluate the degree of impact that digital technology has on their work. Higher scores represent higher levels of the employees’ digital creativity. The Cronbach alpha for this scale is 0.76.

3.2.3. Change Self-efficacy

Change self-efficacy is assessed by a five-item scale developed by Ng and Lorenzo [28]. A sample item is “I am sure I can handle whatever changes occur in the organization”. The Likert 6-point scale was used to evaluate employees' attitudes towards making changes in the organization from “1 = strongly disagree” to “6 = strongly agree”. The Cronbach

alpha for this scale is 0.86.

3.2.4. Openness to Change

Openness to change is measured using four items drawing from Wanberg and Banas [24]. A sample item is “I am open and receptive to organizational change”. Employees rated their acceptance of organizational change from “1=strongly disagree” to “6=strongly agree”, with higher scores indicating greater openness to change. The Cronbach alpha for this scale is 0.83.

4. Results

4.1. Discriminant Validity Test

In order to verify the discriminant validity among the study variables, this study conducted confirmatory factor analysis (CFA) using Mplus 8.3. The results showed in Table 2. The four-factor model had good fit index to the sample data ($\chi^2/df = 1.59$, CFI= 0.96, TLI=0.96, RMSEA=0.05, SRMR = 0.04), which was significantly better than the other competing models: a three-factor model collapsing openness to change and change self-efficacy ($\Delta\chi^2_{(3)}=171.39$, $p < 0.001$; CFI = 0.89, TLI= 0.87, RMSEA= 0.09, SRMR = 0.06); a two-factor model combining digital transformational leadership with digital creativity as a factor, combining openness to change with change self-efficacy as a factor ($\Delta\chi^2_{(5)}=263.61$, $p < 0.001$; CFI = 0.84, TLI= 0.82, RMSEA= 0.11, SRMR = 0.08); and a one-factor model collapsing all variables into a single factor ($\Delta\chi^2_{(6)}=569.75$, $p < 0.001$; CFI = 0.70, TLI= 0.66, RMSEA= 0.15, SRMR = 0.10). This shows that the four variables in the study have good discriminant validity.

Table 2. Discriminant validity of the research variables (n = 219).

Model	χ^2/df	RMSEA	SRMR	CFI	TLI	$\Delta\chi^2_{(df)}$
Hypothesized 4-factor model (DTL, OC, CS, DC)	1.59	0.05	0.04	0.96	0.96	
Three factor model (DTL, OC + CS, DC)	2.85	0.09	0.06	0.89	0.87	171.39(3)***
Two factor model (DTL + DC, OC + CS)	3.50	0.11	0.08	0.84	0.82	263.61(5)***
One factor model (DTL + DC+OC + CS)	5.74	0.15	0.10	0.70	0.66	569.75(6)***

Note. DTL is the abbreviation for digital transformational leadership; OC is the abbreviation for openness to change; CS is the abbreviation for change self-efficacy; DC is the abbreviation for digital creativity.

4.2. Descriptive Statistics and Correlations Coefficient

Table 3 presents the descriptive statistics and correlation analysis of research variables in this study. The results showed that digital transformational leadership was significantly and positively correlated with digital creativity ($r = 0.55, p <$

0.001), change self-efficacy ($r = 0.47, p < 0.001$), and openness to change ($r = 0.50, p < 0.001$). Change self-efficacy was positively associated with openness to change ($r = 0.52, p < 0.001$) and digital creativity ($r = 0.45, p < 0.001$). Additionally, openness to change was positively related to digital creativity ($r = 0.49, p < 0.001$). These results initially support our hypotheses.

Table 3. Descriptive statistics and correlations coefficient (n = 219).

Variables	M	SD	1	2	3	4	5	6	7	8	9
1 Gender	1.60	0.49									
2 Age	2.34	1.15	-0.19**								
3 Education	2.78	0.99	0.09	-0.07							
4 Job tenure	5.80	4.61	-0.19**	0.41***	-0.02						
5 Organizational tenure	3.05	2.10	-0.19**	0.37***	0.01	0.65***					
6 Digital Transformation Leadership	4.48	1.13	0.10	0.06	0.08	0.06	0.18**	(0.91)			
7 Digital Creativity	4.65	1.00	0.16*	-0.03	0.11	-0.06	-0.00	0.55***	(0.76)		
8 Change self-efficacy	4.50	0.97	-0.01	0.11	0.05	0.13*	0.10	0.47***	0.45***	(0.86)	
9 Openness to Change	4.52	1.04	0.06	0.06	0.05	-0.01	0.05	0.50***	0.49***	0.52***	(0.83)

Note. Gender was coded as 1=female, 2=male; Age was coded as 1=20-25, 2=26-30, 3=31-40, 4=41-50, 5=51-60; Education was coded as 1=High school, 2=College, 3= Bachelor, 4=Mater 5=PHD; values on the diagonal are the Cronbach's a reliability of our research variables. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.3. Hypotheses Test

4.3.1. Direct Effect of Digital Transformational Leadership on Digital Creativity

We used Mplus 8.3 to test our hypothesized model. Results of path analysis were shown in Table 4. Hypothesis 1 assess that digital transformational leadership is positively related to digital creativity. The results showed that after controlling for

employees' gender, age, education level, job tenure, and organizational tenure, digital transformational leadership had a significant positive relationship on digital creativity ($\beta = 0.36, p < 0.001$). Therefore, Hypothesis 1 was supported.

4.3.2. Mediating Effect of Openness to Change

Hypothesis 2 propose that openness to change mediates the relationship between digital transformational leadership and digital creativity. The results showed that digital transformational leadership had a positive and significant effect on

openness to change ($\beta = 0.51, p < 0.001$). After controlling for the effect of digital transformational leadership, openness to change was positively related to digital creativity ($\beta = 0.20, p < 0.01$). The indirect effect of openness to change is significant (effect = 0.09, SE = 0.03, 95%CI = [0.03, 0.15]). Therefore, Hypothesis 2 was supported.

4.3.3. Mediating Effect of Change Self-efficacy

Hypothesis 2 propose that change self-efficacy mediates the relationship between digital transformational leadership and digital creativity. The results showed that digital transformational leadership had a positive and significant effect on change self-efficacy ($\beta = 0.28, p < 0.001$). After controlling for the effect of digital transformational leadership, change self-efficacy was positively related to digital creativity ($\beta =$

0.19, $p < 0.01$). The indirect effect of change self-efficacy is significant (effect = 0.05, SE = 0.02, 95%CI = [0.01, 0.08]). Therefore, Hypothesis 3 was supported.

4.3.4. Chain-mediated Effects of Openness to Change and Change Self-efficacy

Hypothesis 4 assess that there is a chain-mediated effect of openness to change and change self-efficacy on the relationship between digital transformational leadership and digital creativity. The chain-mediated results showed (Table 5) that the effect of digital transformation leadership on digital creativity through openness to change and change self-efficacy was statistically significant (effect = 0.03; SE = 0.01, 95% CI = [0.01, 0.06]), indicating that the chain-mediated effect was significant. Therefore, Hypothesis 4 was supported.

Table 4. Results of regression analysis (n = 219).

Variables	Openness to Change (M1)	Change self-efficacy (M2)	Digital Creativity (Y)
	Model 1 (β)	Model 2 (β)	Model 3 (β)
Gender	0.01	-0.06	0.08
Age	0.07	0.03	-0.03
Education	0.01	0.02	0.05
Job tenure	-0.05	0.16	-0.06
Organizational tenure	-0.03	-0.01	-0.03
Digital Transformational Leadership (X)	0.51***	0.28***	0.36***
Openness to Change (M1)		0.39***	0.20**
Change self-efficacy (M2)			0.19**
R ²	0.26***	0.36***	0.41***

Note. ** $p < 0.01$, *** $p < 0.001$.

Table 5. Results of Chain Mediation Effect Analysis (n = 219).

Effect	Path Analysis	Effect Size	SE	95%CI	
				LLCI	ULCI
Indirect effect 1	X→M1→Y	0.09	0.03	0.03	0.15
Indirect effect 2	X→M2→Y	0.05	0.02	0.01	0.08
Indirect effect 3	X→M1→M2→Y	0.03	0.01	0.01	0.06
Total indirect effect		0.17	0.04	0.10	0.24
Total effect		0.49	0.05	0.39	0.59

5. Discussion

Based on social information processing theory and social cognition theory, this study tested the dual-path mechanisms for the influence of digital transformational leadership on digital creativity.

Firstly, we found that digital transformational leadership positively predicts digital creativity, which is consistent with the findings of existing studies that digital transformational leadership positively promotes employees' innovative behavior and creativity [15, 17, 32]. In line with the theoretical framework, digital transformational leadership provides employees with positive information signals as well as a role model, which can effectively enhance employees' digital creativity.

Secondly, openness to change partially mediates the relationship between digital transformational leadership and digital creativity. According to social information processing theory, when a leader's digital transformational leadership stands out, it provides a positive environmental message that motivates employees to show a more proactive attitude toward digital change. When employees are more open to change, they are more likely to accept changes to be carried out in the organization. Employees would then express their support for the organization carrying out change by participating in more change activities or using rich digital technology, which is more likely to promote digital creativity.

Thirdly, change self-efficacy partially mediates the relationship between digital transformational leadership and digital creativity. According to social cognitive theory, digital transformational leadership provides a role model for employees to use and accept digital technology. Under the influence of this leadership approach, employees have more confidence in digital change, as well as and more courage to face and solve the problems and challenges inherent in the process of digitization. This, in turn, effectively stimulates their digital creativity.

Fourthly, openness to change and change self-efficacy have a chain mediation effect in the relationship between digital transformational leadership and digital creativity. The data from this study support our hypotheses and clarify the mechanism by which digital transformational leadership has an impact on digital creativity—that is, the chain mediation model appears to be supported. Digital transformational leadership first acts on digital creativity by influencing employees' attitudes toward digital change, which subsequently influences self-efficacy. This enhanced self-efficacy then further acts on digital creativity. In other words, when a leader demonstrates more digital transformational leadership and employees have a greater understanding of the organizational environment, they are more accepting of change and use digital technology more frequently to accomplish their work goals. This leads to higher confidence in accomplishing the goals of organizational change and, ultimately, to more creative behaviors.

5.1. Theoretical Contributions and Practical Implications

The contributions of this study are reflected in two main points. First, this study expanded the antecedent research on digital creativity from the perspective of leadership type. The findings confirmed that digital transformational leadership positively promotes digital creativity, thus providing a new perspective for the study of digital creativity and compensating for the lack of research linking the two. Second, based on the digital context, this study revealed the dual-path mechanism of employees' openness to change and change self-efficacy in the relationship between digital transformational leadership and digital creativity. Using social cognitive theory and social information processing theory, this study not only provides a solid theoretical foundation for explaining the path mechanism, it further enriches the scope for applying these theories, thus bridging the gap in the theoretical research on how openness to change and change self-efficacy drive digital creativity.

The results of this study also have important implications for management practices. First, leaders need to recognize the significance of digital transformation for firm survival and development. They also need to understand the challenges and opportunities that are part of the process of digital transformation and take the initiative to integrate digital thinking into management. Firms can also develop special digital talent training programs to enhance the ability of leaders to manage digital transformation in the organization. Second, in view of the important role of digital creativity in the digital transformation of firms, leaders can create an inclusive atmosphere and culture for this transformation to stimulate employees' openness to change and change self-efficacy, thus promoting the generation of digital creativity.

5.2. Limitations and Future Directions

This study has some limitations. First, it used a cross-sectional research design to collect data through employee self-assessment. It is thus subject to common method bias and cannot accurately infer causal relationships between variables. Future research could attempt to test the robustness of this study's results by collecting multi-wave and multi-source data. Second, this study only considered the mediating mechanism for how digital transformational leadership influences digital creativity without fully considering the boundary conditions of the research model. To compensate for this shortcoming, moderating variables such as environmental factors, individual characteristics, and time factors could be considered in future studies.

6. Conclusion

Digital transformation leadership significantly promotes digital creativity. Change self-efficacy and openness to

change partially mediate between the relationship between digital transformational leadership and digital creativity. Openness to change and change self-efficacy chain mediate between digital transformational leadership and digital creativity.

Abbreviations

DTL	Digital Transformational Leadership
OC	Openness to Change
CS	Change Self-efficacy
DC	Digital Creativity

Author Contributions

Rui Xia: Data curation, Formal Analysis, Project administration, Writing – original draft

Liang Hou: Conceptualization, Formal Analysis, Funding acquisition, Methodology, Supervision, Writing – review & editing

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Conflicts of Interest

No potential conflict of interest was reported by the authors.

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