

MEDIATING EFFECTS OF THE RELATIONSHIP BETWEEN TRANSFORMATIONAL LEADERSHIP
AND TEAM INNOVATION PERFORMANCE IN INTERDISCIPLINARY TEAMS
IN UNIVERSITIES UNDER ANHUI PROVINCE

Liu Wentao

Peerapong Tipanark

Pornthep Mengman

Educational Administration,

Faculty of Education, Bangkokthonburi University

E-mail: tarinee.kit@bkkthon.ac.th

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ABSTRACT

The objectives of this study are: 1. To determine the components and indicators of the transformational leadership, team innovation performance, organizational innovation climate and knowledge sharing in Interdisciplinary teams from universities in Anhui Province. 2. To propose the Structural Equation Modeling the mediating effect of knowledge sharing and organizational innovation climate on the relationship between transformational leadership and team innovation performance of interdisciplinary teams in universities of Anhui province.

Quantitative research methods are utilized. The study surveyed 462 faculty members from eight universities in Anhui Province who teach interdisciplinary majors and engage in research. The sample size was determined using a statistical program and obtained through proportional stratified sampling method, resulting in a total of 360 participants. Data was collected using a five-point scale questionnaire. Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were the statistical methods used for data analysis.

The findings of the study revealed that 1. organizational innovation climate and knowledge sharing play a mediating effect between transformational leadership and team innovation performance, and the agreement between the model and empirical data is statistically significant at $P < 0.01$, and the values of the complete model are $P < 0.01$: Chi-

square = 74.29, df = 59, GFI = 0.97, AGFI = 0.96, TLI = 0.99, the CFI = 0.99, and SRMR = 0.03;

2. Transformational leadership has a direct and significant effect on team innovation performance, organizational innovation climate, and knowledge sharing, Organizational innovation climate and knowledge sharing act as mediating variables and play a partial mediating role in the relationship between transformational leadership and team innovation performance.

Keywords: Interdisciplinary Teams, Transformational Leadership, Knowledge Sharing, Team Innovation Performance, Organizational Innovation Climate

1. Introduction

As complex science, technology and social issues rely more and more on multidisciplinary joint research, interdisciplinary research plays an increasingly important role in knowledge production and complex problem solving. On the one hand, modern science is undergoing a process of continuous crossover and integration. It has become an important feature of modern research to flexibly use theories and methods from different disciplines to tackle a complex subject. Whether in the high-tech field or in the field of humanities and social sciences, the collaboration of researchers from different disciplines has become the main way to break through technical problems. On the other hand, interdisciplinary cooperation between natural sciences and humanities and social sciences will receive more and more attention. With the frequent emergence of new global challenging issues, such as climate change, refugees caused by wars in the Middle East, air, water, and soil pollution, etc., these issues cannot be solved by a single country, nor can they be solved by traditional science and technology. Changes must be explored and resolved through cooperation between countries and the integration of different technologies, natural sciences, humanities and social sciences. Moreover, as new technologies such as artificial intelligence, machine learning, and big data continue to influence and infiltrate the fields of humanities and social sciences, social science researchers have begun to cooperate with natural scientists and engineers to discuss solutions to issues in the new era. Nevertheless, we should also realize that interdisciplinary research is an inevitable manifestation of the nature of science, because whether it is the natural world studied by natural sciences or the human society studied by social sciences, they are all categories of the objective material world. As Liu Ji, the former vice president of the Chinese Academy of Social Sciences, said: "I am afraid that there has

never been single-disciplinary research. It is more or less directly and indirectly related to other disciplines in one way or another. This is the unconscious starting point. "The development of interdisciplinary research is the result of people's awareness of the one-sided and fragmented view of problems caused by the continuous differentiation of disciplines in the past two hundred years, especially when researchers and students are bound by a single discipline, they realize the important the limitations and creativity of problem solving are constrained, thus gradually consciously shifting to interdisciplinary thinking of holism and system theory. Not only that, but various disciplines are increasingly intersecting and infiltrating, interacting and combining. Today, if we want to discuss a certain discipline, we can find that almost no discipline can be "independent", and they are all adjacent to other disciplines or have common boundaries. Tony Becher interviewed more than 200 university teachers in 12 different disciplines and found: "People think that economics and mathematics have a common boundary, and political science has another common boundary, which has some cooperative relations with history and sociology. and psychology, philosophy, and law share less territory. Biology is described as being related to mathematics, physics especially physics, chemistry, and physical geography at one end, and the humanities especially psychological sciences at the other end. Anthropology, Anthropology, and Human Geography" (Tony Becher 1989)

After decades of development, a considerable number of interdisciplinary activities are thriving behind the orthodox disciplines. Take history as an example, history is never isolated, it is called "one of the busiest places for interdisciplinary mergers", because history is widely involved with the whole of human activities, learning other subjects is the characteristic of history. With the development of historical research, its relationship with archaeology, anthropology, sociology, and literary theory has been changing. Similar to people, a discipline is a "fluctuating, fragile self-balancing system in which research methods and specialties are constantly evolving, diverging, merging, adapting, and dying"(Jin Wu Lun 1997). Geoffery Squires also said: "Far from a simple, standard theory or conceptual structure, a discipline has a variety of internal 'compositions': including a rigorous theoretical core with applied branches; many parallel centers, a series of Wien-style cross-cutting fields; a matrix of interwoven problems and approaches; a series of loosely linked subfields"(Geoffery Squires 1992).

At present, the integration and intersection of disciplines in colleges and universities has created the emergence of interdisciplinary teams, and complex scientific research projects

are often holistic and systematic. Interdisciplinary teams that combine knowledge from different disciplines are just right for solving complex scientific problems. As the main producer of high-tech technology in my country, universities have successively established various interdisciplinary platforms. In contrast to the early construction and early research on interdisciplinary platform research in foreign countries, Chinese interdisciplinary teams started late and have relatively insufficient management systems and organizational mechanisms. Therefore, this article will study the team innovation performance of interdisciplinary teams in universities.

As an important aspect of interdisciplinary team management, scholars have done a lot of research on team innovation performance. During the research process, we found that leaders in universities have a significant impact on team performance, and leaders play a decisive role in team development. effect. After further research on leaders, it is believed that the comprehensive quality of leaders can bring rich returns to the team or make it disappear, and it can also have an impact on employees' thoughts and behaviors, which will have an impact on team performance. Bass (1990) proposed that leaders determine more than half of the success factors of an organization. Transactional and transformational leadership occupy a major position in the research on related leader behaviors, among which the research on transformational leadership is more popular, and the relationship between transformational leadership and team performance has always been a research hotspot at home and abroad.

Transformational leadership is highly matched with the leadership type required by scientific research teams because of its own characteristics of being good at motivating, supporting, and encouraging employee creativity. Such characteristics can easily create an organizational innovation atmosphere within the team that supports, encourages, and tolerates failure. Encouraging the team to dare to break through and explore boldly can mobilize the willingness of scientific research members to share experience and knowledge, which is conducive to breaking through R&D bottlenecks and promoting the improvement of the team innovation performance of the scientific research team.

Since interdisciplinary research requires the fusion of knowledge and skills from different fields, knowledge sharing plays a key role as a possible mediating variable between transformational leadership and the team innovation performance of university interdisciplinary teams. Knowledge sharing involves knowledge sharing and interaction among team members, which helps to eliminate information silos and promote interdisciplinary

cooperation, which in turn affects team innovation performance. However, current research on the relationship between transformational leadership, knowledge sharing, and university interdisciplinary team innovation is still relatively limited, especially in the context of Chinese universities.

From a personal perspective, it is conducive to the development and cultivation of transformational leadership in Chinese universities and the transformation from traditional leadership methods to transformational leadership. This study explores the relationship between transformational leadership and interdisciplinary team innovation performance, and summarizes and puts forward suggestions for cultivating transformational leadership to promote team innovation performance, in order to make team leaders realize that they want to improve team competitiveness and promote team performance. Development begins with cultivating one's own transformational leadership style, achieving both ability and political integrity, focusing on motivating members, promoting knowledge sharing within the team, and achieving healthy and stable development of the organization as a whole.

From a team perspective, it is helpful for universities to improve the team innovation performance of scientific research teams. Nowadays, the dependence and cooperation between individuals in the team are getting stronger and stronger. The formation of a high-performance team requires the excellent qualities of the team leader. Based on the characteristics of transformational leadership, transformational leadership has a strong advantage over other leadership styles in enhancing the enthusiasm of members and motivating them to strive for team goals. This study can help team leaders use transformational leadership behaviors to promote knowledge sharing and improve the team innovation performance of interdisciplinary teams.

This study takes undergraduate college teachers with interdisciplinary research teams in Anhui Province as the research object. With the purpose of improving team innovation performance, it uses theories related to transformational leadership, organizational innovation climate, and knowledge sharing. The relationship between transformational leadership and team innovation performance was investigated and analyzed. Regarding the relationship between four key variables: transformational leadership, team innovation climate, knowledge sharing and team innovation performance. This study will first formulate hypotheses to clarify the research direction between the variables. Subsequently, a quantitative research methodology will be used, aiming to verify the rationality and

scientifically validity of the hypotheses and to explore the interrelationships between these variables in a comprehensive and in-depth manner. On this basis, empirical research will be conducted to improve the team innovation performance of interdisciplinary teams in undergraduate universities in Anhui Province, and to provide empirical evidence and theoretical support for the decision-making of team leaders.

2. Research Questions

2.1 What are the components and indicators of the transformational leadership, team innovation performance, organizational innovation climate and knowledge sharing in Interdisciplinary teams from universities in Anhui Province?

2.2 What are the direct and indirect effects of transformational leadership on the team innovation performance of interdisciplinary teams in undergraduate universities in Anhui Province? Additionally, do organizational innovation climate and knowledge sharing mediate interdisciplinary team innovation performance?

3. Research Objectives

3.1 To determine the components and indicators of the transformational leadership, team innovation performance, organizational innovation climate and knowledge sharing in Interdisciplinary teams from universities in Anhui Province.

3.2 To proposed the Structural Equation Model for relationship between transformational leadership and team innovation performance of interdisciplinary teams in universities under Anhui province.

4. Research hypothesis

1. Transformational leadership has a significant direct effect on team innovation performance.

2. Transformational leadership has a significant direct effect on Knowledge Sharing.

3. Knowledge Sharing has a significant direct effect on team innovation performance.

4. Transformational leadership has a significant direct effect on organizational innovation climate.

5. Organizational innovation climate has a significant direct effect on Knowledge Sharing.

6. Organizational innovation climate has a significant direct effect on team innovation performance.

7. Transformational leadership has a significant indirect effect on team innovation performance through Knowledge Sharing.

8. Transformational leadership has a significant indirect effect on team innovation performance through organizational innovation climate.

9. Transformational leadership has a significant indirect effect on team innovation performance through Organizational innovation climate and Knowledge Sharing.

5. Research Method

5.1 Research Design

Step 1. A mixed-methods approach combining qualitative and quantitative methods was used to identify the components and indicators of transformational leadership, team innovation performance, knowledge sharing, and organizational climate for innovation by first conducting a content analysis of 20 relevant studies.

Step 2. Based on the indicators and components obtained in the first stage, the author used a questionnaire to obtain the data and used validated factor analysis (CFA) and structural equation modeling (SEM) to validate the direct, indirect, and mediating relationships among the four variables.

5.2 Population and Sample

The population used in this study is all 17 interdisciplinary teams from 7 universities in Anhui Province, a total of 462 people. The sample group has been selected respondents by using proportional stratified sampling method random sampling in the G*Power program version 3.1 to obtain the number of samples (set as Chi-square test at: $Df = 59$, $\alpha = 0.05$, effect size $w = 0.3$, power $= 0.8$), totally 360 teachers. Then, use the proportional stratified sampling method to determine the specific number of samples in each interdisciplinary team.

5.3 Research Instruments

The primary instrument utilized in this phase is a questionnaire. The study incorporates relevant theoretical frameworks and previous research findings into its methodology by designing a questionnaire based on established instruments used by other researchers. Index of item-objective congruence (IOC) technique has been applied to calculate the experts' agreement: Qualified items are required to have IOC equal to or above 0.50 (Rovinelli and

Hambleton,1976). Then by using questionnaire quality check: The reliability coefficient values equal to or above 0.80. The questionnaire is adapted and refined to suit the specific context of the research. The instrument employs a combination of a checklist format and a 5-level Likert Scale to comprehensively capture participants' response

5.4 Data Collection

The first was to request permission from Faculty of Education of Bangkok Thonburi University to collect data. Then requesting letters of recommendation from researchers in relevant interdisciplinary teams. The last step is to collect data from each team. The teachers were informed about the details of the questionnaire and data collection.

5.5 Data Analysis

This chapter provides a comprehensive examination of the data collected. First, a detailed introduction to the sample characteristics is provided. Thereafter, the validity of the pilot study was critically assessed, convergent validity was assessed, discriminant validity was analyzed, and the fit of the measurement model was assessed. Proceeding further, descriptive statistics were thoroughly analyzed and detailed correlation analysis was performed. Following these preliminary analyses, path analysis was employed to scrutinize direct and indirect effects and to systematically disaggregate these effects. Finally, the application of structural equation modeling is clarified, culminating in a succinct summary of the results obtained for hypothesis testing.

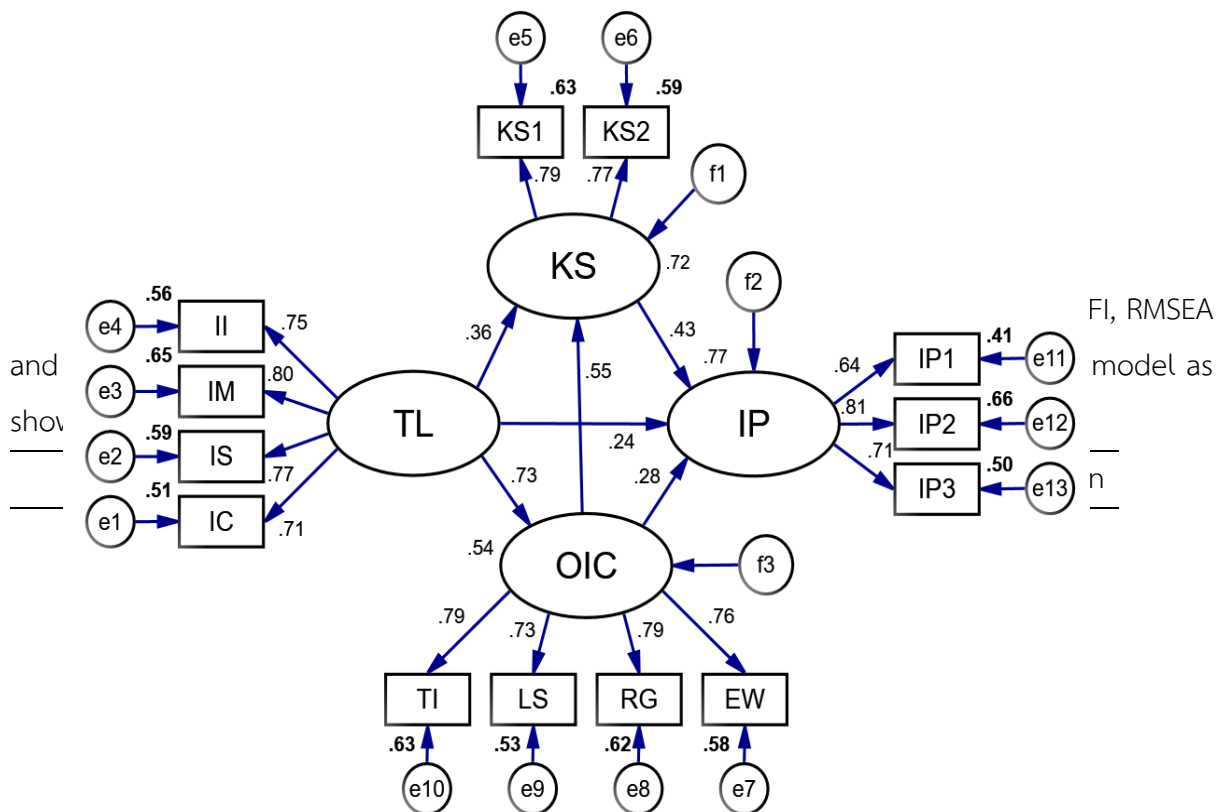
For assessment the model fit with the empirical data, based on the suggestions of Bagozzi and Yi (1988), Bollen (1989), Browne and Cudeck (1993) and Hair et al (1998), the following parameters were used as model fit evaluation metrics: the value of X^2/df should less than 3, the value of GFI and AGFI should more than 0.8, the value of RMR should less than 0.05, the value of CFI and TLI should more than 0.9 and the value of RMSEA should less than 0.08.

For mediating effect analysis, this study employs the Bootstrapping method in AMOS24.0 to test the mediating effect. The number of bootstrap sampling times is set to 5000, and the confidence interval percentile and bias-corrected confidence interval are both set to 95%. The study uses the independent variables in the unstandardized indirect effect to determine the lower bounds (Lower Bounds) and upper bounds (Upper Bounds) of the influence on the dependent variable, which determines whether there is a mediating effect between the independent variable and the dependent variable. It is commonly accepted that

a mediating effect exists if the non-standardized indirect effect falls outside the 95% confidence interval between the lower and upper limits. Conversely, if the lower and upper limits fall within the 0 value, there is no mediating effect.

6. Research Results

6.1 Model of mediating effects of the relationship between transformational leadership and team innovation performance in interdisciplinary teams in universities under Anhui province that proposed which fit with the empirical data as showed in Figure below:



Chi-square=74.294 Degree of freedom=59 P value=.087
 GFI=.971 AGFI=.955 CFI=.993 RMSEA=.027 TLI=.991 IFI=.993 RMR=.019
 Table 1 Model fitting index

6.2 The model fit with the empirical data has shown in Figure and Table 1, and when focus on the effects of variables on team innovation performance of interdisciplinary teams in universities under Anhui province, The results are shown in Table 2 and Table 3.

Hypothesis	path	Estimate	Standardized	S.E.	T-value	P
H1	TL→IP	.222	.241	.082	2.717	.007
H2	TL→KS	.416	.360	.096	4.318	***
H3	KS→IP	.342	.429	.101	3.373	***
H4	TL→OIC	.775	.733	.074	10.523	***
H5	OIC→KS	.595	.546	.093	6.369	***
H6	OIC→IP	.244	.281	.092	2.667	.008

*** P<0.001 Table 2 Direct effect analysis

The table2 shows a significant positive effect of TL on OIC (Estimate=0.775, $p<0.001$), a significant positive effect of TL on KS (Estimate=0.416, $p<0.001$), and a significant positive effect of OIC on KS (Estimate=0.595, $p<0$). There was a significant positive effect of TL on IP, OIC (Estimate=0.244, $p=0.008<0.01$) and KS (Estimate=0.342, $p<0.001$). Additionally, there was a significant positive effect of TL on IP (Estimate=0.222, $p=0.007<0.01$).

Hypothesis	Path	Estimate	SE	Bias-corrected 95% CI		Percentile 95% CI	
				LLCI	ULCI	LLCI	ULCI
H7	TL→KS→IP	0.142	.080	0.035	0.367	0.026	0.343
H8	TL→OIC→IP	0.189	.089	0.023	0.381	0.012	0.372
H9	TL→OIC→KS→IP	0.158	.078	0.053	0.365	0.047	0.346

Table 3 indirect effect and mediating effect analysis

The table3 shows the results of the analysis. The Bootstrap method was used to test the mediation effect in the OIC and KS models. The indirect effect value of TL→KS→IP is 0.142, and the Bias-corrected 95% confidence interval [0.035, 0.367] and the 95% confidence interval of Percentile [0.026, 0.343] do not include 0, indicating that the indirect effect is established. Therefore, KS plays a significant mediating role in the model. The indirect effect value of TL→OIC→IP is 0.189. The 95% confidence interval of Bias-corrected [0.023, 0.381] does not include 0, and the 95% confidence interval of Percentile [0.012, 0.372] also does not include 0. Therefore, the indirect effect is established, indicating that OIC plays a significant

mediating role in the model. The indirect effect value of $TL \rightarrow OIC \rightarrow KS \rightarrow IP$ is 0.158. The 95% confidence interval of Bias-corrected [0.053, 0.365] does not include 0, and the 95% confidence interval of Percentile [0.047, 0.346] also does not contain 0. Therefore, it can be concluded that the indirect effect is established and plays a significant mediating role. Since TL has a significant direct effect on IP, both KS and OIC are partial mediating variables.

6.3 Summary of hypothesis results

Hypothesis 1 ($TL \rightarrow IP$): Transformational leadership (TL) has a significant direct effect on team innovation performance (IP), the estimated path coefficient was 0.222 which was statistically significant ($p < 0.01$). This hypothesis was accepted.

Hypothesis 2 ($TL \rightarrow KS$): Transformational leadership (TL) has a significant direct effect on Knowledge Sharing (KS), the estimated path coefficient was 0.416 which was statistically significant ($p < 0.001$). This hypothesis was accepted.

Hypothesis 3 ($KS \rightarrow IP$): Knowledge Sharing (KS) has a significant direct effect on team innovation performance (IP), the estimated path coefficient was 0.342 which was statistically significant ($p < 0.001$). This hypothesis was accepted.

Hypothesis 4 ($TL \rightarrow OIC$): Transformational leadership (TL) has a significant direct effect on organizational innovation climate (OIC), the estimated path coefficient was 0.775 which was statistically significant ($p < 0.001$). This hypothesis was accepted.

Hypothesis 5 ($OIC \rightarrow KS$): Organizational innovation climate (OIC) has a significant direct effect on Knowledge Sharing (KS), the estimated path coefficient was 0.595 which was statistically significant ($p < 0.01$). This hypothesis was accepted.

Hypothesis 6 ($OIC \rightarrow IP$): Organizational innovation climate (OIC) has a significant direct effect on team innovation performance (IP), the estimated path coefficient was 0.244 which was statistically significant ($p < 0.01$). This hypothesis was accepted.

Hypothesis 7 ($TL \rightarrow KS \rightarrow IP$): Transformational leadership (TL) has a significant indirect effect on team innovation performance (IP) through Knowledge Sharing (KS), the estimated path coefficient was 0.142 which was statistically significant ($p < 0.001$). This hypothesis was accepted.

Hypothesis 8 ($TL \rightarrow OIC \rightarrow IP$): Transformational leadership (TL) has a significant indirect effect on team innovation performance (IP) through organizational innovation climate (OIC), the estimated path coefficient was 0.189 which was statistically significant ($p < 0.01$). This hypothesis was accepted.

Hypothesis 9 (TL→OIC→KS→IP): Transformational leadership (TL) has a significant indirect effect on team innovation performance (IP) through Organizational innovation climate (OIC) and Knowledge Sharing (KS), the estimated path coefficient was 0.158 which was statistically significant ($p < 0.01$). This hypothesis was accepted.

7. Discussion

This study delves into the relationship between transformational leadership and team innovation performance. The study reveals that transformational leadership has a significant positive impact on team innovation performance, thus further validating the perspectives on transformational leadership theory as posited by Li Ying et al (Li Ying et al, 2019).

Under the guidance of transformational leadership, various incentivizing methods such as shaping organizational vision, demonstrating personal charisma, exemplifying positive roles, inspiring talent, granting team members autonomy, and setting high expectations are employed. These approaches stimulate the self-actualization of team members and their identification with the organization, consequently enhancing their creativity. Furthermore, transformational leadership emphasizes the establishment of a culture of mutual respect, support, and professional development within the team. Through providing guidance and training, team members' skills and confidence are bolstered, thus expanding the scope for creativity and improvement.

Of particular note, transformational leadership also focuses on subordinates' career development, granting them autonomy and opportunities to express creativity. This research aligns with the theories proposed by Li Tao, indicating that the transformational leadership style effectively reduces the power distance between employees and leaders, integrates better with organizational members, and enhances organizational cohesion and centripetal force (Li Tao, 2020). Additionally, transformational leadership attends to employees' personal interests and spiritual satisfaction, thereby increasing employee engagement and innovation. This significantly promotes the occurrence and development of innovative behaviors within university research teams, consistent with the theories of Liu Zihan ((Liu Zihan, 2021).

Transformational leadership not only addresses work and personal issues through various channels, continuously igniting employees' enthusiasm and loyalty, and promoting the unity and integration of personal and organizational goals, but also encourages employees to

try new work methods and innovative workflows. It helps them recognize the importance of innovation and motivates them to continually improve traditional work processes. The findings of other researchers further support the positive correlation between transformational leadership and team innovation performance.

This study also delves into the influence of transformational leadership on knowledge sharing and the organizational climate for innovation. The findings reveal a significant positive impact of transformational leadership on knowledge sharing. Under the guidance of transformational leadership, team members are inclined to share knowledge, thereby facilitating the flow of information and fostering innovation activities within the organization. This discovery further underscores the proactive role of transformational leadership in fostering team innovation and knowledge dissemination. Transformational leadership also demonstrates a significant positive impact on team innovation performance, indicating its role in cultivating an environment that motivates team members towards self-actualization and organizational alignment, thereby stimulating creativity and self-improvement motivation.

Furthermore, transformational leaders are capable of cultivating a culture of mutual respect, support, and professional development, providing guidance and mentorship to team members to enhance their skills and confidence, thus expanding the space for creativity and improvement.

Finally, this study validates the mediating role of knowledge sharing and the organizational climate for innovation in the impact of transformational leadership on team innovation performance. By addressing both work-related and individual issues, transformational leadership continuously stimulates employee enthusiasm and loyalty, fostering alignment and integration of individual and organizational goals. This psychological shift encourages employees to experiment with new work methods and innovative processes, helping them realize the importance of innovation and motivating them to continuously improve traditional workflows. Therefore, knowledge sharing and the organizational climate for innovation serve as mediators in the influence of transformational leadership, driving organizational innovation development.

8. Recommendations

This study aims to explore strategies for enhancing the innovative behavior of university research teams to facilitate the improvement of organizational innovation capabilities and the cultivation of an innovative atmosphere. The research model primarily encompasses variables such as transformational leadership style, team innovation atmosphere, knowledge sharing, and team innovation performance. Relevant hypotheses are validated through data analysis. Based on the research findings and the characteristics of interdisciplinary teams in universities, the following managerial implications regarding the construction of research teams are proposed.

Firstly, in terms of policy formulation, the study suggests strengthening the development of leadership among team leaders. Universities in Anhui Province should enhance leadership training and development programs, providing systematic training through specialized courses for team leaders. Within these programs, leaders would acquire core concepts, principles, and skills of leadership, learn to address challenges amidst change, unleash the potential of team members, and effectively communicate and coordinate within the team. Such initiatives lay the groundwork for leadership, enhancing leaders' capacity to navigate change.

Secondly, universities can offer various opportunities and resources to continuously enhance the leadership capabilities of team leaders. For instance, universities could establish leadership development programs, offering students practical opportunities to assume leadership roles in real team projects. These programs could also provide feedback and guidance to help students improve their leadership methods and effectiveness. Additionally, universities could implement a leadership mentorship system where experienced leaders mentor new leaders, providing guidance and support to facilitate smooth leadership development.

By improving leadership training and development programs, universities in Anhui Province can provide employees with better opportunities for developing leadership skills. This will help cultivate a pool of talent with innovative thinking and leadership abilities, driving change and innovation. Furthermore, this will enhance the overall competitiveness and influence of universities, injecting new momentum into the development and construction of the institutions.

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