

Mechanism of Team Leadership on the Performance of Scientific Research Teams of Higher Educational Institutions in Anyang City Under Henan Province

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Abstract

This article studies the impact mechanism of scientific research team leadership on team performance in vocational colleges in Anyang City, Henan Province, including: (1) determining the dimensions of team leadership and scientific research team performance in colleges and universities in Anyang City, Henan Province; (2) exploring the impact of team leadership on team performance in Henan Province The influencing mechanism of the performance of scientific research teams in universities in Anyang City, Henan Province; (3) Propose guidance on improving the performance of scientific research teams in universities in Anyang City, Henan Province. This study adopted a mixed qualitative and quantitative research method. The research subjects were all faculty and staff of four universities, a total of 4452 people, and a total of 315 randomly selected samples were collected. Content analysis was used to establish a questionnaire, and confirmatory factor analysis was used to determine team leadership and The reliability and validity of performance dimensions are analyzed in depth through the establishment of structural equation models and mediation models to analyze the influencing mechanisms.

The research conclusions are: (1) The components of scientific research team leadership include professional commitment, problem decision-making, learning and innovation, communication motivation, mission goals, and authorized collaboration; the components of scientific research team performance include team scientific research output, team satisfaction, and team Adaptability; (2) Scientific research team leadership has a significant and strong correlation with team performance. Among them, communication incentives, mission goals and learning innovation have a significant positive correlation with scientific research results; communication incentives and mission goals have a significant positive correlation with team satisfaction. There is a significant positive correlation; professional commitment and learning innovation have a significant positive correlation with team adaptability. The suggestion is: In order to improve team performance, team leaders should give priority to motivation through communication, clarify the team's scientific research mission and goals, focus on members' research skills training, respect members' independent opinions, and support innovation. At the same time, leaders also need to pay attention to the forefront of the industry and strive for resources. Promote the continuous development of the team.

Keywords: Team Leadership; Scientific Research Team; Higher Educational Institution; Anyang City; Henan Province

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Introduction

The world is currently experiencing a major change that has not been seen in a century. The global economy is in a downturn, and scientific and technological innovation has become the main battlefield of international strategic competition. China uses scientific and technological self-reliance as the support for the national development strategy. As an important force in basic research and technological breakthroughs, universities play a key role in scientific and technological innovation and talent training. Universities need to adapt to the new era, deepen the transformation of scientific research paradigms and organizational models, focus on practical problems, serve national security and social and economic development, and the construction of high-level scientific research teams has become a key starting point. As the cornerstone of technological innovation, the performance research of scientific research teams helps to identify problems, optimize management, improve efficiency and promote the transformation of results. However, the team faces challenges such as communication barriers and unclear goals in collaboration, and improper leadership may aggravate the problem. It is crucial to study the mechanism of the impact of team leadership on performance, which provides guidance for the efficient operation of the team and the improvement of scientific research capabilities. Henan, as a major province in the Central Plains, bears important responsibilities in the Central Plains Rise Strategy. Universities in Henan Province need to deepen the reform of scientific research mechanisms, optimize organizational forms, highlight innovative qualities and practical contributions, establish a diversified evaluation system and representative results evaluation mechanism, encourage giving more autonomy to scientific researchers, improve scientific research ethics and academic style, and create a good academic atmosphere. As the northernmost city in Henan Province, Anyang City shoulders the important responsibility of developing the city through science and technology. Universities should actively promote scientific and technological innovation and contribute to local economic and social development.

How to promote scientific and technological innovation in universities? Considering that the scientific research strength of universities mainly comes from scientific research teams, how to improve the performance of scientific research teams in universities has become an urgent problem to be solved. However, among the many factors that affect team performance, team leaders play an important role. Therefore, this paper focuses on the impact mechanism of scientific research team leadership on team performance.

This study hopes to provide scientific methods for team leaders and help scientific research teams develop efficiently by studying the impact mechanism of team leadership on scientific research performance. At the same time, it provides direction guidance for scientific researchers in Anyang universities and makes due contributions to local and national development.

Research Objectives

1. To confirm the mechanism of team leadership on the scientific research team performance of higher education institution in ANYANG city under HENAN province.
2. To explore the relationship mechanism of team leadership on the scientific research team performance of higher education institution in ANYANG city under HENAN province.
3. To propose the guideline to improve the performance of scientific research team of higher education institution in ANYANG city under HENAN province.

Litterature Review

The leadership of scientific research teams and their performance management have become an important area of concern for scholars at home and abroad in recent years. Researchers believe that to comprehensively measure the performance of scientific research teams, it is necessary not only to pay attention to scientific research output, but also to ensure the satisfaction and adaptability of team members (Feng Hao (2007)).

The willingness of team members to share knowledge, the foresight of leadership, team identity and member perception are crucial to the long-term development of the team (Ren Rongrong 2020). The leaders of scientific research teams have played a key role since the early stages of team building. Usually, the leaders of scientific research teams guide the team through informal management methods, gain authority through academic ability rather than traditional performance appraisals, and improve the team's scientific research output and innovation capabilities by setting long-term goals, promoting internal collaboration and knowledge sharing within the team. Leaders of scientific research teams must not only manage the daily affairs of the team, but also have a strategic vision to lead the development of disciplines, combine scientific research directions with social needs, and promote scientific research teams to solve major social problems. The theory of "learning organization" has also been applied in the management of scientific research teams. The research proposes to solve the obstacles in team building and improve the overall effectiveness of the team by setting scientific common goals, optimizing the team's knowledge structure, establishing a flat management model, strengthening knowledge sharing, and creating an innovative culture. At the same time, the application of shared leadership model in scientific research teams has gradually attracted attention. This model ensures that team members can make progress together in a free and equal environment by reasonably distributing power, thereby improving the team's innovation ability and overall performance. The cooperation mechanism in scientific research teams is also one of the research hotspots. The research found that factors such as cooperation scale, cooperation closeness and cooperation path have a direct impact on the team's work ability and scientific research output. In the study of international scientific research team leadership, many scholars focus on shared leadership, team dynamics, innovation management and other fields. Shared leadership promotes the participation and collaboration of team members by dispersing power; team dynamics research focuses on the impact of communication, trust and role clarity on performance; innovation management emphasizes that leaders need to enhance the team's innovation capabilities by promoting knowledge sharing and creating an innovative environment; in short, scientific research team leaders usually improve the overall performance of the team through dimensions such as mission goals, communication and collaboration, and team culture building (Luo Jianfeng 2013)

Research Methodology

1. Research Design

Phase I: The researchers searched for relevant research and literature through Google Scholar and library document repositories, used content analysis to obtain dimensional indicators of scientific research team leadership and performance, and determined the dimensions and indicators of team leadership and scientific research team performance in colleges and universities in Anyang City, Henan Province through IOC, made questionnaires, and verified content validity and reliability.

Phase II: The researchers conducted quantitative research. First, the questionnaires developed in the first phase were distributed and collected, and confirmatory factor analysis was performed based on the collected data to test the dimensional composition of scientific research team leadership and team performance. Secondly, a structural equation model was constructed based on the collected data to test the impact of team leadership on team performance. Thirdly, a structural equation model of the effect of team leadership on each dimension of team performance and a mediating model of each dimension of team leadership on each dimension of team performance were constructed based on the collected data to explore the direct and indirect effects of each dimension of team leadership on each dimension of team performance.

Phase III: The researchers developed guidelines for improving the performance of scientific research teams through key informants.

2. Population and Sample

The study population consists of 4452 individuals, including deans, heads of research departments, and members of research teams from Anyang University, Anyang Institute of Technology, Anyang Vocational and Technical, Anyang Preschool Education College. The sample selection method utilized the G*Power tool to randomly choose 315 participants, encompassing deans, heads of research departments, project leaders, as well as faculty and staff members from the aforementioned institutions.

3. Research Instruments

Phase I: The researchers utilized a three-part questionnaire for the study: Demographic variables and general information, and Variables related to team leadership and research team performance (on a five-point Likert scale).

Phase II: The researchers used structural equation modeling (SEM) and mediation models to analyze the relationship between variables. SEM reveals the strength of direct and indirect relationships through path diagrams. Mediation models identify mediating effects and key factors in variable interactions. These methods ensure the accuracy and reliability of measurement tools and provide comprehensive and profound insights into the influence mechanisms between variables and variables, dimensions and dimensions.

Phase III: The researchers developed the Research Team Leadership Discussion Form with the goal of improving the performance of higher education institutions by discussing how research can enhance the leadership of team leaders.

4. Data Analysis

The researchers used data analysis software to classify, organize and analyze the collected data. Jamovi was used to statistically evaluate the reliability of the questionnaire through Cronbach's Alpha, conduct confirmatory factor analysis (CFA), and establish structural equation models and mediation models.

Conceptual Framework

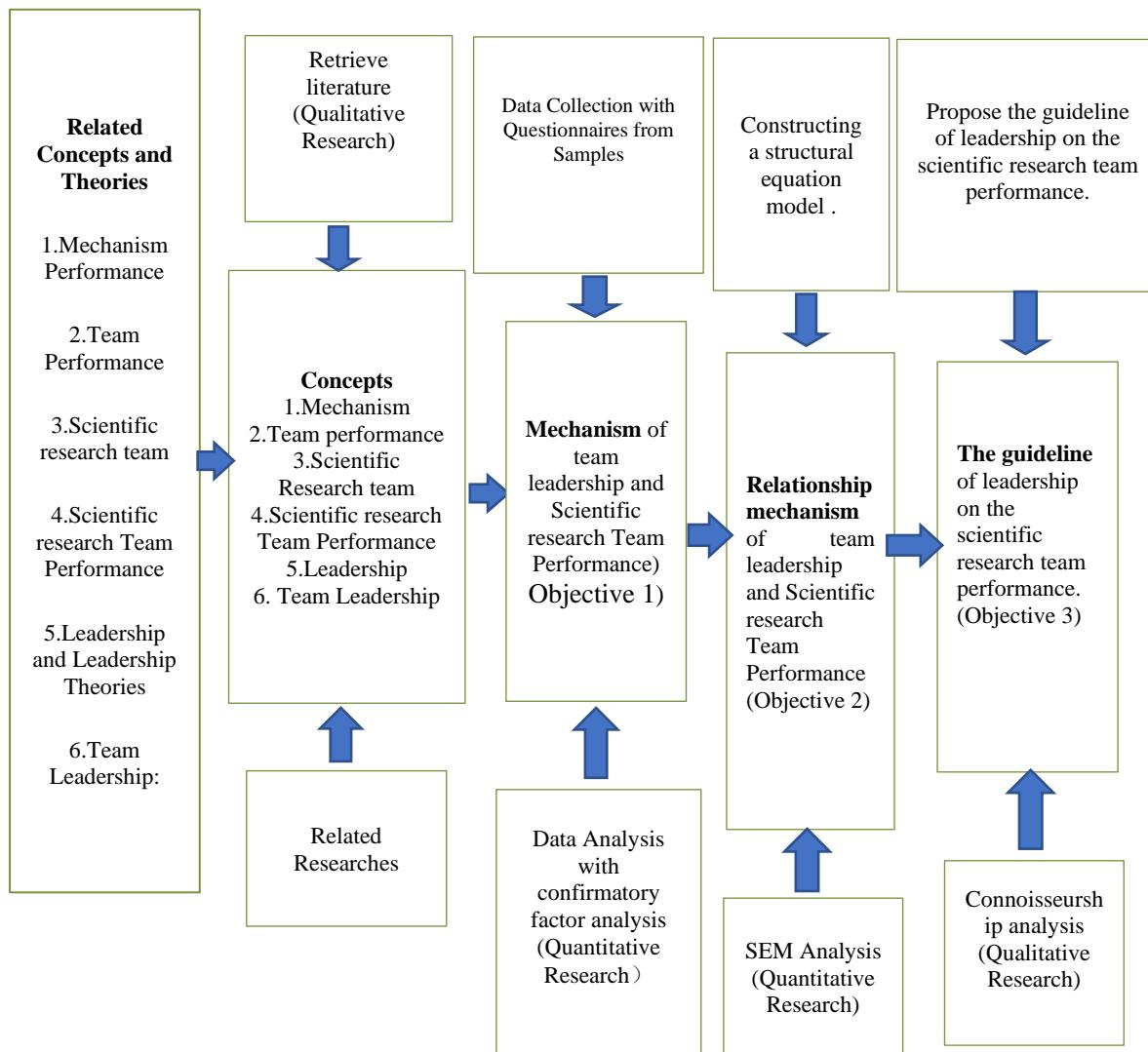


Figure 1 The research framework

Research Findings

Major findings were revealed as follows:-

1. To confirm the mechanism of team leadership on the scientific research team performance of higher education institution in ANYANG city under HENAN province

There were six components of Scientific team leadership which consisted of professional commitment, problem decision, learning innovation, communication motivation, mission goals and Empower collaboration。There were three components of Research team performance which consisted of Team scientific research output, team satisfaction, and Team adaptability.

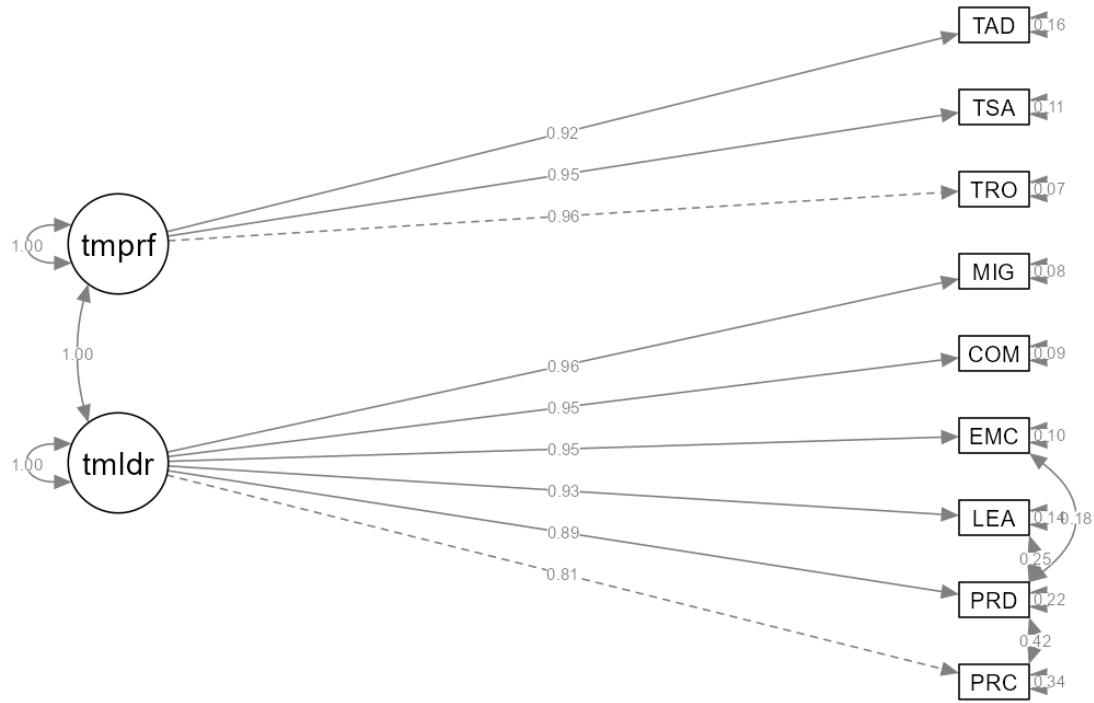


Figure 2: The factor model of Components of research team leadership and research team performance

$\chi^2=56.9$, $df=23$, $p< .001$, $SRMR=0.008$, $RMSEA=0.068$, $CFI=0.993$, $TLI=0.988$, $RFI=0.981$

PRC	Professional commitment
COM	Communication and motivation
LEA	Learning and innovation
EMC	Empowerment and collaboration
MIG	Mission and goals
PRD	Problem decision
TRO	Team research output
TSA	Team satisfaction
TAD	Team adaptability
tmprf	Team performance
tmldr	Team leadership

The parameters show that the fit indicators SRMR, RMSEA, CFI, TLI, etc. all indicate that the model has a good fit effect, high validity and reliability. At the same time, the indicators of team leadership (PRC, PRD, LEA, EMC, COM, MIG) all have high β values in the measurement, and the p values are all less than 0.001, indicating that these indicators are very effective in evaluating team leadership. The indicators of team performance (TRO, TSA, TAD) also show good measurement characteristics, and the estimated values and p values of each indicator also indicate their importance in team performance evaluation. These results support

the overall validity of the model and show a reliable correlation between team leadership and team performance.

2. To explore the relationship mechanism of team leadership on the scientific research team performance of higher education institution in ANYANG city under HENAN province

1) The impact of research team leadership on research team performance

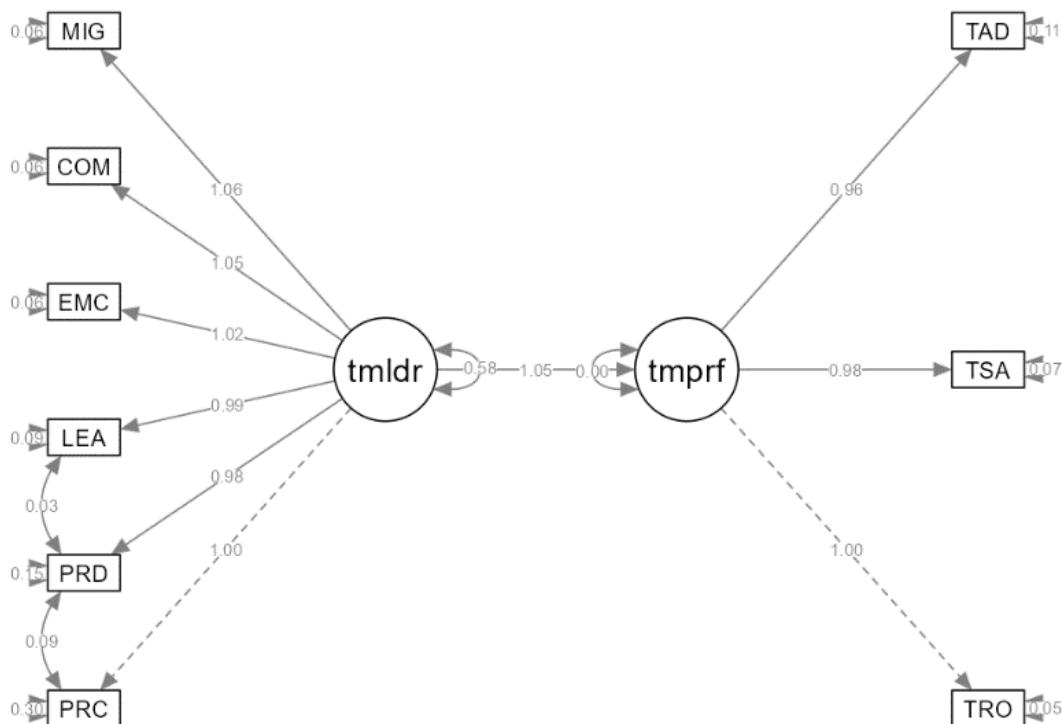


Figure 3: SEM of the impact of research team leadership on research team performance

$\chi^2=67.9$, $df=24$, $p<.001$, SRMR=0.009, RMSEA=0.076, CFI=0.990, TLI=0.986, RFI=0.978

From the parameter point of view, SRMR is 0.009, RMSEA is 0.076, which is lower than 0.08, CFI is 0.990, TLI is 0.986, and RFI is 0.978, which proves that the model has a good fit and can effectively explain how team leadership affects team performance from different dimensions.

2) The relationship between the dimensions of leadership in scientific research teams on team outcomes

Table 1 :Parameter Estimation

Dep	Pred	Estimate	SE	z	p
tro	prc	-0.0375	0.0426	-0.880	0.379
tro	prd	0.0226	0.0634	0.357	0.721
tro	lea	0.1634	0.0934	1.750	0.080
tro	emc	0.2079	0.1465	1.419	0.156
tro	com	0.3773	0.1226	3.078	0.002
tro	mig	0.2334	0.0801	2.915	0.004

Parameter estimates show that "com" and "mig" have significant positive effects on "tro", while other variables have relatively weak contributions to "tro".

3) The mechanism of each dimension of leadership in the research team on team satisfaction

Table 2 :Parameters estimates

Dep	Pred	Estimate	SE	β	z	p
tsa	prc	-0.0287	0.0508	-0.0324	-0.564	0.573
tsa	prd	0.0768	0.0752	0.0786	1.021	0.307
tsa	lea	0.0533	0.1108	0.0507	0.482	0.630
tsa	emc	-0.0954	0.1722	-0.0900	-0.554	0.580
tsa	com	0.5697	0.1479	0.6034	3.851	<.001
tsa	mig	0.3302	0.0953	0.3625	3.464	<.001

Parameter estimates show that both COM and MIG have a significant positive impact on TSA, while the impact of other variables is not significant.

4) The mechanism of each dimension of leadership in scientific research teams on team adaptability

Table 3: Parameters estimates

Dep	Pred	Estimate	SE	β	z	p
tad	prc	0.0711	0.0606	0.0782	1.173	0.241
tad	prd	-0.2151	0.0905	0.2144	2.378	0.017
tad	lea	0.3021	0.1320	0.2793	2.288	0.022
tad	emc	0.3206	0.2035	0.2946	1.576	0.115
tad	com	0.0861	0.1688	0.0887	0.510	0.610
tad	mig	0.3920	0.1124	0.4202	3.488	< .001

Parameter estimates show that problem decision-making has a negative impact on team adaptability, learning innovation and task goal improvement significantly enhance team adaptability, and other factors such as authorized collaboration, communication incentives, and professional commitment have limited or insignificant effects.

3. To propose the guideline to improve the performance of scientific research team of higher education institution in ANYANG city under HENAN province.

There were total 18 managerial guidelines Scientific team leadership on Research team performance from 4 aspects . Details were as follows;

First aspect: There wereThe team's scientific research output managerial guidelines which were Pay attention to the important role of communication incentives and mission goals in scientific research results, and ensure that these dimensions are effectively implemented and promoted; Encourage team members to clarify mission goals, and enhance the team's overall research capabilities through learning, innovation, and empowerment and collaboration; Even if the direct effect of empowered collaboration on scientific research results is not significant, its influence should be enhanced through the mediating role of learning innovation, communication incentives, and mission goals. In order to improve scientific research outcomes, leaders should prioritize the integrated application of communication incentives, learning innovation, and mission goals to maximize the benefits of empowered collaboration. Strengthen the indirect impact of problematic decision-making and improve research performance through empowering collaboration, communication incentives, mission goals, and learning innovation

Second aspect: There are Team satisfaction managerial guidelines which were Mission objectives should not only be seen as a core factor in team satisfaction, but should also be further enhanced through communication incentives; Prioritize communication incentives to improve team member satisfaction in both direct and indirect ways; Indirectly improve team satisfaction by enhancing empowerment and collaboration, combined with mission goals and communication incentives; In order to improve team satisfaction, the role of communication motivation and mission goals should be enhanced through learning and innovation. Strengthen problem-solving decision-making skills, especially by communicating the path of motivation and mission goals to improve team satisfaction; Elevate professional commitment to enhance the positive impact of communication motivation and mission goals on team satisfaction.

Third aspect: There were Team adaptability managerial guidelines which were Strengthen the indirect impact of professional commitment on team adaptability by enhancing communication incentives, mission goals, empowerment collaboration, and learning innovation; When improving team adaptability, the indirect effect through mission objectives should be prioritized, because it has the most significant impact on team adaptability. Enhance the direct and indirect impact of learning innovation to enhance team resilience, especially in the face of new challenges; Apps that drive empowerment collaboration, even if their direct impact is close to significant, enhance their indirect effects through communication incentives, mission goals, and learning innovation; Strengthen the role of communication motivation and use its significant direct and indirect effects to improve the team's adaptability in a dynamic environment.

Fourth aspect: There were overall managerial guidelines which were When improving team performance, leaders should focus on enhancing the overall effectiveness of the team through four key dimensions: communication and motivation, mission goals, learning and innovation, and empowerment and collaboration. When developing a team management strategy, the interaction between the dimensions should be considered comprehensively to maximize the team's research output, satisfaction, and adaptability, especially in resource-constrained settings, where the most impactful variables should be prioritized.

Discussion

Based on the research objectives, the discussion will be presented as follows:-

1. Discussion about major findings of objective 1

Scientific research team leadership has six components, including professional commitment, problem decision-making, communication and motivation, learning and innovation, task goals, authorization and collaboration. Scientific research team performance has three components, including team scientific research output, team satisfaction and Team adaptability. The main findings of the study are as follows: The dimension of professional commitment significantly predicts the scientific research results of the team, indicating that the higher the professional commitment of team members, the better the research results. This may be because team members with high professional commitment invest more energy and effort in their work. effort. Effective problem posing is positively related to team satisfaction, and teams that are good at solving research questions tend to experience higher levels of satisfaction, suggesting that the ability to solve research challenges has a positive impact on overall team satisfaction. Communication motivation has a significant impact on team adaptability, and strong communication and motivation strategies can improve the team's ability to adapt to changes and challenges. This finding highlights the importance of open and motivational communication to keep teams flexible and responsive. The emphasis on learning and innovation is positively correlated with team scientific research results and team adaptability. Teams that value continuous learning and innovation tend to produce better results and can adapt more effectively to the changing scientific research environment. Clear and shared missions and goals have a positive impact on team satisfaction and team scientific research results. Under the guidance of common goals and missions, teams usually show higher satisfaction and better scientific research results. Empowerment and collaboration practices have been found to increase team satisfaction and team adaptability, and when team members are empowered and encouraged to collaborate, it leads to higher satisfaction and better

adaptability. The results of this study are consistent with Raymond Belbin's Team Role Theory and Charles Pellerin's Team Excellence Theory. In addition, the results of this study are consistent with the research directions of Wu Hanqing (2021), Xie Ye and Huo Guoqing (2014). From Ma Changlong and Yu Miao (2019) who proposed the impact of shared cognition on the performance improvement of scientific research teams, Yang Xiaolan (2015) once again emphasized the impact of establishing an incentive mechanism on the performance improvement of scientific research teams. Corresponding to the research of researcher Zeng Yan (2018), Li Chunlin (2023) believes that power sharing, equal communication, joint decision-making, and respect for free time and space among leadership members of university scientific research teams are important means for scientific research groups to maintain vitality and creativity. and ways, but Zhang Qingwen (2016) based on the research on corporate team performance, did not consider the components of authorization and motivation when analyzing the influencing factors of team leadership, and the conclusion was different.

2. Discussion about major findings of objective 2

According to the objective data in the structural equation model and mediation model, communication motivation and mission goals have a significant positive impact on team scientific research performance. Although learning innovation and authorized collaboration also have a positive impact on these performance indicators, the direct impact is not significant. It is found that mission goals have a significant indirect impact on team scientific research results and team adaptability through learning innovation, authorized collaboration and communication incentives. Similarly, authorized collaboration also has an indirect impact on team scientific research results and team adaptability through learning innovation, communication Motivation and mission goals are significantly enhanced. In addition, although the direct impact of problem decision-making and professional commitment on team performance is not significant, the above-mentioned mediating variables indirectly improve team scientific research results, satisfaction and adaptability, especially mission goals, communication incentives, authorization and collaboration, and learning innovation. is the key mediating path of these indirect effects. The findings are consistent with the dynamic team leadership theory proposed by Kozlowski et al and Patrick Lencioni's Five Barriers to Team Building theory. In addition, the results of this study are consistent with the research direction of Miya (2015), Mukua-Maru, J., Linge, T., & Ouma, C. (2024), and from Liao Qingyun, Zhu Donghua, Wang Xuefeng, and Huang Ying (2021) found that team size, institutional diversity, and richness of funding sources have a positive impact on the quantity of scientific research output, while national diversity, interdisciplinarity, and team instability have a negative impact on the quantity of output. Corresponding to the study by Li Youjun and Jing Qinling (2020) which revealed the impact of cooperation scale, cooperation intensity, cooperation path and other factors on team working ability and scientific research output, Zijian, Huang., Stavros, Sindakis., Sakshi, Aggarwal ., Ludivine, Thomas. (2022) pointed out that leadership has a positive impact on team innovation through collective creativity, especially the close connection between the generation of innovative ideas and leadership. However, the research of Heldal and Antonsen (2014) found the dynamic interaction between situational factors and team processes, arguing that team leaders must learn to interpret and respond to complex situations and recognize the interactions between different situations, Helena, Kovačić. , Barbara, Lužar., Hajdeja, Iglič. (2024) research points out that there are significant differences in network characteristics among leaders. This trend is not randomly distributed. It is pointed out that team leadership is eager to do dynamic analysis in multiple organizational contexts

and believes that learning type Organizations are conducive to the construction and innovation of scientific research teams. Jing Runtian (2022) believes that successful scientific research team leaders are not only managers of the team, but also "strategic scientists", that is, those who can formulate strategic plans for the development of science and technology in disciplines, universities and even countries. Leaders with keen forward-looking understanding of scientific and technological knowledge, able to lead the team to solve major social problems, and expand external resources in the academic network to provide more support for the development of the team, while problem-based decision-making and career commitment are in this study There was no significant impact on team performance, which was different.

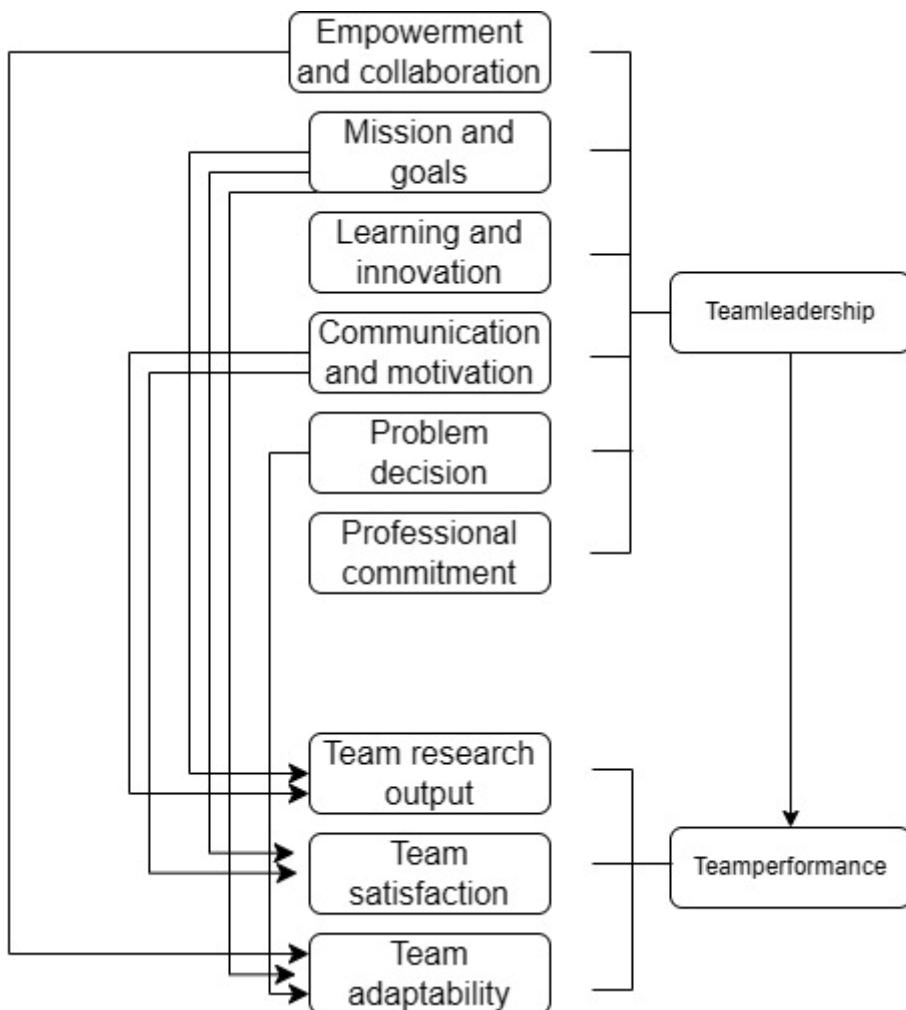


Figure 4: Research found mind mapping

Suggestion

1. Policy Recommendations

In order to improve the performance of scientific research teams in different types of universities in Anyang, Henan Province, the following policy recommendations are made:

1) All universities should strengthen task goal setting to ensure that scientific research work is closely integrated with school positioning and regional needs;

2) Improve the communication incentive mechanism to enhance the interaction and cohesion among team members;

3) Strengthen the authorization and collaboration mechanism, give team members more autonomy and decision-making power, and promote scientific research innovation and achievement transformation. These strategies will help public undergraduate colleges, public undergraduate colleges, and private undergraduate colleges achieve higher quality development in scientific research.

2. Practical Recommendations

The Practical Recommendations for public undergraduate schools, public junior colleges, and private undergraduate schools are as follows:

1) For public undergraduate schools, it is recommended to promote cross-college and cross-disciplinary team collaboration, establish interdisciplinary research centers, integrate resources, enhance innovation capabilities, establish a scientific research platform connected with national key laboratories, increase equipment sharing mechanisms, encourage teams to participate in major national projects, implement a reward system for achievement transformation, improve the enthusiasm of team members, and encourage the publication of high-level papers and the application of major scientific research projects.

2) For public junior colleges, it is recommended to build a scientific research team guided by industry needs, strengthen cooperation with enterprises, improve the conversion rate of technological achievements, rely on local industrial advantages, establish regional technical service centers, provide technical support for enterprises, promote scientific research to serve local economic development, and regularly carry out training in scientific research methods and project applications to improve the professional skills and scientific research capabilities of team members.

3) For private undergraduate colleges, it is recommended to support young teachers in forming scientific research teams, provide special funds, encourage them to apply for local and corporate cooperation projects, jointly build research and development centers with regional enterprises, carry out joint research between schools and enterprises, attract social resources to support team development, and formulate a scientific research evaluation system suitable for the characteristics of private universities, pay more attention to actual application effects and social service value, and avoid "one-size-fits-all" evaluation standards.

3. Recommendation for Further Research

Combined with the above data analysis and research findings, the following four valuable topics can be further studied:

- 1) Differences in scientific research management models of different types of universities and their impact on team performance.
- 2) Research on the interactive mechanism of communication incentives and mission goals in scientific research teams
- 3) The role of empowered collaboration in scientific research teams and its impact on the transformation of innovative results
- 4) The potential impact of professional commitment on the long-term performance of scientific research teams

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