Factors Fostering a Research and Innovation Culture: a Case Study of a Technological College in Mianyang, China

Yu Tao[a]
Tachakorn Wongkumchai[b*]

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[a] *MBA, Faculty of Management Science, Dhonburi Rajabhat University, Bangkok, Thailand, E-mail: 2953997874@qq.com*
[b*] *Faculty of Management Science, Dhonburi Rajabhat University, Bangkok, Thailand, E-mail: tachakorn.w@dru.ac.th*

Abstract

The objectives of this research were 1) to investigate the factors that fostered a research and innovation culture within an educational institution, and 2) to assess the impact of these factors on research output, innovation adoption, and cultural change. The methodology employed was quantitative. The population and sample consisted of 200 faculty members from Technological College in Mianyang, China. They were selected using a simple random sampling method, calculated by Yamane's formula. A questionnaire was used as the research instrument, and its content validity was verified by experts , yielding a Cronbach's alpha reliability coefficient of 0.81. The statistical methods used for data analysis included descriptive statistics, correlation analysis, and regression analysis.

The research findings revealed that 1) the factors fostering a research and innovation culture within the educational institution, comprising leadership style, resource allocation, professional development opportunities, and collaborative networks, all had a significant positive influence, and 2) the assessment of the impact of these factors showed that: leadership style significantly influenced cultural change (β=0.225), research output (β=0.167), and innovation adoption (β=0.160), resource allocation demonstrated the strongest positive influence on innovation adoption (β=0.350), cultural change (β=0.253), and research output (β=0.305), professional development opportunities significantly influenced research output (β=0.250), innovation adoption (β=0.217), and cultural change (β=0.181), and collaborative networks significantly impacted cultural change (β=0.261), innovation adoption (β=0.147), and research output (β=0.125). These research findings collectively underscored the importance of leadership style, resource allocation, professional development opportunities, and collaborative networks in fostering a strong research and innovation culture within the studied institution. These factors were found to contribute significantly to creating an environment that supported research, encouraged innovation, and facilitated cultural change, ultimately leading to improvements in educational quality. The research recommends that educational institutions prioritize effective leadership, ensure appropriate resource allocation, provide ample professional development opportunities, and cultivate strong collaborative networks to enhance their research and innovation capabilities, which will benefit the overall quality of education.

Keywords: Leadership, Resource Management, Professional Development, Collaboration, Educational Quality

Introduction

In the 21st century's rapidly evolving global landscape, research and innovation have emerged as critical drivers of societal progress and economic development. Educational institutions, as primary cradles of knowledge dissemination and creation, bear a significant responsibility in cultivating individuals equipped with innovative spirits and practical skills. A thriving research and innovation culture within these institutions is paramount for fostering new ideas, promoting unconventional solutions, and applying cutting-edge methodologies. This environment not only empowers students, educators, and administrators to think critically but also encourages them to challenge established paradigms and contribute meaningfully to the advancement of knowledge (Martins & Terblanche, 2003; Hughes et al., 2022).

Despite the recognized importance of a research and innovation culture, its cultivation within educational settings, particularly within complex organizational structures, has encountered numerous challenges. Traditional educational concepts and models often hindered the stimulation and development of innovative thinking. Practical issues such as uneven resource allocation, insufficient incentive mechanisms, and barriers to interdisciplinary collaboration frequently constrained the effective development of research and innovation activities (Pasillas-Díaz et al., 2022). Furthermore, cultural differences and communication barriers between various levels and types of educational institutions within larger educational groups exacerbated the difficulty of establishing a unified and dynamic research and innovation culture (Trippl & Tödtling, 2022). These systemic problems collectively presented significant obstacles, underscoring an urgent need for systematic strategies to address them effectively, especially in the context of current global trends and future demands for adaptable and innovative workforces.

Recognizing these challenges, this study aimed to deeply analyze the prevailing situation, specific challenges, and underlying root causes hindering the development of a research and innovation culture within educational institutions. It sought to explore effective promotion and support strategies by identifying key factors influencing the formation of this culture, evaluating the efficacy and shortcomings of existing approaches, and proposing operational strategic recommendations. These recommendations were tailored to the unique characteristics of educational institutions, with the ultimate goal of promoting deep integration and sustainable development of research and innovation culture (Audretsch & Belitski, 2022). Through this comprehensive investigation, the study intended to provide a systematic framework to guide educational institutions in effectively fostering a research and innovation culture in practice, thereby cultivating high-quality talents with innovative spirits and practical abilities, and contributing significantly to long-term societal development.

Research Objectives

1. To investigate the factors that fostered a research and innovation culture within an educational institution.
2. To assess the impact of these factors on research output, innovation adoption, and cultural change.

Literature Review

The researcher conducted a comprehensive review of relevant concepts, theories, and research to inform the development of research guidelines.

Research and Innovation Culture

A research and innovation culture in educational institutions refers to an environment that fosters and values research and innovation activities, crucial for enhancing educational quality and generating new knowledge. Key components include: (Hughes et al., 2022) Values: Emphasizing the pursuit of new knowledge, critical thinking, experimentation, and development, which are fundamental for innovation and knowledge creation. Beliefs: Confidence in the potential of research and innovation to improve education, solve problems, and contribute to societal development. Behaviors: Encouraging behaviors that support research and innovation, such as collaboration, knowledge sharing, continuous learning, and the application of research findings. Norms: Establishing norms that encourage experimentation, acceptance of failure, and learning from mistakes. Symbols: Using symbols to represent a commitment to fostering research and innovation, such as logos, awards, and events. Building a research and innovation culture requires collaboration from all stakeholders to cultivate values, promote supportive behaviors, and create an enabling environment. This fosters educational advancement and contributes to sustainable national development.

Organizational Factors Influencing Research and Innovation Culture

A research and innovation culture is essential for driving academic progress and generating new knowledge. Organizational factors play a significant role in fostering this culture (Audretsch & Belitski, 2022). Key factors include: Leadership: Leaders with vision and a commitment to research and innovation are crucial. They should provide resources, funding, and encouragement, empowering personnel to explore and develop new ideas. Organizational Structure: Organizational structures should be flexible and promote collaboration to facilitate knowledge exchange and joint innovation. Resources: Adequate resource allocation, including budget, personnel, and equipment, is essential for research and innovation activities. Systems and Processes: Systems and processes, such as evaluation, reward, and support mechanisms, should be designed to incentivize and promote research and innovation. Strategy: The organization's strategy should explicitly prioritize and support research and innovation, ensuring that personnel understand its importance and actively participate in its development. Developing these factors creates an environment and culture conducive to research and innovation, leading to sustainable knowledge generation and academic advancement.

Individual Factors Contributing to Research and Innovation Culture

Building a research and innovation culture requires factors at multiple levels, with individual factors being fundamental, as individuals are the ones who conceive, develop, and create innovations (Hughes et al., 2022). Key individual factors include: Motivation: Both intrinsic motivation, such as interest, curiosity, and the desire for self-improvement, and extrinsic motivation, such as rewards and recognition, are crucial for encouraging personnel to engage in research and innovation activities. Skills and Knowledge: Personnel should be developed to possess the necessary skills and knowledge for research and innovation, such as critical thinking, problem-solving, domain-specific expertise, and technology skills. Attitude: A positive attitude toward research and innovation, including openness to new ideas, acceptance of failure, and a commitment to improvement, is essential for fostering this culture. Personality: Personality traits such as open-mindedness, creativity, adaptability, perseverance, and responsibility contribute to innovation. Developing these qualities in individuals will help promote a strong research and innovation culture, leading to the continuous generation of new knowledge and ongoing development.

External Factors Shaping Research and Innovation Culture

A research and innovation culture is not solely determined by internal organizational factors; it is also influenced by various external factors (Trippl & Tödtling, 2022) that can shape its direction and development. These factors include: Government Policies: Government policies play a crucial role in setting the direction and providing support for research and innovation, such as through financial incentives, tax breaks, and promoting collaboration between the public sector, private sector, and educational institutions. Economic Environment: The economic climate affects investment and support for research and innovation. For example, during periods of economic growth, there is often increased investment and support for research and innovation. Social Environment: Societal values and norms influence the research and innovation culture. Societies that value knowledge and development tend to have a stronger research and innovation culture. Technology: Technological advancements are key drivers of innovation, such as digital technologies, artificial intelligence, and the internet. Globalization: Globalization facilitates knowledge exchange and international collaboration, which positively influences the development of a research and innovation culture. Monitoring and analyzing these external factors allows educational institutions to adapt and formulate strategies to develop a research and innovation culture that aligns with the social and economic context.

Research Methodology

Research Design

This study employed a quantitative research design to investigate the relationships between independent and dependent variables. The data were collected using a questionnaire, which utilized a 5-point Likert-type scale for attitude measurements, ranging from 1 to 5.

Population and Sample Size

The population of this study comprised all faculty members at Technological College in Mianyang, China, numbering over 400 faculty and administrative staff. This institution, formerly known as Southwest University of Science and Technology City College, was approved by the Ministry of Education in 2006 and renamed Mianyang City College in 2021.The sample group consisted of 200 teachers from Technological College in Mianyang, China. The sample size was determined using Yamane's formula (Wongkumchai, T., & Kiattisin, S., 2021) for a finite population, with a 95% confidence level and a margin of error of ±5%:

Research Tools

The primary research instrument was a questionnaire developed based on a comprehensive review of relevant theories, academic concepts, and empirical research. Validity Test: The content validity of the questionnaire was assessed and deemed acceptable by subject matter experts. However, empirical data such as an Index of Item-Objective Congruence (IOC) was not explicitly provided in this study. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.849, and Bartlett's Test of Sphericity yielded a Chi-Square value of 384.434 with 21 degrees of freedom and a p-value of 0.00, indicating that the data were suitable for factor analysis and that there was significant correlation between variables. Reliability Test: To ensure the internal consistency of the questionnaire, a pilot test was conducted with 30 sample respondents. The reliability was assessed using Cronbach's Alpha, which yielded an overall coefficient of 0.81, indicating good internal consistency reliability (values equal to or greater than 0.7 are generally considered acceptable). The Corrected Item-Total Correlation (CITC) values for most indicators were above 0.4, further supporting the consistency of the items.

Data collection

Data collection was conducted according to the following process 1) the questionnaire was developed based on a comprehensive review of relevant theories, academic concepts, and empirical research, serving as reference materials, 2) the questionnaire was designed and disseminated to the sampled population through online channels, including various website communities and social media platforms (e.g., www.weibo.com, WeChat, QQ, Facebook, Google Document, www.wjx.cn), and 3) a random sampling survey was conducted with 200 respondents between January 2024 and March 2024.

Data Analysis

Data analysis employed the following statistical methods: descriptive statistics for summarizing data, reliability analysis using Cronbach's alpha, correlation analysis to determine relationships between variables, and regression analysis to assess the impact of independent variables on dependent variables and test hypotheses.

Conceptual Framework

The conceptual framework presented in Figure 1 visually depicted the hypothesized relationships between the independent variables (Leadership Style, Resource Allocation, Professional Development Opportunities, and Collaborative Networks) and the dependent variables (Research Output, Innovation Adoption, and Cultural Change in Education). This framework guided the study by illustrating how these key factors were expected to collectively foster a research and innovation culture within private higher education institutions.

Independent Variables:

- Leadership Style: This refers to the manner in which leaders influence, motivate, and guide their followers. As depicted in Figure 1, leadership style was hypothesized to play a pivotal role in shaping the overall direction and culture of an educational institution. Transformative leaders, in particular, were expected to inspire and empower their followers to embrace new ideas, take risks, and strive for excellence, thereby positively influencing research output, innovation adoption, and cultural change (H1).
- Resource Allocation: This pertains to the strategic distribution of financial, material, and human resources within an institution. The framework hypothesized that adequate and strategic resource allocation was critical for supporting research and innovation activities (H2). When resources were effectively distributed, innovative projects could be executed and sustained over time, leading to higher research output, increased innovation adoption, and positive cultural change.
- Professional Development Opportunities: These are avenues provided for educators and researchers to enhance their skills, knowledge, and competencies. As illustrated, professional development opportunities were hypothesized to be essential for fostering a culture of continuous learning and innovation (H3). By allowing individuals to update their knowledge and master new methodologies, these opportunities were expected to enhance research capabilities, promote innovative practices, and contribute to cultural transformation.
- Collaborative Networks: These refer to the partnerships and interactions established both internally (within departments) and externally (with other institutions, industries, research organizations, and government agencies). The framework hypothesized that robust collaborative networks facilitated knowledge sharing, resource pooling, and interdisciplinary collaboration (H4). These networks were expected to lead to the creation and

dissemination of innovative educational practices, significantly contributing to cultural change and the adoption of new innovations.

Dependent Variables:

- Research Output: This represents the tangible results of research activities, including publications, projects, and patents. The framework posited that a supportive environment created by the independent variables would lead to a higher quantity and quality of research output.
- Innovation Adoption: This refers to the speed and effectiveness with which new ideas, technologies, and methodologies are embraced and implemented within the institution. The framework suggested that the interplay of the independent variables would improve the institution's ability to adapt to change and integrate innovations into educational programs and practices.
- Cultural Change in Education: This denotes a transformation in the institution's underlying values, attitudes, and behaviors, prioritizing research, innovation, and continuous improvement. The framework hypothesized that the combined influence of the independent variables would drive this cultural shift, fostering an environment conducive to exploration and experimentation.

In summary, the conceptual framework posited that Leadership Style, Resource Allocation, Professional Development Opportunities, and Collaborative Networks interact dynamically to foster an innovative cultural education environment. This synergy was hypothesized to lead to enhanced Research Output, increased Innovation Adoption, and significant Cultural Change within educational institutions.

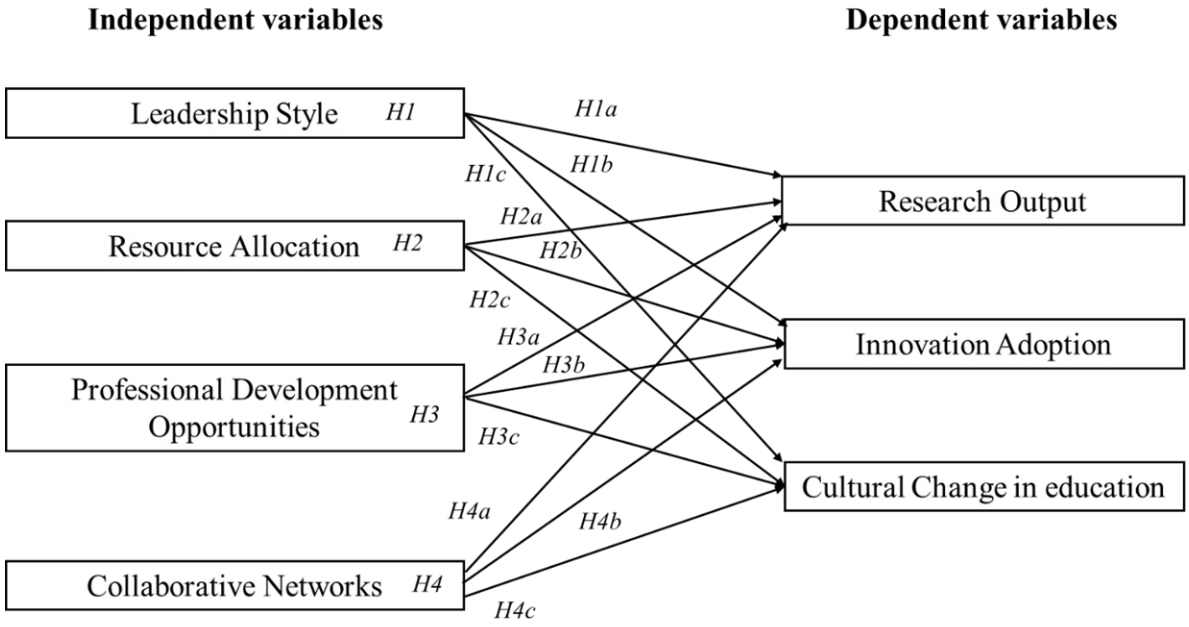

Figure 1: Conceptual Framework

Based on the provided diagram (Figure 1), the following research hypotheses can be formulated:

H1: Leadership Style has a positive influence on: H1a: Research Output, H1b: Innovation Adoption, and H1c: Cultural Change in education.

H2: Resource Allocation has a positive influence on: H2a: Research Output, H2b: Innovation Adoption, and H2c: Cultural Change in education.

H3: Professional Development Opportunities have a positive influence on: H3a: Innovation Adoption, H3b: Cultural Change in education., and H3c: Research Output.

H4: Collaborative Networks have a positive influence on: H4a: Research Output, H4b: Innovation Adoption, and H4c: Cultural Change in education.

Research Finding

The following presents the findings of the study, derived from the collected data and subsequent analysis.

Demographic Analysis

The demographic characteristics of the 200 respondents who participated in the study. Frequency analysis revealed the following: The majority of respondents were teachers (55%), followed by administrators (37.5%) and researchers (7.5%). The high proportion of teachers underscores their central role in educational practices and their valuable perspectives on educational reform and curriculum design. The significant proportion of administrators highlights the importance of leadership and management in shaping institutional direction and quality. Respondents with 0-5 years and 6-10 years of experience constituted the largest groups (28.5% and 27% respectively), indicating a considerable proportion of early-career professionals in the sample. This allows for insights into the challenges and needs of individuals in the initial stages of their careers. The remaining respondents were distributed across those with 11-15 years (18%), 16-20 years (17%), and 21+ years (9.5%) of experience, providing a valuable perspective on long-term career development and professional growth within the field. Overall, the demographic data suggests that the sample was diverse and representative of various roles and experience levels within educational and research institutions. This diversity strengthens the study's ability to provide a comprehensive understanding of the factors influencing research and innovation culture in these settings. As shown in Table 1.

Table 1: Demographic Characteristics of Respondents

Name	Categories	N	Percent (%)
Position	Administrator	75	37.5
	Teacher	110	55
	Researcher	15	7.5
Years of Experience	0-5 years	57	28.5
	6-10 years	54	27
	11-15 years	36	18
	4. 16-20 years	34	17
	21+ years	19	9.5
Summarize		200	100

Note: 'n' denotes the sample count for each category.

Correlation Analysis

The Pearson correlation coefficients between the variables examined in the study. All reported correlations were statistically significant ($p < 0.05$ or $p < 0.01$).

Leadership Style was positively correlated with all other variables: Resource Allocation ($r = 0.397$), Professional Development Opportunities ($r = 0.358$), Collaborative Networks ($r = 0.264$), Research Output ($r = 0.410$), Innovation Adoption ($r = 0.416$), and Cultural Change ($r = 0.459$). These positive correlations suggest that leadership style plays a role in facilitating resource allocation, professional development, collaboration, research output, innovation adoption, and cultural change within educational institutions.

Resource Allocation was also positively correlated with all other variables: Professional Development Opportunities ($r = 0.264$), Collaborative Networks ($r = 0.278$), Research Output ($r = 0.472$), Innovation Adoption ($r = 0.512$), and Cultural Change ($r = 0.463$). This indicates that the allocation of resources is associated with increased opportunities for professional development, collaboration, research productivity, and the adoption of innovations, ultimately contributing to cultural change.

Professional Development Opportunities showed positive correlations with: Collaborative Networks ($r = 0.203$), Research Output ($r = 0.416$), Innovation Adoption ($r = 0.397$), and Cultural Change ($r = 0.381$). This suggests that providing professional development opportunities may foster collaboration, enhance research output, and promote the adoption of innovations, leading to cultural change within institutions.

Collaborative Networks were positively correlated with: Research Output ($r = 0.305$), Innovation Adoption ($r = 0.330$), and Cultural Change ($r = 0.428$). This highlights the importance of collaborative networks in facilitating research, promoting innovation, and driving cultural change in educational settings.

Overall, the correlation analysis revealed a network of positive relationships between the variables. These findings suggest that leadership, resource allocation, professional development, and collaboration are interconnected and contribute to research productivity, innovation adoption, and cultural change within educational institutions. As shown in Table 2.

Table 2: Pearson Correlation Coefficients

Pearson Correlation							
	Leadership Style	**Resource Allocation**	**Professional Development Opportunities**	**Collaborative Networks**	**Research Output**	**Innovation Adoption**	**Cultural Change**
Leadership Style	1						
Resource Allocation	0.397**	1					
Professional Development Opportunities	0.358**	0.264**	1				
Collaborative Networks	0.264**	0.278**	0.203**	1			
Research Output	0.410**	0.472**	0.416**	0.305**	1		
Innovation Adoption	0.416**	0.512**	0.397**	0.330**	0.375**	1	
Cultural Change	0.459**	0.463**	0.381**	0.428**	0.535**	0.434**	1
*** p<0.05 ** p<0.01**							

Regression Analysis

Correlation analysis was a prerequisite for regression analysis, as the latter aimed to establish a quantitative relationship model between a dependent variable and one or more independent variables. If no correlation existed between variables, regression analysis would be meaningless. Only when a certain degree of correlation was present could regression analysis identify specific relationship patterns and predict or explain the dependent variable. In this study, the significant correlations between variables provided a foundation for further regression analysis, which helped to explore causal relationships and influencing mechanisms in depth. The details are as follows:

Table 3: (details below) presents the results of a linear regression analysis with Research Output as the dependent variable and Leadership Style, Resource Allocation, Professional Development Opportunities, and Collaborative Networks as independent variables. The model was statistically significant ($F(4, 195) = 26.776$, $p = 0.000$), with an R-squared of 0.355, indicating that the four independent variables explained 35.5% of the variance in Research Output. The regression coefficients for all four independent variables were positive and statistically significant: Leadership Style: ($B = 0.193$, $t = 2.521$, $p = 0.012$). This suggests that leadership style had a significant positive impact on research output. Effective leadership can create a supportive and stimulating environment for research, influencing resource allocation, professional development, and collaboration. Resource Allocation: ($B = 0.306$, $t = 4.741$, $p = 0.000$). Resource allocation also had a significant positive impact on research output. Adequate resources, including funding, equipment, and personnel, are essential for supporting research activities and achieving research goals. Professional Development Opportunities: ($B = 0.260$, $t = 3.997$, $p = 0.000$). Professional development opportunities positively influenced research output. Opportunities for training, academic exchange, and skill enhancement can improve researchers' competence and innovation capacity, leading to increased research productivity. Collaborative Networks: ($B = 0.124$, $t = 2.044$, $p = 0.042$). Collaborative networks also contributed positively to research output. Collaboration with experts and scholars from diverse fields can facilitate knowledge sharing, stimulate creativity, and enhance research outcomes.

Table 3: Regression Analysis of the Dependent Variable (Research Output)

Parameter Estimates (n=200)							
	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**p**	**Collinearity diagnosis**	
	B	**Std. Error**	**Beta**			**VIF**	**Tolerance**
Constant	0.560	0.316	-	1.775	0.078	-	-
Leadership Style	0.193	0.077	0.167	2.521	0.012*	1.319	0.758
Resource Allocation	0.306	0.064	0.305	4.741	0.000**	1.253	0.798
Professional Development Opportunities	0.26	0.065	0.250	3.997	0.000**	1.181	0.847
Collaborative Networks	0.124	0.06	0.125	2.044	0.042*	1.128	0.886
R^2	0.355						
Adjust R^2	0.341						
F	F (4,195) = 26.776, p = 0.000						
D - W	1.412						
Note：Dependent Variable = Research Output							
* p < 0.05 ** p < 0.01							

Table 4: (details below) presents the results of a linear regression analysis with Innovation Adoption as the dependent variable. The model, which included Leadership Style, Resource Allocation, Professional Development Opportunities, and Collaborative Networks as independent variables, was statistically significant (F (4, 195) = 29.949, p = 0.000) and explained 38.1% of the variance in Innovation Adoption (R-squared = 0.381). The analysis revealed that all four independent variables had a statistically significant positive impact on Innovation Adoption: Leadership Style: (B = 0.159, t = 2.474, p = 0.014). This indicates that leadership style played a significant role in fostering innovation adoption within educational institutions. Leaders who promote innovation, provide support, and encourage experimentation are likely to create a culture conducive to adopting new ideas and practices. Resource Allocation: (B = 0.300, t = 5.549, p = 0.000). Resource allocation also had a strong positive influence on innovation adoption. Adequate financial resources, infrastructure, and support systems are crucial for facilitating the implementation and integration of innovations. Professional Development Opportunities: (B = 0.193, t = 3.548, p = 0.000). Opportunities for professional development were positively associated with innovation adoption. By providing training, workshops, and opportunities for knowledge sharing, institutions can equip their staff with the skills and knowledge necessary to embrace and implement innovations effectively. Collaborative Networks: (B = 0.124, t = 2.450, p = 0.015). Collaborative networks also played a significant role in promoting innovation adoption. Collaboration and knowledge sharing within and across institutions can facilitate the dissemination of best practices and encourage the adoption of new ideas.

Table 4: Regression Analysis of the Dependent Variable (Innovation Adoption)

Parameter Estimates (n=200)							
	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**p**	**Collinearity diagnosis**	
	B	**Std. Error**	**Beta**			**VIF**	**Tolerance**
Constant	0.914	0.264	-	3.457	0.001**	-	-
Leadership Style	0.159	0.064	0.16	2.474	0.014*	1.319	0.758
Resource Allocation	0.300	0.054	0.35	5.549	0.000**	1.253	0.798
Professional Development Opportunities	0.193	0.055	0.217	3.548	0.000**	1.181	0.847
Collaborative Networks	0.124	0.051	0.147	2.45	0.015*	1.128	0.886
R^2	0.381						
Adjust R^2	0.368						
F	F (4,195) = 29.949, p = 0.000						
D - W	0.322						
Note: Dependent Variable = Innovation Adoption							
*** p < 0.05 ** p < 0.01**							

Table 5: (details below) displays the results of a linear regression analysis with Cultural Change as the dependent variable. The model, incorporating Leadership Style, Resource Allocation, Professional Development Opportunities, and Collaborative Networks as independent variables, was statistically significant (F(4, 195) = 32.628, p = 0.000) and accounted for 40.1% of the variance in Cultural Change (R-squared = 0.401). All four independent variables demonstrated a statistically significant positive impact on Cultural Change: Leadership Style: (B = 0.217, t = 3.529, p = 0.001). This suggests that leadership style played a crucial role in driving cultural change within educational institutions. Leaders who champion innovation, embrace new ideas, and foster a collaborative environment are likely to be more effective in facilitating cultural shifts. Resource Allocation: (B = 0.211, t = 4.080, p = 0.000). Resource allocation also had a significant positive influence on cultural change. Providing adequate resources, such as funding, infrastructure, and technology, can support the implementation of new initiatives and facilitate the adoption of new practices, ultimately leading to

cultural change. Professional Development Opportunities: (B = 0.157, t = 3.006, p = 0.003). Opportunities for professional development were positively associated with cultural change. By offering training, workshops, and mentoring programs, institutions can empower their staff to embrace new ideas, develop new skills, and contribute to cultural transformation. Collaborative Networks: (B = 0.215, t = 4.434, p = 0.000). Collaborative networks emerged as a strong predictor of cultural change. Collaboration and knowledge sharing within and between institutions can facilitate the dissemination of innovative practices and create a shared understanding of the need for change, thereby accelerating cultural shifts.

Table 5: Regression Analysis of the Dependent Variable (Cultural Change)

Parameter Estimates (n=200)							
	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity diagnosis	
	B	Std. Error	Beta			VIF	Tolerance
	0.983	0.253	-	3.881	0.000**	-	-
Leadership Style	0.217	0.062	0.225	3.529	0.001**	1.319	0.758
Resource Allocation	0.211	0.052	0.253	4.08	0.000**	1.253	0.798
Professional Development Opportunities	0.157	0.052	0.181	3.006	0.003**	1.181	0.847
Collaborative Networks	0.215	0.049	0.261	4.434	0.000**	1.128	0.886
R^2	0.401						
Adjust R^2	0.389						
F	F (4,195) = 32.628, p = 0.000						
D - W	1.83						
Note: Dependent Variable = Cultural Change							
*** p < 0.05 ** p < 0.01**							

Note: Dependent Variable = Cultural Change
* p<0.05 ** p<0.01

This study highlighted the importance of leadership, resource allocation, professional development, and collaboration in promoting research productivity, innovation adoption, and cultural change within educational institutions. To foster research and innovation, institutions should prioritize the development of effective leadership, ensure adequate resource allocation, provide opportunities for professional growth, and build strong collaborative networks.

Hypotheses H1 (H1a, H1b, H1c), H2 (H2a, H2b, H2c), H3 (H3a, H3b, H3c), and H4 (H4a, H4b, H4c) were supported, as detailed in Table 6.

Table 6 (details below) presents the results of hypothesis testing for the study. All hypotheses were supported by the data.

H1: Leadership Style

The results confirmed that leadership style had a significant positive influence on all three dependent variables: H1a: Research Output (β = 0.167, p = 0.012). This indicates that effective leadership contributed to increased research productivity within educational institutions. Leaders who inspire, motivate, and provide intellectual stimulation are likely to foster a more productive research environment. H1b: Innovation Adoption (β = 0.160, p = 0.014). Leadership style also played a significant role in promoting the adoption of innovations. Leaders who encourage experimentation, provide support for new ideas, and create a culture of openness to change can facilitate the successful implementation of innovations. H1c: Cultural Change (β = 0.225, p = 0.001). Furthermore, leadership style significantly influenced cultural change within institutions. Leaders who champion innovation,

embrace new ideas, and foster collaboration can effectively drive cultural transformation towards a more innovative and dynamic environment.

H2: Resource Allocation

The findings supported the hypothesis that resource allocation positively influenced the dependent variables: H2a: Research Output ($\beta = 0.305$, $p = 0.000$). Resource allocation had a strong positive impact on research productivity. Adequate funding, equipment, and personnel are essential for supporting research activities and achieving research goals.H2b: Innovation Adoption ($\beta = 0.350$, $p = 0.000$). Similarly, resource allocation significantly influenced innovation adoption. Providing the necessary resources for implementing and integrating new ideas and technologies is crucial for successful innovation. H2c: Cultural Change ($\beta = 0.253$, $p = 0.000$). Resource allocation also played a significant role in facilitating cultural change. Investing in resources that support new initiatives and practices can enable institutions to embrace change and create a more innovative culture.

H3: Professional Development Opportunities

The results confirmed the positive influence of professional development opportunities on the dependent variables: H3a: Research Output ($\beta = 0.250$, $p = 0.000$). Providing opportunities for professional development significantly enhanced research output. Training, workshops, and mentoring programs can improve researchers' skills and knowledge, leading to increased research productivity. H3b: Innovation Adoption ($\beta = 0.217$, $p = 0.003$). Professional development opportunities also promoted innovation adoption. Equipping staff with the necessary skills and knowledge through professional development can facilitate the effective implementation of new ideas and technologies. H3c: Cultural Change ($\beta = 0.181$, $p = 0.000$). Furthermore, professional development opportunities contributed to cultural change. By empowering staff to embrace new ideas and develop new skills, institutions can foster a culture that is more receptive to innovation and change.

H4: Collaborative Networks

The findings supported the hypothesis that collaborative networks positively influenced the dependent variables: H4a: Research Output ($\beta = 0.125$, $p = 0.042$). Collaborative networks had a positive impact on research productivity. Collaboration and knowledge sharing within and across institutions can enhance research outcomes by facilitating the exchange of ideas and resources. H4b: Innovation Adoption ($\beta = 0.147$, $p = 0.015$). Collaborative networks also promoted innovation adoption. By sharing best practices and collaborating on the implementation of new ideas, institutions can accelerate the adoption of innovations. H4c: Cultural Change ($\beta = 0.261$, $p = 0.000$). Furthermore, collaborative networks played a significant role in driving cultural change. Collaboration can foster a shared understanding of the need for change and facilitate the dissemination of innovative practices, leading to cultural transformation.

In summary, the results of hypothesis testing provide strong evidence for the importance of leadership, resource allocation, professional development, and collaboration in fostering a culture of research and innovation within educational institutions. These findings have important implications for policymakers and administrators seeking to promote innovation and enhance the quality of education.

Table 6: Hypothesis Testing Results

Hypothesis	Independent Variable	Dependent Variable	Result	Coefficient (Beta)	p-value
H1: Leadership Style has a positive influence on					
H1a	Leadership Style	Research Output	Supported	0.167	0.012*
H1b	Leadership Style	Innovation Adoption	Supported	0.160	0.014*
H1c	Leadership Style	Cultural Change	Supported	0.225	0.001**
H2: Resource Allocation has a positive influence on					
H2a	Resource Allocation	Research Output	Supported	0.305	0.000**
H2b	Resource Allocation	Innovation Adoption	Supported	0.350	0.000**
H2c	Resource Allocation	Cultural Change	Supported	0.253	0.000**
H3: Professional Development Opportunities have a positive influence on					
H3a	Professional Development Opportunities	Research Output	Supported	0.250	0.000**
H3b	Professional Development Opportunities	Innovation Adoption	Supported	0.217	0.003**
H3c	Professional Development Opportunities	Cultural Change	Supported	0.181	0.000**
H4: Collaborative Networks have a positive influence on					
H4a	Collaborative Networks	Research Output	Supported	0.125	0.042*
H4b	Collaborative Networks	Innovation Adoption	Supported	0.147	0.015*
H4c	Collaborative Networks	Cultural Change	Supported	0.261	0.000**

Based on the findings, a conceptual framework was developed as follows Figure 2. This result-based conceptual framework highlights that leadership style, resource allocation, professional development opportunities, and collaborative networks collectively explain 34.10% of the variance in research output, 36.80% in innovation adoption, and 38.90% in cultural change. This visual representation consolidates the key findings regarding the predictive power of the identified factors.

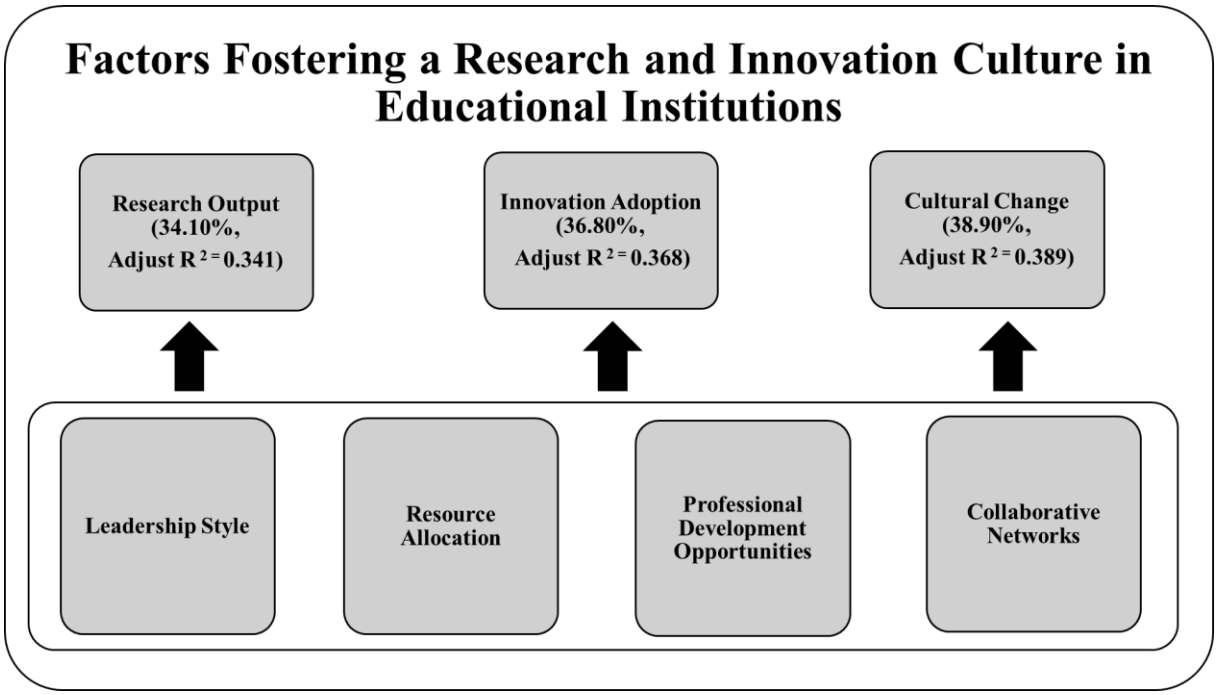

Figure 2: Conceptual Framework of Factors Fostering a Research and Innovation Culture in Educational Institutions

Conclusion

This study aimed to explore the factors that foster a research and innovation culture in educational institutions, focusing on four key factors: leadership, resource allocation, professional development opportunities, and collaborative networks. The findings revealed that all four factors positively influence research output, innovation adoption, and cultural change within educational institutions. This study provided insights into the complex dynamics of research and innovation culture, particularly highlighting the importance of participation from all levels of personnel in creating an enabling environment. The findings can benefit policymakers and administrators in developing strategies and initiatives to promote research and innovation culture and enhance the quality of education sustainably.

Discussion

The findings of this study largely align with and extend existing literature on fostering research and innovation culture in educational settings, while also providing nuanced insights specific to a technological college in Mianyang, China.

Leadership Style: The significant positive influence of leadership style on research output, innovation adoption, and cultural change (β values ranging from 0.160 to 0.225) corroborates previous research emphasizing the crucial role of leadership in fostering a research and innovation culture (Hughes et al., 2022). Transformational leaders, with their vision, creativity, and ability to champion change, were shown to inspire and motivate personnel to engage in research and innovation activities (Bush & Glover, 2023; Bass & Riggio, 2020). This study reinforces that leaders should actively participate in creating an

environment that encourages experimentation, learning, and knowledge sharing (Somech, 2023), including providing resources and supporting personnel development. The qualitative interview data further supported this, highlighting the importance of leaders who clarify vision, empower teams, encourage feedback, and lead by example.

Resource Allocation: Resource allocation emerged as a consistently strong predictor across all dependent variables, particularly for innovation adoption (β=0.350, p=0.000). This finding strongly supports the notion that adequate resources, including budget, equipment, and personnel, are fundamental for conducting research and adopting innovations (Audretsch & Belitski, 2022; Lee et al, 2019). The qualitative data underscored that insufficient resources can indeed hinder research development and innovation adoption. The results emphasize that strategic allocation, prioritizing key projects, and flexible adjustment of resources are vital for ensuring the smooth progress of research and innovation initiatives.

Professional Development Opportunities: Professional development opportunities significantly enhanced research capabilities and innovative practices, positively impacting all three dependent variables (e.g., β=0.250 for research output). This aligns with literature suggesting that such opportunities improve personnel's knowledge, skills, and experience (Poekert et al., 2022; Asbari et al, 2020). The study's findings suggest that supporting access to comprehensive professional development programs is a valuable investment that directly contributes to increased research output, innovation adoption, and cultural change by equipping staff with necessary skills and fostering a continuous learning environment. Qualitative data further highlighted the value of continuing education, international exchanges, and internal promotion mechanisms.

Collaborative Networks: Collaborative networks demonstrated a significant positive influence on cultural change (β=0.261, p=0.000), innovation adoption, and research output. This reinforces the established understanding that both internal and external collaborative networks play a vital role in promoting research and innovation culture (Gajda & Kozielska, 2022; Chou et al, 2019). The exchange of knowledge, experiences, and resources among individuals and organizations stimulates creativity and new innovations. The interview analysis further emphasized the benefits of industry-academia-research integration and cross-disciplinary cooperation in breaking down disciplinary barriers and fostering new ideas.

Suggestion

Suggestions for Research Utilization

1. Develop leadership training programs: Educational institutions should develop leadership training programs that focus on enhancing transformational leadership skills, such as inspiring others, communicating effectively, and promoting collaboration. This would enable leaders to effectively foster a research and innovation culture within their organizations.

2. Allocate resources strategically: Institutions should strategically allocate resources to support research and innovation, considering project needs and potential impact. This includes providing modern equipment and technology to promote innovation development.

Suggestions for Future Research

1. Conduct in-depth studies on individual factors: Future research should delve deeper into individual factors, such as motivation, skills, and personality, that influence research and innovation culture to gain a more comprehensive understanding.

2. Expand the scope of research: The scope of research should be expanded to include other types of educational institutions, such as schools and colleges, to enhance the generalizability and applicability of the findings.

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