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Mapping the Pathways to Innovation in PhD Scholars: The Interplay of University Structure, Academic Leadership and Psychological Capital

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Abstract

This study investigates the impact of university structure, academic leadership, and psychological capital on the innovation capabilities of PhD scholars in Haryana's state, central, deemed, and private universities. Using a quantitative survey method, data were gathered via online (204 responses) and offline (210 responses) questionnaires rated on a 1 to 5 Likert scale. Participants were chosen through stratified random sampling. Data analysis was performed with PLS-SEM 4 (Partial Least Squares Structural Equation Modelling) after validating and confirming the reliability of the questionnaires. Validity was determined by correlating individual question items with the overall item score for each variable. The analysis addressed the research questions and tested the hypotheses. Results highlight that psychological capital has the most substantial and statistically significant effect on enhancing the innovation capacity of PhD scholars.

Keywords: PLS-SEM, Academic Leadership, University Structure, Psychological Capital, Innovation and PhD Scholar.

1. Introduction

Innovation and creativity are often hailed as essential catalysts for progress across sectors such as business, technology, and the arts (Amabile, 1996; Sternberg, 2008). However, their influence within academic environments has not been as thoroughly examined. Scholars, who are at the forefront of knowledge creation, have the capacity to produce transformative ideas (Runco & Jaeger, 1999). This research seeks to explore the complex connection between creativity and innovation in academic contexts.

According to Damapour (1991), innovation involves the successful implementation of new ideas, which originates from creativity—the initial drive that generates unique solutions (Sternberg, 2008). In the academic world, this manifests in innovative curriculum designs, creative teaching

strategies, and novel research methodologies. Despite the extensive study of creativity and innovation in fields like psychology and business, academia tends to concentrate on organizational factors, such as resource allocation and institutional culture (Clark, 1998), often overlooking the individual factors that foster creativity. The concept of "innovation systems" highlights the importance of knowledge and learning processes in driving economic development (Freeman, 1987). Nevertheless, higher education institutions frequently emphasize critical thinking over nurturing creativity, pointing to a need for a cultural shift that better supports creative efforts (Jackson et al., 2007; Wisdom, 2007).

2. Literature Review and Hypothesis

Innovation plays a pivotal role in driving development across academia, business, and society. Bingham et al. (2007) emphasize that a nation's capacity to innovate is essential for its prosperity, impacting areas ranging from manufacturing to global challenges in health and education. The idea of "innovation systems," first introduced in the late 1980s, highlights the importance of knowledge and institutional interactions in promoting economic growth (Freeman, 1987). This concept later expanded into "National Innovation Systems" (NIS), which involve collaboration among industries, universities, and governments (Dosi et al., 1988; Lundvall, 1992; Nelson, 1993; Edquist, 1997).

In higher education, nurturing creativity is critical. Cheung et al. (2006) and Jackson (2006) contend that universities must develop creative students to equip them for a rapidly changing workforce. Creativity is especially crucial for PhD scholars, enabling them to make unique contributions to their fields (Walsh et al., 2013; Lovetts, 2005). This study examines how academic innovation is influenced by disciplinary culture, institutional support, and personal characteristics. Psychological Capital (PsyCap) encompasses resilience, self-efficacy, optimism, and hope, forming a positive psychological state that enhances performance in various settings. Research highlights PsyCap as crucial for fostering creativity and innovative thinking, alongside individual expertise and intrinsic motivation (Shalley, Zhou, & Oldham, 2004; Zhou & Shalley, 2010). For researchers, PsyCap plays a significant role in sustaining imaginative inquiry, with Luthans et al. (2007) noting its impact on creative capacities. Positive Organizational Behavior (POB) studies emphasize PsyCap as a critical asset for performance improvement (Luthans, 2002). Individuals with high PsyCap exhibit strong self-efficacy, hopeful goal-setting, resilience, and optimism, all of which boost their creative and innovative abilities (Luthans & Youssef, 2004). Organizational culture and external factors like resources and leadership also significantly influence creativity (Amabile, 1997; Spreitzer et al., 2005).

Ho1: Psychological Capital does not have significant effect on innovation.

The structure of a university plays a pivotal role in either promoting or inhibiting creativity within higher education institutions. A study by the European University Association, which included 42 institutions across 21 countries, explored factors that influence creativity, particularly focusing on innovative teaching methods, organizational structures, and leadership strategies (Olsen, 2007). "University structure" refers to the hierarchical arrangement of an institution's various components, such as administrative, academic, and support departments, which are critical for achieving its goals in teaching, research, and community engagement. Institutions that are actively engaged in societal change are often termed "innovative universities" (Van Vught, 1999). Banshal et al. (2019) found that national and central universities in India conduct more research than private universities. The design of a university's structure is essential for supporting academic activities and addressing social, political, and cultural challenges (Inamdar & Kirloskar, 2022).

Ho2: University Structure does not have significant effect on innovation.

Academic Leadership (AL) plays a vital role in influencing innovation among PhD students, as underscored by Organizational Behavior theory. Evidence shows that a supervisor's leadership style significantly impacts students' innovative potential (Zhang & Bartol, 2010; Shalley, Zhou, & Oldham, 2004; Zhou & Shalley, 2003). Transformational and transactional leadership positively affects creativity by acting as role models, whereas passive-avoidant leadership can stifle it (Haslam et al., 2019; Bargar & Duncan, 1990). Effective academic leadership involves behaviors such as fostering collaboration, encouraging autonomy, and acknowledging achievements, which boost self-efficacy and intrinsic motivation (Meng & Zhao, 2018; Amabile et al., 2004). Componential theory of creativity connects these leadership behaviors to research processes (Amabile, 1983; Amabile et al., 1996; Amabile & Mueller, 2008).

Ho3: Academic Leadership does not have significant effect on innovation

3. Research Methodology

The research employs a quantitative survey method. Data were collected through both online and offline questionnaires, designed with a Likert scale ranging from 1 to 5, and distributed to 414 PhD scholars using stratified random sampling. The data processing was conducted using PLS-SEM 4. Prior to data analysis, the validity and reliability of the questionnaire were assessed. Validity was evaluated by correlating each item's score with the total score for that variable. Once validity and reliability were confirmed, data analysis was performed to address the research questions and test the hypotheses.

Figure 2 illustrates a proposed model in which Academic Leadership, University Structure, and Psychological Capital are independent variables affecting Innovation among PhD scholars, the dependent variable. The arrows or lines in the figure depict the hypothesized causal relationships:

- H1 explores the connection between Academic Leadership and Innovation.
- H2 examines the impact of University Structure on Innovation.
- H3 assesses how Psychological Capital influences Innovation.

Each hypothesis outlines a distinct pathway through which these independent variables are anticipated to affect Innovation.

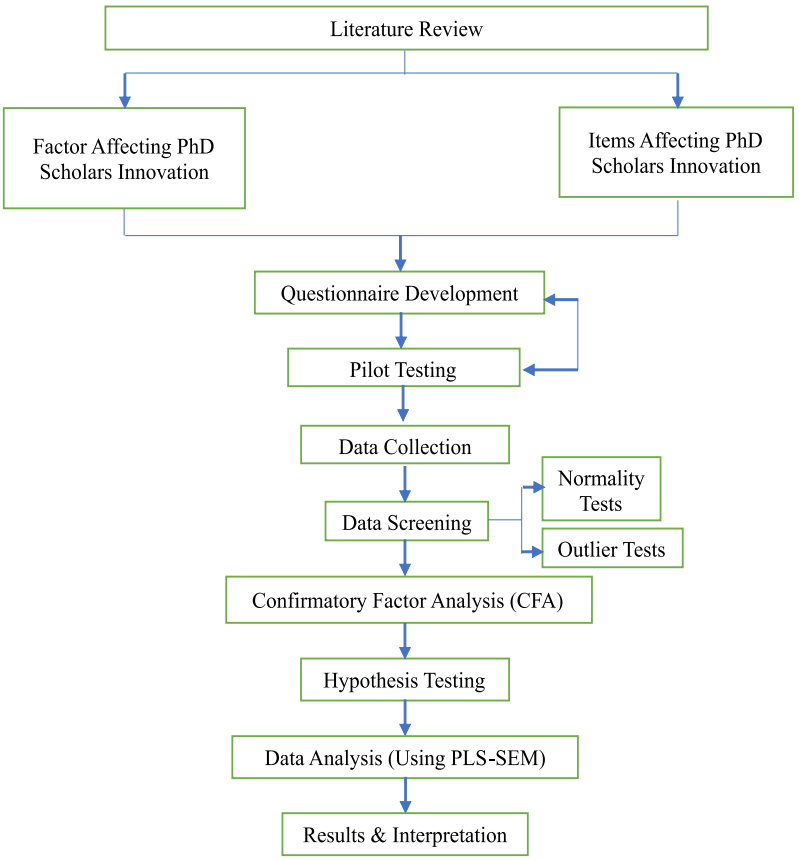


Figure 1. Research flow of the study

3.1 The Definition and measurement of Research Dimensions

Table 1: Innovation Competences in PhD Scholars (factors used in this study)

S.No.	Factors	Operational Definitions	Description of Items
1	**Psychological Capital**	A person's positive psychological condition, defined by resilience, optimism, hope, and self-efficacy, is known as psychological capital (PsyCap) (Luthans, Youssef, & Avolio, 2007).	Hope Self-Efficacy Resilience Optimism
2	**Academic Leadership**	The process of motivating and directing people to accomplish the objectives of a higher education establishment is known as academic leadership (Northouse, 2020).	Empowering Behaviour Considering Behaviour Developing Behaviour
3	**University Structure**	The formal organisation of duties, responsibilities, and channels of communication inside an institution of higher learning is referred to as the university structure (Mintzberg, 1979).	Structural Dimension Relational Dimension Cognitive Dimension
4	**Innovation**	Innovation, in terms of novelty, is the creation and implementation of original ideas, products, or processes that significantly deviate from existing practices (Anderson N, Zhou J, 2014).	Domain Relevant skills Creative Thinking Task Motivation

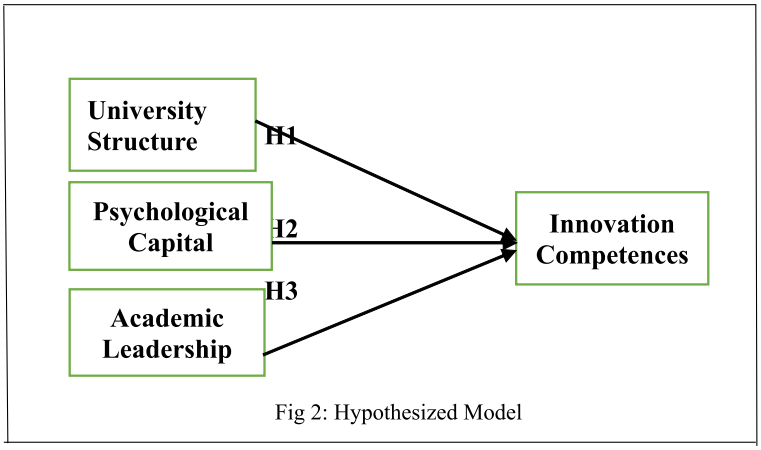


Fig 2: Hypothesized Model

3.2 Data Collection and Analysis Method

To collect data on innovation among PhD students, a survey featuring 39 items and four hypothesized elements was designed. This survey targets PhD scholars from Central, State, Deemed, and Private universities in Haryana. The questionnaire is divided into two sections: the first includes nine questions about demographics, and the second contains four sections evaluating factors affecting innovation. These sections address Academic Leadership (9 statements), University Structure (9 statements), Psychological Capital (12 statements), and Creativity/Innovation (9 statements). Respondents indicate their level of agreement on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). A pilot study with four professors and four assistant professors from both private and public institutions validated the survey, involving specialists in human resources, psychology, organizational behavior, and HR/marketing.

Table 2: Measured Cronbach alpha values for the study factors

Factors	Cronbach's Alpha Value
Overall	.941
Psychological Capital	.897
Academic Leadership	.879
University Structure	.906
Innovation	.908

Table 2 shows the Cronbach's alpha value which is .941 (overall) that is excellent. Academic leadership Cronbach's alpha value is .897 that is acceptable, Cronbach's alpha value of university structure is .879 which is also acceptable, Cronbach's alpha value of psychological capital is .906, which is excellent and value of innovation is also excellent that is.908.

Table 3: KMO and Bartlett's Test [a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.845**
Bartlett's Test of Sphericity	Approx. Chi-Square	3088.846
	df	741
	Sig.	.000

Table 3 displays the results of Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy. The KMO value is 0.845, indicating that the data is well-suited for factor analysis, with values between 0.8 and 0.9 suggesting significant factors are likely (Huang, 2021). Bartlett's Test shows a significance level of 0.000 and a Chi-Square value of 3088.846 with 741 degrees of freedom, confirming that the correlation matrix is significantly different from an identity matrix. Smart-PLS 4.0 uses partial least squares structural equation modeling (PLS-SEM) to measure relationships between observation and latent variables, offering superior performance for exploratory research (Pavlou, 2006; Melchor, 2008; Henseler, 2010).

4. Research Results

4.1 Reliability and Validity Test

Reliability, referring to the consistency of a scale tool, encompasses both internal consistency and individual item reliability (Hair et al., 1998). Internal consistency is measured using Cronbach's alpha and latent variable composition reliability (CR), with values recommended to be above 0.7. Factor loading evaluates the reliability of each item. Validity, reflecting the accuracy of the scale tool, includes both convergent and discriminant validity. Convergent validity is assessed through average variance extraction (AVE), with a suggested value greater than 0.5 (Bagozzi et al., 1998). Discriminant validity is determined by comparing the square root of AVE with the correlations between items of different dimensions, which should be higher (Fornell et al., 1981). Tables 4 and 5 show that factor loadings, Cronbach's alpha, CR, and AVE values all surpass the recommended levels, indicating robust reliability and validity. Table 6 supports good discriminant validity with values under 0.9, according to heterotrait–monotrait analysis (Henseler et al., 2015).

Table 4: Measurement Model

Dimensions	Question Items	Factor Loadings	Cronbach's alpha	CR	AVE
Academic leadership (AL)	**ALC1**	0.796	0.929	0.934	0.669
	ALC2	0.802			
	ALD1	0.799			
	ALD2	0.795			
	ALD3	0.789			
	ALE1	0.834			
	ALE2	0.859			
	ALE3	0.868			
Psychological Capital (Psy)	**PSYH1**	0.744	0.934	0.935	0.579
	PSYH2	0.709			
	PSYH3	0.744			
	PSYO1	0.827			
	PSYO2	0.718			
	PSYO3	0.726			
	PSYR1	0.77			
	PSYR2	0.772			
	PSYR3	0.783			
	PSYS1	0.736			
	PSYS2	0.813			
	PSYS3	0.781			
University Structure (US)	**USC1**	0.813	0.907	0.914	0.604
	USC2	0.795			
	USC3	0.751			
	USR1	0.782			
	USR3	0.782			
	USS1	0.736			
	USS2	0.799			
	USS3	0.756			
Innovation (I)	**ICT1**	0.876	0.951	0.953	0.721
	ICT2	0.853			
	ICT3	0.85			
	IPK1	0.861			
	IPK2	0.78			
	IPK3	0.806			
	ITM1	0.859			
	ITM2	0.895			
	ITM3	0.857			

4.2 Structural Equation Modelling

The table 4 summarizes the measurement model analysis across four dimensions: Academic Leadership (AL), Psychological Capital (Psy), University Structure (US), and Innovation (I). Each dimension is assessed through multiple items, with their factor loadings reflecting the strength of their connection to the underlying construct. For Academic Leadership, items such as ALC1 (0.794) and ALE3 (0.864) show a Cronbach's alpha of 0.916, Composite Reliability (CR) of 0.933, and Average Variance Extracted (AVE) of 0.612, indicating strong internal consistency and convergent validity. Psychological Capital, featuring items like PSYH1 (0.743) and PSYS3 (0.826), demonstrates a high Cronbach's alpha of 0.949, CR of 0.950, and AVE of 0.641, reflecting robust reliability and validity. University Structure, with items such as USC1 (0.807) and USS3 (0.759), has a Cronbach's alpha of 0.915, CR of 0.924, and AVE of 0.593, showing strong internal consistency and acceptable convergent validity. Finally, Innovation, with items like ICT1 (0.876) and ITM3 (0.858), reports a Cronbach's alpha of 0.952, CR of 0.954, and AVE of 0.723, indicating excellent reliability and high convergent validity.

Table 5: Discriminant validity Test (Fornell-Larcker)

Dimensions	AVE	AL	I	Psy	US
AL	0.669	0.818			
I	0.721	0.681	0.849		
Psy	0.579	0.59	0.774	0.761	
US	0.604	0.632	0.655	0.629	0.777

Table 5 illustrates the results of the Fornell-Larcker discriminant validity test, which evaluates the distinctiveness of constructs. The diagonal values represent the Average Variance Extracted (AVE) for each construct, with their square roots shown. According to Fornell and Larcker (1981), discriminant validity is confirmed if the AVE exceeds the squared correlations with other constructs. The table demonstrates that each construct's AVE (shown on the diagonal) surpasses its correlations with other constructs, thereby confirming adequate discriminant validity. For instance, psychological capital (Psy) has an AVE of 0.579 and a square root of 0.761, which exceeds its correlations with other constructs, validating the uniqueness of each dimension (Fornell & Larck

Table 6 Discriminant validity Test (HTMT)

	AL	I	Psy	US
AL				
I	0.717			
Psy	0.631	0.818		
US	0.676	0.689	0.679	

Discriminant validity ensures that each construct in the model is distinct from the others. This is commonly evaluated by comparing the square root of the Average Variance Extracted (AVE) for each construct to its correlations with other constructs. To confirm good discriminant validity, the square root of a construct's AVE should be greater than the highest correlation it has with any other construct.

Table 6 shows the correlation coefficients among four variables: Academic Leadership (AL), Innovation (I), Psychological Capital (Psy), and University Structure (US), excluding self-correlations. AL correlates with I at 0.717, Psy with I at 0.818, and Psy with AL at 0.631. US positively correlates with AL (0.676), I (0.689), and Psy (0.679). These results indicate that each construct has good discriminant validity, as the square roots of the AVE values exceed the highest correlations, confirming distinct constructs.

Table 7: Hypothesis Testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Hypothesis
AL -> I	0.281	0.283	0.047	5.923	0	Rejected (Significant)
Psy -> I	0.51	0.507	0.049	10.33	0	Rejected (Significant)
US -> I	0.157	0.159	0.051	3.073	0.002	Rejected (Significant)

The table 7 summarizes the findings of a statistical analysis that explores the impact of three variables—Academic Leadership (AL), Psychological Capital (Psy), and University Structure (US)—on Innovation (I). The analysis reports the original sample coefficient (O), sample mean (M), standard deviation (STDEV), T statistics, P values, and the outcomes of hypothesis testing.

The impact of Academic Leadership (AL) on Innovation (I) is substantial, with a coefficient of 0.281, a T statistic of 5.923, and a P value of 0, signifying a significant positive effect. Psychological Capital (Psy) has a strong influence on Innovation (I), reflected by a coefficient of 0.51, a T statistic of 10.33, and a P value of 0. Additionally, University Structure (US) positively affects Innovation (I), with a coefficient of 0.157, a T statistic of 3.073, and a P value of 0.002. All these relationships are statistically significant, supporting the rejection of the null hypothesis and confirming their positive effects on Innovation.

The figure 3 presents a Structural Equation Model (SEM) that illustrates the relationships between Psychological Capital (Psy), Academic Leadership (AL), University Structure (US), and Innovation (I). Among these, Psychological Capital exerts the strongest positive influence on Innovation (path coefficient = 0.510), followed by Academic Leadership (0.281) and University Structure (0.157). Each construct is represented by several indicators with strong factor loadings, indicating the model's effectiveness in capturing the impact of these variables on Innovation. Overall, the model demonstrates that increased levels of Psychological Capital, Academic Leadership, and a supportive University Structure play a significant role in fostering Innovation.

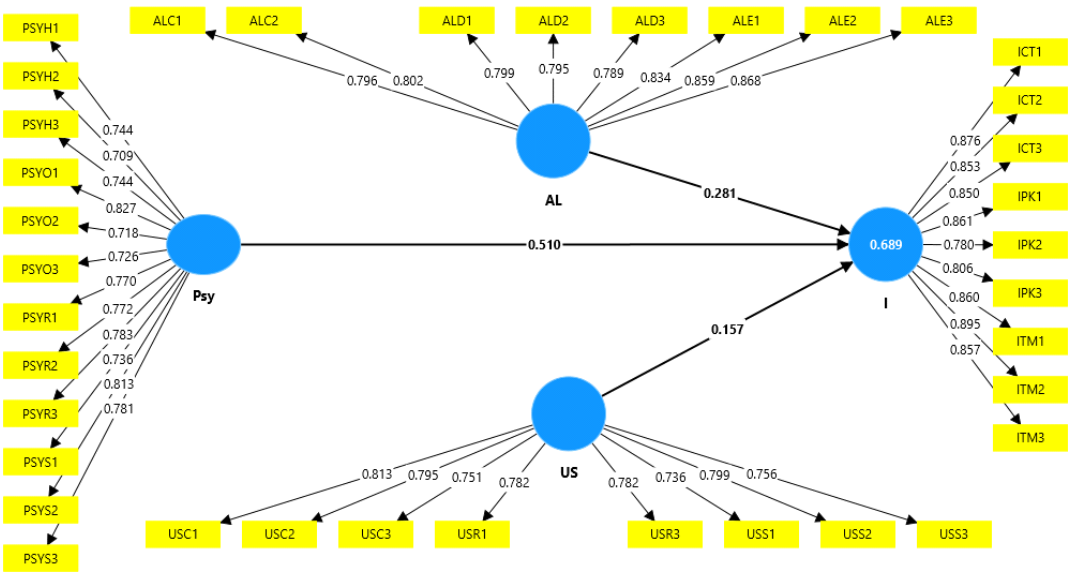


Figure 3: Model of PLS-SEM Path Analysis

1. Discussion

The Structural Equation Modelling (SEM) analysis offers valuable insights into how Academic Leadership (AL), Psychological Capital (Psy), and University Structure (US) contribute to Innovation (I) among PhD scholars.

Psychological Capital (Psy) as a Major Influence on Innovation: The results show that Psychological Capital has the most significant impact on Innovation, with a path coefficient of 0.510. Recent studies support this, demonstrating that individuals with higher psychological capital are more likely to engage in creative problem-solving and innovation (Newman et al., 2014; Avey, Reichard, Luthans, & Mhatre, 2011).

Importance of Academic Leadership (AL): Academic Leadership also significantly influences Innovation, as shown by a path coefficient of 0.281. This suggests that effective academic leadership—characterized by clear vision, support, and resource allocation—creates an environment that fosters innovation. Recent research emphasizes the role of leadership in cultivating a culture of innovation in academic settings, showing that leaders who actively promote creativity and provide necessary resources are key drivers of innovative outcomes (Carmeli, Gelbard, & Reiter-Palmon, 2013; Hargreaves & Fullan, 2020).

Role of University Structure (US): Although the impact of University Structure on Innovation is smaller compared to Psy and AL, it remains significant, with a path coefficient of 0.157. This suggests that a well-organized and supportive institutional structure promotes innovation by providing essential infrastructure, resources, and collaborative opportunities. Recent studies confirm that universities with flexible and supportive structures are better equipped to foster innovative research environments (Deem, Hillyard, & Reed, 2020; Martin, 2021).

Interconnectedness of Variables: The correlation matrix shows positive relationships among AL, Psy, and US, with the strongest correlation between Psychological Capital and Innovation. This interconnectedness suggests a synergistic effect, where the combination of strong leadership, high psychological capital, and a supportive university structure collectively enhances innovation. Recent literature on innovation ecosystems in academic institutions supports this view, emphasizing that innovation thrives when these elements are aligned and mutually reinforcing (Etzkowitz & Zhou, 2017; Cunningham, Menter, & O'Kane, 2018).

2. Conclusion

This study emphasizes the crucial roles of Psychological Capital (PsyCap), Academic Leadership (AL), and University Structure (US) in promoting innovation among PhD scholars. The Structural

Equation Modelling (SEM) results indicate that PsyCap exerts the strongest influence on innovation, with a path coefficient of 0.510, followed by Academic Leadership (0.281) and University Structure (0.157). This finding highlights the vital role of resilience, self-efficacy, optimism, and hope in fostering creativity and innovation (Luthans et al., 2007; Newman et al., 2014). Transformational and transactional academic leadership enhances creativity by creating a supportive and motivating environment (Zhang & Bartol, 2010; Haslam et al., 2019). Additionally, a well-organized university structure that facilitates collaboration and resource access is essential for cultivating innovation (Carlsson, 2003; Banshal et al., 2019). This study advances our understanding of how these factors interact to drive scholarly innovation, suggesting that a combination of strong leadership, effective institutional frameworks, and high psychological capital can significantly boost academic creativity and productivity. Future research should expand on these findings by incorporating diverse samples and longitudinal approaches to further unravel the complexities of academic innovation (Amabile et al., 2004; Jackson et al., 2007).

3. Limitations & Suggestions

This study has several limitations, such as its cross-sectional design, which hinders causal inference and the ability to track changes over time. The findings may not be generalizable to other universities or disciplines, and the reliance on self-reported data could introduce biases that affect accuracy. Moreover, the study overlooks other potential influences on innovation, such as personal motivation and external collaborations, and depends on measurement tools whose validity might impact the results. Future research should address these issues by using longitudinal designs to investigate causal relationships, incorporating more diverse samples, combining objective measures with self-reports, and examining additional variables. Strengthening measurement tools and exploring different contexts will offer a more comprehensive understanding of the factors that drive innovation.

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Appendix

Table 1: Questionnaire Items and References

Dimension	Variable	Questions	References
	Empowering Behaviour	Does your supervisor allow you to work in your own way.	
		Does your supervisor give you adequate freedom to choose your research topic and make similar important decisions.	Yi M, Congjian Z. 2018
		Does your supervisor give you the opportunity to voice your ideas and opinions.	
Academic Leadership	Considering Behavior	Does your supervisor express sympathy and give comfort when you are upset and anxious.	
		Does your supervisor recognize your efforts even if the experiment/research failed.	Yi M, Congjian Z. 2018
		Is your supervisor concerned about your ability enhancement and career development.	
	Developing Behaviour	Does your supervisor guide you to think critically about early research works.	
		Does your supervisor patiently teach you the technology needed for research.	Yi M, Congjian Z. 2018
		Did your supervisor appreciate novel ideas in research work.	
	Structural Dimension	Is your university have the availability of equipment and technological facilities.	
		Is your university providing sufficient time for research.	Oya TAMTEKİN AYDIN, 2019
		Is your university have the sufficient revenue for research.	

University Structure	Relational Dimension	Is your university have the availability of government and non-governmental fund for research.	
		Is your university have the subscription to a large number of journals.	Oya TAMTEKİN AYDIN, 2019
		Is your university fulfilling research responsibilities for scholars.	
	Cognitive Dimension	Is your university providing sufficient freedom to do research.	
		Is your university providing research training for scholars.	Oya TAMTEKİN AYDIN, 2019
		Is your university have the scholars demand in teaching and administrative.	
	Hope	If I find myself in a difficult situation, I can think of alternate ways to get out of it.	
		I can think of alternate ways to reach my work goal if the current one gets blocked.	Gupta V, Singh S. 2014
		There are lots of ways to overcome any problem.	
Psychological Capital	Self-Efficacy	I am highly skilled at my work.	
		I have confidence in my ability to solve problems creatively	Gupta V, Singh S. 2014
		I am good at further developing ideas of others	
	Resilience	I am determined to overcome difficulties that I encounter in my work.	
		In spite of difficulties, I execute the plans that I make for my work.	Gupta V, Singh S. 2014
		I have the self-discipline needed to overcome difficulties.	

	Optimism	I m optimistic about my future.	
		In uncertain times, I usually expect the best.	Gupta V, Singh S. 2014
	Creative Thinking	When I encounter a problem, I tend to focus on the possible causes of the problem.	
		I possess the relative knowledge, skills, and insight needed to complete my research work.	Yi M, Congjian Z. 2018
		I am able to find out the most appropriate way from a variety of ways to solve the problem.	
Creativity/Innovation	Task Motivation	I like to explore ways to solve problems.	
		I like to come up with new ideas for solving research questions.	Yi M, Congjian Z. 2018
		I am enjoying the process of improving research methods.	
	Domain relevant skills (Professional Knowledge)	I have the basic knowledge about the conceptions and principles, and the significant theories which is related to my thesis.	
		I have the knowledge about the experimental equipment, tools and materials in the professional disciplines.	Yi M, Congjian Z. 2018
		I have well known about my research questions and objectives of my thesis.	