

Research on the Transformation Path from Critical Thinking in General Education in Colleges and Universities to Creative Problem-solving in Enterprises

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Abstract:

At present, there are certain predicaments in the transformation of the transfer critical thinking cultivated by colleges and universities into the problem-solving ability and creativity of enterprises. This paper innovatively selects self-efficacy as the mediator and supervisor support as the moderating factor to construct a cross-scenario transformation path model of critical thinking. A survey and analysis were conducted on 343 enterprise employees in Hubei, Beijing and Guangzhou. The proposed hypotheses were verified through methods such as reliability and validity tests, correlation analysis and regression analysis. The results show that general education in colleges and universities cultivates the critical thinking of enterprise employees, and it promotes the ability of enterprise employees to solve problems creatively. The sense of innovation self-efficacy plays a mediating role between the two. Supervisor support has a positive moderating impact on the self-efficacy of innovation on creative problem-solving ability. This research has broken through the limitations of other studies that merely focus on thinking or ability. It can be regarded as providing a reference for the general education reform in colleges and universities and is conducive to the cultivation and implementation of enterprises' innovation capabilities.

Keywords:

Critical Thinking, Creative Problem-solving, Innovative Self-efficacy, Supervisor's Sense of support, Capability Transformation Path

1. Introduction

There is a certain gap between the development of critical thinking in higher education and the actual needs of companies. After entering the actual work, there may be varying degrees of "transformation gap" in the academic field. With the advancement of the digital economy era, more and more enterprises are gradually raising their demands for employees' creativity and critical thinking abilities. However, employees' creative problem-solving is influenced by two factors: innovation self-efficacy and supervisor support. Low innovation self-efficacy of employees and insufficient supervisor support can reduce their ability to solve

creative problems. This study identified the transformation path model's central selection of innovation, self-efficacy, and supervisor support, highlighting the influence of critical thinking on the resolution of creative problems, and simultaneously providing a theoretical basis for the cross-context application of thinking. In practice, promoting the integration of general education with the corporate context has accelerated the formation of a psychological empowerment and environmental support thinking implementation mechanism in enterprises, addressing the gap between talent development and the innovation demands of enterprises.

2. Definition of Relevant Concepts and Theoretical Basis

2.1. Definition of Relevant Concepts

(1) As a non-utilitarian subject course, general education in colleges and universities attaches great importance to the cross-context transfer of students' critical thinking, comprehensive quality and thinking ability. Its courses have the characteristics of interdisciplinarity, universality, practicality and criticality [1].

(2) Critical thinking, as a form of systematic cognition, is formed on the basis of rationality and evidence. It can objectively examine information through analysis, evaluation, reasoning and reflection, and then make reasonable choices. It is mainly reflected in the ability to decompose problems, the ability to screen evidence, the ability to logically argue, and the thinking tendency of seeking truth, openness and prudence [2].

(3) Creative problem-solving in enterprises refers to the ability of enterprise employees to solve complex and difficult problems through innovation. The key lies in innovating the solution methods under the premise of being in line with the actual production processes and resources of the enterprise, emphasizing goal orientation, practical feasibility and adaptability [3].

(4) Innovation self-efficacy is an individual's perception that "ability is being transformed into innovative behavior", which is contextual and dynamic, and is not limited to the difficulty of the task, the availability of resources, successful results, or encouragement from others [4].

(5) Manager support perception is the subjective feeling of employees towards whether managers recognize their contributions, care about their development, and provide necessary resources and emotional support when employees encounter difficulties. It consists of three core elements: emotional support, resource support, and work support, representing the behavior of employees understanding and supporting their superiors [5].

2.2. Theoretical Basis

(1) The social exchange theory was proposed by the American sociologist Homans in 1958. Its core viewpoint holds that all social interactions among human beings are essentially exchange behaviors based on rational calculations of cost, remuneration and fairness [6]. This theory provides a crucial theoretical perspective for this research: general education can be understood as a long-term social exchange process between students and enterprises.

(2) Social cognitive theory was proposed by psychologist Bandura. Its core proposition emphasizes the dynamic interactive and decisive relationship among

individual behavior, cognition and environmental factors. This theory particularly focuses on two key mechanisms, “observational learning” and “self-efficacy”, providing a theoretical basis for explaining the transfer and transformation of thinking ability from educational scenarios to working scenarios [7].

2.3. The Theory and Hypothesis of the Transformation Path from Critical Thinking to Creative Problem-Solving

(1) Critical thinking runs through the entire process of employees’ creative problem-solving and constitutes the core cognitive foundation of enterprise innovation. During the problem identification and solution conception stage, its “analysis and decomposition” and “evidence evaluation” functions help employees break through conventional thinking patterns, accurately identify the essence of the problem and screen out feasible solutions. Entering the execution optimization stage, the “dynamic reflection” characteristic of critical thinking drives the continuous improvement of the solution. By tracking the execution effect and identifying the root causes of deviations, an innovative cycle of “practice-reflection-optimization” is achieved. This cognitive mechanism effectively enhances the accuracy of problem judgment, the rationality of solution design and the effectiveness of the execution process, thereby strengthening employees’ creative problem-solving abilities. Based on this, the hypothesis is proposed:

H1: The critical thinking cultivated by general education in colleges and universities is positively correlated with the creative problem-solving ability of enterprise employees.

(2) Based on social cognitive theory, critical thinking enhances employees’ innovative self-efficacy through three key mechanisms: at the cognitive level, it helps employees effectively break down complex problems and accumulate successful experiences through logical analysis and evidence evaluation; At the behavioral regulation level, by leveraging the trait of self-reflection, employees are encouraged to respond rationally to setbacks and maintain confidence in innovation. At the level of environmental interaction, relying on the feature of open learning, we encourage employees to actively draw on others’ practical experience and strengthen their self-belief. Based on this, the hypothesis is proposed:

H2: The critical thinking cultivated by general education in colleges and universities is positively correlated with the innovative self-efficacy of enterprise employees.

(3) Based on social cognitive theory, innovation self-efficacy, as employees’ belief judgment on their ability to complete innovation tasks, promotes creative problem-solving through three key paths: In the problem identification stage, high self-efficacy drives employees to actively explore business pain points; During the scheme generation stage, enhance employees’ willingness to try new methods and their ability to continuously optimize. During the implementation optimization stage, enhance employees’ initiative in responding to risks and the sustainability of dynamic reflection. This firm belief in innovation ability directly translates into a higher level of task commitment and stronger innovation persistence, thereby effectively transforming the subjective perception of “believing in one’s own innovation ability” into innovative behaviors and achievements. Based on this, the hypothesis is proposed:

H3: The innovative self-efficacy of enterprise employees is positively correlated with their creative problem-solving abilities.

(4) Critical thinking, through accumulating successful experiences and enhancing the sense of control over tasks, first boosts employees' self-efficacy in innovation, fostering a subjective belief of "being able to innovate and daring to innovate". This belief in turn inspires employees to demonstrate greater initiative and perseverance in the process of creative problem-solving, driving them to transform their critical thinking skills into concrete actions for identifying business pain points, proposing innovative solutions and optimizing processes. If an employee lacks a sense of self-efficacy in innovation, even if they have critical thinking skills, they may avoid high-risk innovation tasks due to a lack of confidence, making it difficult for their thinking to be transformed into practical results. Therefore, innovative self-efficacy plays a key mediating role between critical thinking and creative problem-solving. Based on this, the hypothesis is proposed:

H4: The innovative self-efficacy of enterprise employees plays a mediating role between critical thinking and their creative problem-solving abilities.

(5) Supervisor support plays an important moderating role between innovative self-efficacy and employees' creative problem-solving. When the supervisor feels a high level of support, the supervisor eliminates employees' psychological concerns through emotional support, provides implementation guarantees for innovative ideas through resource and work support, and encourages employees to fully transform their confidence in innovation into innovative actions. Conversely, in an environment with a low sense of support, even if employees have confidence in innovation, they often find it difficult to implement innovative actions due to the lack of necessary support, thereby weakening the positive effect of innovation self-efficacy. Based on this, the hypothesis is proposed:

H5: The sense of supervisor support plays a moderating role in the path from innovation self-efficacy to the creative problem-solving ability of enterprise employees.

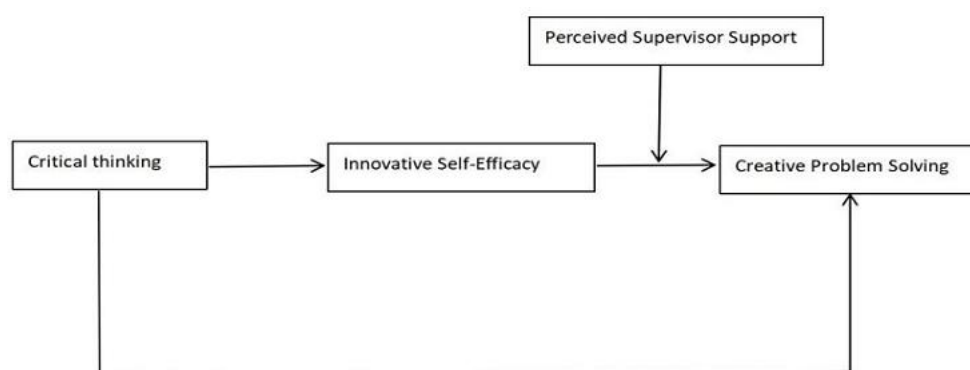


Figure 1. Transformation path model.

(6) Model Construction of Transformation Path Based on the above analysis, this paper constructs a relationship model of critical thinking, innovative self-efficacy, creative problem-solving, and supervisor support. As shown in Figure 1, this study intends to assume that critical thinking has a significant positive effect on employees' creative problem-solving, and this effect is transmitted through employees' innovative self-efficacy, that is, innovative self-efficacy plays a mediating role in the process in which critical thinking influences employees' creative problem-solving. Meanwhile, the sense of supervisor support can play a significant moderating role in the process in

which the sense of innovation self-efficacy affects employees' creative problem-solving.

3. Empirical Research

This study takes enterprise employees as the subjects and adopts the questionnaire survey method. First, an appropriate scale is selected based on the research variables. Then, data is collected by distributing and returning questionnaires. Finally, statistical analysis methods are used to test the relationship hypotheses among the variables.

(1) **Scale Selection** All the questionnaires used in this research were scored using the Likert 5-point scoring method, where 1 point indicates a complete non-compliance and 5 points indicates a complete compliance. Relevant empirical research has found that gender, age, highest educational attainment, and years of work experience need to be controlled. To obtain more accurate research results, it has been decided to take the above four variables as control variables.

Critical thinking. This study adopted the scale developed by Jiang Jing et al. (2014) [8], and selected five items such as “seeking alternative solutions to problems” and “daring to challenge difficulties that affect work performance”.

Innovative self-efficacy. This study adopted the scale of Tierney et al. (2004) [9] and selected four items: “I am good at coming up with new solutions to solve problems at work” and “I am very confident in my ability to creatively solve work problems”.

Creative problem-solving ability. This study adopted the scale of Carmelie et al. (2013) [10], selecting five items: “This member can creatively identify and define the problems that arise in the project” and “This member can evaluate and select the best solution for solving specific project problems”.

Sense of support from the supervisor. This study adopted the scale of Bao Gongmin et al. (2011) [11], selecting five items: “The leader provides me with the necessary information for innovative work”, “The leader will give me sufficient work autonomy to try innovative methods”, etc.

Control variables. Considering that some variables at the individual and organizational levels may interfere with employees' creative problem-solving, in order to more accurately examine the relationships among core variables, this study selected gender, age, highest educational attainment, and years of work experience as control variables. The digital processing of control variables is as follows: Gender (1= male, 2 = female); Age (1=25 years old and below, 2=26-35 years old, 3=36-45 years old, 4=46 years old and above); The highest educational attainment (1= high school or below, 2= junior college, 3= bachelor's degree, 4= master's degree or above); Years of work experience (1=1 year or less, 2=2-5 years, 3=6-10 years, 4=11 years or more).

(2) Sample Selection

This questionnaire selects on-the-job employees from enterprises of different industries and scales in Hubei, Beijing and Guangzhou as the research subjects. The industries covered include manufacturing, information technology, services and finance. To facilitate data collection, the questionnaires can be distributed through the network of acquaintances. The research adopts a combination of online questionnaire platforms and offline paper questionnaires. The questionnaire filling method is anonymous. A total of 380 questionnaires were distributed and 343 were retrieved,

with a retrieval rate of 90.26%. The sample feature analysis of the recovered valid questionnaires is shown in Table 1.

Table 1. Descriptive Statistical Results of Demographic Variables [n=343].

Project	Category	Frequency	Percentage (%)
Gender	Male	184	53.64
	Female	159	46.36
Age	25 years old and below	86	25.07
	26-35 years old	166	48.40
	36-45 years old	73	21.28
	46 years old and above	18	5.25
Highest Education	Senior high school and below	22	6.41
	Junior college	78	22.74
	Bachelor's degree	189	55.10
	Master's degree and above	54	15.74
Work Experience	1 year and below	68	19.82
	2-5 years	172	50.15
	6-10 years	71	20.70
	11 years and above	32	9.33

(3) Data Analysis

Common Method Deviation Measurement Common Method Variance (CMV) is the data error caused by factors such as data being taken from the same group of subjects and obtained through the same measurement environment. To control this deviation, this study tested it in the statistical analysis stage. This study employed the Harman single-factor analysis method to conduct an exploratory factor analysis on all items including critical thinking, innovative self-efficacy, supervisor support, and creative problem-solving ability. The results show that the unrotated primary factor only explains 28.35% of the variation, which is far below the critical standard of 40%, indicating that the common method bias of this study is not serious and will not significantly interfere with the validity of the research conclusion.

Descriptive Statistics and Correlation Analysis as shown in Table 2, all variables were significantly positively correlated ($P < 0.01$).

Table 2. Descriptive Statistics and Correlation Coefficient Analysis [n=343].

Variable	M	SD	1	2	3	4
1.Critical Thinking	16.85	3.40	—			
2.Innovation Self-Efficacy	11.59	2.36	0.623**	—		
3. Perceived Supervisor Support	16.90	3.15	0.385**	0.432**	—	
4.Creative Problem-Solving Ability	17.00	3.00	0.651**	0.682**	0.527**	—

Note: * indicates $P < 0.05$, ** indicates $P < 0.01$, *** indicates $P < 0.001$

Reliability and Validity Analysis As shown in Table 3, the results of reliability and validity analysis indicate that the factor loadings of each item in the critical thinking, innovative self-efficacy, creative problem-solving ability, and supervisor support scale are all greater than 0.50, and Cronbach's α is greater than 0.70, suggesting that the credibility and aggregated validity of each scale are good.

Table 3. Reliability and Validity Analysis of the Scale [n=343].

Scale	Item	Factor Loading	Cronbach's α
Critical Thinking	Seeks alternative solutions to problems	0.68	0.82
	Dares to tackle difficulties that affect work performance	0.72	
	When facing difficulties, I carefully consider the problem context and make prudent judgments	0.65	
	I adopt targeted strategies based on the type of problem	0.70	
	To solve problems, I am willing to adopt potential solutions that go beyond existing procedures or rules	0.63	
Innovation Self-Efficacy	I am good at coming up with new solutions to solve work problems	0.75	0.85
	I have great confidence in my ability to creatively solve work problems	0.78	
	I am good at developing others' ideas in depth	0.66	
	I think I am good at coming up with new ideas and thoughts	0.71	
Creative Problem-Solving Ability	This member can creatively identify and define problems arising in the project	0.73	0.88
	This member can generate innovative ideas to solve problems arising in the project	0.76	
	This member can provide innovative solutions to problems arising in the project	0.69	
	This member can evaluate and select the best solution for solving specific project problems	0.74	
	For problems arising in the project, this member can implement the selected innovative solution to solve the specific problem	0.67	
Perceived Supervisor Support	The leader provides me with necessary information for innovative work	0.65	0.76
	The leader grants me sufficient work autonomy to try innovative methods	0.62	
	The leader is willing to proactively understand the difficulties I encounter in innovative work	0.58	
	The leader forgives my unintentional mistakes in innovation attempts	0.69	
	The leader cares about the development of my innovative ability and my career growth	0.71	

Confirmatory Factor Analysis as shown in Table 4, to test the discriminative validity among the research variables, this study conducted a confirmatory factor analysis on four variables: critical thinking, innovative self-efficacy, creative problem-solving ability, and perceived support. The excellent fitting results of the 4-factor model indicate that the core variables of this study have good discriminative validity, with clear boundaries of each variable dimension and no cross-confusion issues. Further analysis can be conducted.

Table 4. Confirmatory Factor Analysis Results [$n=343$].

Model	Factor	χ^2/df	CFI	NFI	NNFI	RMSEA
Model1	4Factor	2.15	0.96	0.93	0.95	0.06
	CT;ISE;PSS;CPS					
Model2	3Factor	3.89	0.86	0.83	0.84	0.09
	CT;ISE;PSS+CPS					
Model3	2Factor	5.23	0.79	0.75	0.77	0.12
	CT;ISE+PSS+CPS					
Model4	1Factor	7.65	0.69	0.66	0.67	0.15
	CT+ISE+PSS+CPS					

Note: CT stands for Critical Thinking; ISE stands for self-efficacy in innovation; PSS stands for Supervisor's sense of support. CPS stands for creative problem-solving ability

(1) Main Effect and Mediating Effect Test As shown in Table 5, M1: Critical thinking positively predicts innovation self-efficacy ($\beta=0.590$), $R^2=0.381$; M2: Weak explanatory power ($R^2=0.055$); M3: Creative Problem-solving ability: Critical thinking positively predicts creative problem-solving ability ($\beta=0.592$), $R^2=0.388$; M4: Innovation self-efficacy positively predicts creative problem-solving ability ($\beta=0.550$), $R^2=0.532$; M5: Innovation self-efficacy still positively predicts creative problem-solving ability ($\beta=0.632$), $R^2=0.574$; The coefficient of critical thinking has dropped to 0.272. In conclusion, it is assumed that H1, H2, H3, and H4 all hold true.

Table 5. Analysis of Main Effects and Mediating Effects [$n=343$].

Indicator	Innovation Self-Efficacy		Creative Problem-Solving Ability		
	M1	M2	M3	M4	M5
Control Variables					
Gender	-0.087***	-0.091** *	-0.073**	-0.028	-0.022
Age	-0.060	-0.064	-0.340***	-0.096**	-0.150***
Highest Education	0.039	0.042	0.103**	0.054**	0.052**
Work Experience	0.052	0.057	0.216***	-0.040	0.021
Independent Variable					
Critical Thinking	0.590***		0.592***		0.272***
Mediating Variable					
Innovation Self-Efficacy				0.550***	0.632***
R^2	0.381	0.055	0.388	0.532	0.574
ΔR^2	0.329**	0.055	0.232***	0.187**	0.373**
F	22.345***	2.558**	22.912***	41.568***	40.637***

Note: * indicates $P<0.05$, ** indicates $P<0.01$, *** indicates $P<0.001$

(2) Test of Moderating Effects As shown in Table 6, M6 indicates that both the sense of innovation self-efficacy ($\beta=0.553$) and the sense of supervisor support ($\beta=0.271$) significantly positively predict the ability to solve creative problems. The model $R^2=0.418$, $\Delta R^2=0.332$; M7 shows that the coefficient of the interaction term “innovation self-efficacy $\times$ supervisor support” is significantly positive ($\beta=0.178$), the model R^2 increases to 0.435, $\Delta R^2=0.017$, and innovation self-efficacy ($\beta=0.568$) and supervisor support ($\beta=0.268$) still significantly positively predict creative problem-solving ability. In conclusion, hypothesis H5 has been verified.

Table 6. *Moderating Effect Analysis [n=343].*

Indicator	Creative Problem-Solving Ability	
	M6	M7
Control Variables		
Gender	-0.132**	-0.124**
Age	0.011	-0.013
Highest Education	-0.010	-0.017
Work Experience	0.048	0.013
Independent Variable		
Innovation Self-Efficacy	0.553***	0.568***
Moderating Variable		
Perceived Supervisor Support	0.271**	0.268**
Interaction Term		
Innovation Self-Efficacy × Perceived Supervisor Support		0.178**
R ²	0.418	0.435
△R ²	0.332**	0.017**
F	19.256**	20.783***

Note: * indicates $P < 0.05$, ** indicates $P < 0.01$, *** indicates $P < 0.001$

As shown in Table 7, the core theoretical framework and hypotheses proposed in the research are all supported by empirical data, and there are no hypotheses that have not been verified, laying a solid foundation for the subsequent research conclusions and discussions.

Table 7. *Summary of Hypothesis Testing Results [n=343].*

Hypothetical question item	Hypothetical content	Inspection results
H1	The critical thinking cultivated by general education in colleges and universities is positively correlated with the creative problem-solving ability of enterprise employees	Support
H2	The critical thinking cultivated by general education in colleges and universities is positively correlated with the innovative self-efficacy of enterprise employees	Support
H3	The innovative self-efficacy of enterprise employees is positively correlated with their creative problem-solving ability	Support
H4	The innovative self-efficacy of enterprise employees plays a mediating role between critical thinking and creative problem-solving abilities	Support
H5	Supervisor support plays a moderating role in the path from innovation self-efficacy to the creative problem-solving ability of enterprise employees.	Support

4. Summary and Outlook

4.1. Discussion on Empirical Results

(1) Empirical results show that critical thinking is positively correlated with the ability of enterprise employees to solve problems creatively. This not only validates the social cognitive theory that the basis of creative activities is critical thinking, but also emphasizes the role of the transfer of critical thinking ability. Questioning, analysis and argumentation logic are all important components of critical thinking.

These contents not only break the inertia of employees' experience, making problem deconstruction, solution screening and optimization efficient solutions, but also accelerate the transformation from passive execution to active innovation. At the same time, the above results also confirm that the core innovative literacy that general education can cultivate is exactly what enterprises need, eliminating enterprises' concerns that general education in colleges and universities is divorced from reality. It has laid a solid foundation for the optimization of the general education curriculum system in colleges and universities, the strengthening of logical analysis and multi-dimensional thinking teaching, as well as the critical thinking training for new employees.

(2) This study confirmed that there is a significant mediating effect of innovation self-efficacy between critical thinking and creative problem-solving ability. This indicates that the cognitive basis in innovation can be obtained through critical thinking, and the key to the subsequent transformation of innovative behavior lies in whether employees have the confidence to innovate. Enterprises should, on the basis of thinking training, assist employees in accumulating successful experiences through the establishment of mechanisms such as small-step trial and error and process incentives, so as to transform the entire chain of cognition into action.

(3) The research also found that the sense of supervisor support can positively regulate the influence path of innovation self-efficacy. Managers can prevent employees from perceiving innovation risks and stimulate their motivation for innovative actions through forms such as abundant resource support, creating a safe atmosphere, and providing effective and positive feedback. On the contrary, if there is a lack of supervisors who do not provide abundant resources or feedback is not positive, even if employees are full of confidence in innovation, they may not take action due to limited resources or fear of failure. Therefore, enterprises should incorporate the degree of innovation support into the core assessment dimensions for managers. Through systematic training, managers can transform from controllers to drivers, proactively providing resource guarantees and fault-tolerant space for the team, ensuring that employees' confidence in innovation is fully converted, and achieving actual results in promoting the development of the enterprise.

4.2. Management Implications

At the university level, general education should be reformed with logical analysis and problem exploration at its core, and students' transferable critical thinking abilities should be cultivated through classroom discussions and research projects. At the enterprise level, the critical thinking potential of candidates should be evaluated during the recruitment process. Break the mindset through training such as case studies and cross-departmental projects; And by establishing a trial-and-error platform, process incentive mechanisms and constructive feedback, continuous psychological empowerment is provided for employees. At the management level, managers need to transform into empowerers, proactively coordinate key resources such as time and budget, cultivate a fault-tolerant culture, and participate in the innovation process as collaborators. Enterprises should incorporate support for innovative behaviors into the performance assessment and promotion system for supervisors, and through institutional guidance, form an innovative ecosystem where resources are accessible, psychological safety is ensured, and feedback is timely.

4.3. Research Deficiencies and Prospects

In terms of the research sample, no distinction was made between enterprise types and employee levels, and the innovation demands in different scenarios vary, which limits the universality of the conclusion. In the future, stratified sampling methods can be adopted to select employees from multiple industries, enterprises of various scales, and different positions as samples. Through cross-scenario comparisons, the applicable boundaries of the research conclusions can be clarified.

In terms of the research framework, it only focuses on the path of “critical thinking - innovative self-efficacy - supervisor support - creative problem-solving”, without incorporating variables such as the organizational innovation atmosphere and employees’ risk preferences. The characterization of the influencing mechanism is still incomplete. Subsequently, multi-dimensional variables can be introduced to construct a more systematic theoretical model and explore the complex interaction relationships among variables to enhance the explanatory power of the theory.

In terms of research methods, static analysis using cross-sectional data is difficult to reflect the dynamic evolution of variable relationships. In the future, longitudinal tracking studies can be designed to collect panel data in stages. Experimental research methods can also be combined to verify the effectiveness of key measures by setting up intervention groups and control groups, providing sustainable improvement plans for practice.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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