

The Effect of Artificial Intelligence Application on Employee Job Performance: Dual Mediating Roles and Moderating Role

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Abstract

With the rapid penetration of artificial intelligence technology into the workplace, its effect on employee job performance has become a research focus in organizational behavior. However, existing studies have mostly focused on single-path effects and lack a systematic analysis of the dual mechanisms and boundary conditions of artificial intelligence. Based on the Job Demands-Resources model, self-determination theory, and job insecurity theory, this study constructs a moderated dual-mediation model. A questionnaire survey was conducted among 260 employees who use artificial intelligence tools in their daily work, and the data were empirically tested through regression analysis and structural equation modeling. The results show that artificial intelligence application has a significant positive direct effect on employee job performance; proactive learning behavior plays a positive mediating role, while job insecurity plays a negative mediating role; organizational support positively moderates the relationship between artificial intelligence application and proactive learning behavior, and negatively moderates the relationship between artificial intelligence application and job insecurity. This study provides an integrated framework for understanding the impact of artificial intelligence in organizations and offers practical guidance for enterprise digital transformation.

Keywords: *artificial intelligence application, employee job performance, proactive learning behavior, job insecurity, organizational support*

1. Introduction

1.1 Research Background

The widespread application of artificial intelligence technology is fundamentally reshaping the nature of work and organizational management practices. As AI tools increasingly become core assistants in daily work, they not only improve task efficiency but also generate profound changes in employees' psychological states and behavioral patterns. Existing research has confirmed that artificial intelligence can enhance organizational productivity, but its impact at the individual level remains controversial.

Some scholars regard artificial intelligence as an important job resource, arguing that it can reduce employees' cognitive burden and release them from repetitive tasks, thereby improving performance (Verma & Singh, 2022). However, other studies suggest that artificial intelligence application may increase employees' job insecurity and technology anxiety, which may in turn inhibit work engagement and performance (Lysyakov & Viswanathan, 2023). These conflicting findings indicate that the mechanism through which artificial intelligence affects employee performance is more complex than previously assumed.

Research on artificial intelligence application in organizational contexts has evolved through three stages: treating AI as a simple technical tool, exploring human-AI interaction, and regarding AI as an important contextual variable in the workplace (Tang et al., 2022). Early studies mainly focused on the technical characteristics of artificial intelligence and its direct effect on productivity, while overlooking employees' psychological and behavioral responses.

In recent years, scholars have begun to apply the Job Demands-Resources (JD-R) model to analyze the dual attributes of artificial intelligence. On the one hand, artificial intelligence can serve as a job resource by providing employees with information support and decision assistance. On the other hand, it may also become a job demand by creating pressure from technological substitution and cognitive burden (Liang et al., 2022). However, existing studies have not yet effectively integrated these two perspectives into a comprehensive theoretical framework.

Employee job performance refers to the overall performance of employees in completing work tasks and achieving organizational goals within a given period. Research on job performance has developed from a single outcome-oriented perspective into a multidimensional integrated framework that includes task performance, contextual performance, and adaptive performance (Han et al., 2007).

With the advent of the digital era, the connotation of job performance has continued to expand, and adaptability and learning ability have become important components of employee performance in the era of artificial intelligence. However, traditional performance research frameworks cannot fully explain changes in employee performance brought about by technological innovation, and further theoretical extension and empirical validation are therefore needed.

Existing research on the relationship between artificial intelligence application and employee performance shows a “dual-effect” pattern. From the resource-enabling perspective, artificial intelligence can improve employee performance by automating repetitive tasks, optimizing information processing, and providing decision support (Sheng et al., 2022). From the stressor perspective, artificial intelligence application may increase employees’ job insecurity and technology anxiety, leading to reduced work engagement and lower performance (Mu et al., 2023).

Although existing studies have begun to introduce mediating variables to explain this relationship, most of them adopt a single-path analytical framework and lack a systematic analysis of the interactions among different mechanisms. At the same time, contextual variables remain insufficiently examined, and how organizational factors influence the effectiveness of artificial intelligence application is still unclear.

1.2 Objectives

To address the above research gaps, this study aims to:

- 1) Examine the direct effect of artificial intelligence application on employee job performance.
- 2) Explore the dual mediating roles of proactive learning behavior and job insecurity.
- 3) Verify the moderating effect of organizational support on the above relationships.

This study not only enriches theoretical research on artificial intelligence in the field of organizational behavior but also provides practical reference for enterprises seeking to maximize the value of artificial intelligence application.

2. Theoretical Foundations and Research Hypotheses

2.1 Theoretical Foundations

The Job Demands-Resources (JD-R) model holds that all job-related factors can be classified into job demands and job resources. Job resources can promote work engagement and performance improvement, whereas excessive job demands may lead to burnout and performance decline. In the context of artificial intelligence application, AI has dual attributes: it is both a job resource that improves efficiency and a potential job demand that creates psychological pressure.

Self-determination theory states that individuals have three basic psychological needs: autonomy, competence, and relatedness. When these needs are satisfied, individuals develop intrinsic motivation and exhibit more proactive learning and innovative behaviors. Artificial intelligence application can satisfy employees’ need for competence by providing personalized learning support and timely feedback, thereby stimulating proactive learning behavior.

Job insecurity refers to employees’ subjective perception of uncertainty regarding job stability and career development. Technological innovation is an important source of job insecurity. The widespread application of artificial intelligence may lead to job replacement and skill obsolescence, causing employees to feel anxious about future career development.

Organizational support theory suggests that employees’ perception of organizational support influences their work attitudes and behaviors. A high level of organizational support can enhance employees’ sense of belonging and security, help them better cope with the challenges brought about by technological change, and maximize the positive effects of artificial intelligence application.

2.2 Research Hypotheses

Direct effect of artificial intelligence application on job performance: According to the JD-R model, artificial intelligence, as an important job resource, can reduce employees’ workload by automating repetitive tasks, improve information-processing efficiency, and provide intelligent decision support. These functions enable employees to devote more time and energy to high-value-added work, thereby improving overall job performance. Therefore, the following hypothesis is proposed:

H1: Artificial intelligence application has a significant positive effect on employee job performance.

Mediating role of proactive learning behavior: Based on self-determination theory, artificial intelligence application can provide employees with personalized learning resources and real-time

performance feedback, satisfy their need for competence, and stimulate intrinsic learning motivation. Employees with a high tendency toward proactive learning continuously update their knowledge and skills and improve their ability to adapt to technological change, thereby achieving better job performance. Therefore, the following hypotheses are proposed:

H2a: Artificial intelligence application has a significant positive effect on proactive learning behavior.

H2b: Proactive learning behavior has a significant positive effect on employee job performance.

H2c: Proactive learning behavior mediates the relationship between artificial intelligence application and employee job performance.

Mediating role of job insecurity: According to job insecurity theory, the widespread application of artificial intelligence may make employees worry about being replaced by technology, thereby increasing job insecurity. A high level of job insecurity consumes employees' psychological resources, reduces their work engagement and initiative, and ultimately has a negative impact on job performance. Therefore, the following hypotheses are proposed:

H3a: Artificial intelligence application has a significant positive effect on job insecurity.

H3b: Job insecurity has a significant negative effect on employee job performance.

H3c: Job insecurity mediates the relationship between artificial intelligence application and employee job performance.

Moderating role of organizational support: Organizational support theory indicates that a high level of organizational support can help employees better cope with the challenges brought about by technological change. On the one hand, organizations that provide sufficient training resources and career development support encourage employees to view artificial intelligence as an opportunity for self-improvement, thereby strengthening the positive relationship between artificial intelligence application and proactive learning behavior. On the other hand, transparent communication and reasonable career planning can reduce employees' uncertainty about the future, thereby weakening the positive relationship between artificial intelligence application and job insecurity. Therefore, the following hypotheses are proposed:

H4a: Organizational support moderates the relationship between artificial intelligence application and employee job performance.

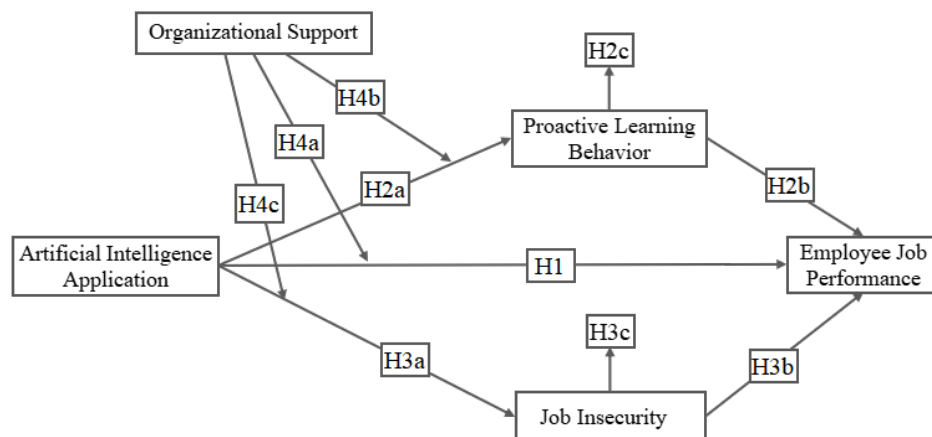
H4b: Organizational support positively moderates the relationship between artificial intelligence application and proactive learning behavior.

H4c: Organizational support negatively moderates the relationship between artificial intelligence application and job insecurity.

2.3 Theoretical Model

Based on the above theoretical analysis and research hypotheses, this study constructs the following theoretical model:

Figure 1 Theoretical Research Model



3. Materials and Methods

This study used a questionnaire survey for empirical research. All variables in the questionnaire were measured using mature scales that have been widely validated in previous studies and were appropriately modified according to the research context. All items were measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Table 1 Measurement Scales

Construct	Number of Items	Adapted Source
Artificial intelligence application	3	Tang et al. (2022)
Employee job performance	4	Chen et al. (2002); Farh and Cheng (1997)
Proactive learning behavior	5	Bezuijen et al. (2010)
Job insecurity	7	Sverke et al. (2002)
Organizational support	6	Eisenberger et al. (1986)

The three items measuring AI application were adapted from (Tang et al., 2022), who developed a scale to assess employees' usage of artificial intelligence in daily work tasks. The artificial intelligence application scale measures the frequency and depth of employees' use of AI tools in daily work. The employee job performance scale measures employees' self-evaluation of their work performance. The proactive learning behavior scale measures the extent to which employees proactively learn new knowledge and skills. The job insecurity scale measures employees' perceptions of uncertainty regarding job stability and career development. The organizational support scale measures employees' perceptions of organizational support and care.

The pilot survey results indicated that the overall questionnaire had good reliability and validity and was suitable for the formal survey. A total of 260 valid questionnaires were ultimately collected in the formal survey. In the sample, men accounted for 60.77% and women for 39.23%; 81.91% of respondents were aged between 21 and 35; 81.54% had a junior college degree or above; non-managerial employees accounted for 75.77% and managers for 24.23%; and the sample covered multiple industries, including the Internet, manufacturing, finance, and education.

4. Results and Discussion

4.1 Data Analysis

4.1.1 Reliability and Validity Tests

Cronbach's alpha coefficient was used to test scale reliability. As shown in Table 2, the Cronbach's alpha coefficients of all variables are greater than 0.8, indicating that the scales have good internal consistency.

Table 2 Reliability Test Results

Variable	Number of Items	Cronbach's Alpha
Artificial intelligence application	3	0.822
Employee job performance	4	0.852
Proactive learning behavior	5	0.859
Job insecurity	7	0.901
Organizational support	6	0.879

After the reliability test was passed, this study further used the KMO test and Bartlett's test of sphericity to analyze the structural validity of the scales. As shown in Table 3, the scales have good structural validity.

Table 3 KMO and Bartlett's Test of Sphericity Results

Test Item	Value
KMO Value	0.892
Approximate Chi-square of Bartlett's Test of Sphericity	3330.016
Degrees of Freedom (df)	300
Significance (Sig.)	0

4.1.2 Common Method Bias Test

Harman's single-factor test was used to examine common method bias. As shown in Table 4, the variance explained by the first unrotated factor is 25.95%, far below the critical value of 40%, indicating that this study does not suffer from serious common method bias.

Table 4 Harman's Single-Factor Test Results

Index	Value
Variance Explained by the First Unrotated Common Factor (%)	25.95
Criterion	< 40%

4.1.3 Descriptive Statistics

The descriptive statistics of the core variables are shown in Table 5. The mean value of artificial intelligence application is 3.164, indicating that employees' use of AI tools is at a moderately high level. The mean value of proactive learning behavior is 3.468, the highest among all variables, indicating that employees generally show a positive learning attitude in the era of artificial intelligence.

Table 5 Descriptive Statistics of Core Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
Artificial intelligence application	1	5	3.164	0.871
Employee job performance	1	5	3.274	0.875
Proactive learning behavior	1.4	5	3.468	0.858
Job insecurity	1	4.833	2.75	0.904
Organizational support	1.5	4.875	3.175	0.714

4.2 Hypothesis Testing

4.2.1 Main Effect Test

Hierarchical regression analysis was used to test the direct effect of artificial intelligence application on job performance. As shown in Table 6, after controlling for demographic variables, artificial intelligence application has a significant positive effect on employee job performance ($\beta = 0.257$, $p < 0.001$). Therefore, H1 is supported.

Table 6 Main Effect Test Results

Variable	Model 1: Control Variables Only	Model 2: Adding Artificial Intelligence Application
Constant	3.080*** (8.351)	2.174*** (5.205)
Gender	-0.070 (-0.611)	-0.043 (-0.389)
Age	0.174* (1.728)	0.163* (1.674)
Education Level	0.046 (0.639)	0.051 (0.730)
Work Tenure	-0.170 (-1.471)	-0.134 (-1.193)
Job Type	-0.017 (-0.174)	-0.031 (-0.328)
Firm Size	0.001 (0.017)	0.000 (0.003)
Region	0.036 (1.020)	0.034 (0.985)
Industry	0.004 (0.310)	0.003 (0.241)
Artificial intelligence application	—	0.257*** (4.193)
R ²	0.021	0.086
Adj.R ²	-0.01	0.053
F-value	0.688	2.606**

Note: The values in the table are unstandardized regression coefficients, and the values in parentheses are t-values;

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2.2 Mediation Effect Test

The actual effects of artificial intelligence application cannot be directly manifested, but exert their impacts indirectly through the dual influences of behavior and psychology. On the one hand, AI technology can improve employee job performance by motivating employees' proactive learning behavior, but it will also exert a certain inhibitory effect on employee work efficiency due to heightened perception of uncertainty. These two effects correspond to the distinct path characteristics of the positive mediating effect and the negative mediating effect respectively. This study attempts to identify the specific ways and underlying mechanisms by which artificial intelligence technology promotes employees' proactive learning behavior.

Then, based on the relationship between artificial intelligence application and proactive learning behavior, it further explores the predictive power of proactive learning tendency on individual job performance. Beyond the behavioral path, this paper further examines the psychological path, namely whether artificial intelligence application affects employee job performance by increasing employees' job insecurity.

Mediation effects were tested using stepwise regression and the Bootstrap method. The results are as follows:

Table 7 Regression Test Results for the Mediating Effect of Proactive Learning Behavior

Variable	Model 2: Performance (Total Effect)	Model 3: Proactive Learning Behavior	Model 4: Performance (Including Mediator)
Constant	2.174*** (5.205)	2.451*** (6.198)	0.875** (2.250)
Gender	-0.043 (-0.389)	-0.094 (-0.899)	0.007 (0.071)
Age	0.163* (1.674)	0.087 (0.943)	0.117 (1.383)
Education Level	0.051 (0.730)	0.014 (0.215)	0.043 (0.717)
Work Tenure	-0.134 (-1.193)	-0.112 (-1.048)	-0.075 (-0.767)
Job Type	-0.031 (-0.328)	0.053 (0.581)	-0.059 (-0.714)
Firm Size	0.000 (0.003)	-0.034 (-0.575)	0.018 (0.336)
Region	0.034 (0.985)	0.045 (1.393)	0.010 (0.328)
Industry	0.003 (0.241)	-0.011 (-0.834)	0.009 (0.760)
Artificial intelligence application	0.257*** (4.193)	0.338*** (5.823)	0.078 (1.377)
Proactive learning behavior	—	—	0.530*** (9.152)
R ²	0.086	0.147	0.316
Adj.R ²	0.053	0.116	0.288
F-value	2.606**	4.769***	11.498***

Note: The values in parentheses are t-values; *p < 0.10, **p < 0.05, ***p < 0.01.

Table 8 Regression Test Results for the Mediating Effect of Job Insecurity

Variable	Model 2: Performance (Total Effect)	Model 5: Job Insecurity	Model 6: Performance (Including Mediator)
Constant	2.174*** (5.205)	1.543*** (3.743)	2.993*** (8.175)
Gender	-0.043 (-0.389)	-0.021 (-0.190)	-0.054 (-0.573)
Age	0.163* (1.674)	-0.092 (-0.953)	0.115 (1.374)
Education Level	0.051 (0.730)	0.021 (0.305)	0.062 (1.043)
Work Tenure	-0.134 (-1.193)	0.113 (1.022)	-0.074 (-0.768)
Job Type	-0.031 (-0.328)	0.034 (0.363)	-0.013 (-0.162)
Firm Size	0.000 (0.003)	0.016 (0.261)	0.009 (0.164)
Region	0.034 (0.985)	-0.015 (-0.448)	0.026 (0.878)
Industry	0.003 (0.241)	0.010 (0.734)	0.008 (0.733)
Artificial intelligence application	0.257*** (4.193)	0.331*** (5.476)	0.433*** (7.824)
Job insecurity	—	—	-0.531*** (-9.718)
R ²	0.086	0.114	0.337
Adj.R ²	0.053	0.082	0.311
F-value	2.606**	3.570***	12.665***

Note: The values in parentheses are t-values; *p < 0.10, **p < 0.05, ***p < 0.01.

Table 9 Bootstrap Mediation Effect Test Results

Path	Coefficient	Standard Error	95% Confidence Interval
H2c	0.178	0.035	[0.116, 0.253]
H3c	-0.178	0.087	[-0.255, -0.108]

Artificial intelligence application has a significant positive effect on proactive learning behavior ($\beta = 0.338$, $p < 0.001$), and proactive learning behavior has a significant positive effect on job performance ($\beta = 0.530$, $p < 0.001$). After proactive learning behavior was included, the direct effect of artificial intelligence application on job performance became non-significant. The Bootstrap test shows an indirect effect of 0.178 (95% CI = [0.116, 0.253]), indicating that proactive learning behavior plays a full mediating role. Therefore, H2a, H2b, and H2c are all supported.

Artificial intelligence application has a significant positive effect on job insecurity ($\beta = 0.331$, $p < 0.001$), and job insecurity has a significant negative effect on job performance ($\beta = -0.531$, $p < 0.001$). The Bootstrap test shows an indirect effect of -0.178 (95% CI = $[-0.255, -0.108]$), indicating that job insecurity plays a partial mediating role. Therefore, H3a, H3b, and H3c are all supported.

4.2.3 Moderation Effect Test

The moderation effect test results are shown in Table 10. The interaction term between artificial intelligence application and organizational support has no significant effect on job performance ($\beta = -0.007$, $p > 0.05$); therefore, H4a is not supported. The interaction term has a significant positive effect on proactive learning behavior ($\beta = 0.218$, $p < 0.01$) and a significant negative effect on job insecurity ($\beta = -0.251$, $p < 0.001$). Therefore, H4b and H4c are supported.

Table 10 Test Results for the Moderating Effect of Organizational Support

Variable	Model 7: Performance	Model 8: Proactive Learning Behavior	Model 9: Job Insecurity
Constant	2.936*** (8.274)	3.498*** (10.480)	2.644*** (7.692)
Gender	-0.017 (-0.158)	-0.078 (-0.758)	-0.052 (-0.485)
Age	0.146 (1.507)	0.087 (0.957)	-0.083 (-0.887)
Education Level	0.034 (0.486)	-0.003 (-0.052)	0.050 (0.741)
Work Tenure	-0.106 (-0.952)	-0.113 (-1.075)	0.101 (0.937)
Job Type	-0.015 (-0.160)	0.085 (0.952)	-0.012 (-0.128)
Firm Size	0.001 (0.008)	-0.029 (-0.500)	0.010 (0.170)
Region	0.030 (0.868)	0.042 (1.306)	-0.009 (-0.274)
Industry	0.008 (0.598)	-0.010 (-0.816)	0.007 (0.540)
Artificial Intelligence Application (Centered)	0.252*** (4.137)	0.320*** (5.570)	0.355*** (6.014)
Organizational Support (Centered)	0.171*** (2.678)	0.049 (0.820)	-0.141** (-2.285)
Interaction Term: AI $\times$ Organizational Support	-0.007 (-0.098)	0.218*** (3.210)	-0.251*** (-3.578)
R ²	0.112	0.182	0.17
Adj.R ²	0.072	0.145	0.134
F-value	2.837***	5.005***	4.634***

Note: The values in parentheses are t-values; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2.4 Moderated Mediation Effect Test

Table 11 Moderated Mediation Effect Test Results at Different Levels of Organizational Support

Mediating Path	Organizational Support Level	Indirect Effect	Boot SE	95% Confidence Interval
H2c(PLB)	Low Level (-1SD)	0.072	0.025	[0.032, 0.128]
	Mean Level	0.17	0.031	[0.118, 0.238]
	High Level (+1SD)	0.268	0.046	[0.195, 0.356]
	Index of Moderated Mediation	0.098	0.029	[0.045, 0.156]
H3c(JI)	Low Level (-1SD)	-0.302	0.052	[-0.408, -0.208]
	Mean Level	-0.176	0.041	[-0.255, -0.108]
	High Level (+1SD)	-0.058	0.028	[-0.118, -0.012]
	Index of Moderated Mediation	0.124	0.037	[0.061, 0.198]

Note: PLB = proactive learning behavior; JI = job insecurity. Bootstrap samples = 5,000. CI = bias-corrected bootstrap confidence interval.

Table 11 presents the conditional indirect effects at different levels of organizational support, along with the index of moderated mediation for each pathway. As organizational support increases, the positive mediating effect of proactive learning behavior gradually strengthens (from 0.072 to 0.268), whereas the negative mediating effect of job insecurity gradually weakens (from -0.302 to -0.058). To formally test whether these differences are statistically significant, we computed the index of moderated mediation using PROCESS Model 7 with 5,000 bootstrap resamples. For the proactive learning behavior pathway, the index is 0.098 (95% CI $[0.045, 0.156]$), confirming that the indirect effect is significantly stronger when organizational support is higher. For the job insecurity pathway, the index is 0.124 (95% CI $[0.061, 0.198]$), indicating that the negative indirect effect is significantly weaker under high organizational support.

The index of moderated mediation quantifies the linear relationship between the moderator (organizational support) and the indirect effect. A positive index for the proactive learning pathway indicates that as organizational support increases by one unit, the indirect effect via proactive learning increases by 0.098 units. For the job insecurity pathway, the positive index (0.124) indicates that higher organizational support reduces the magnitude of the negative indirect effect (i.e., makes it less negative). These results confirm that organizational support significantly moderates both mediation pathways, consistent with H4b and H4c.

4.2.5 Heterogeneity Test

To explore the differentiated effects of artificial intelligence application on the job performance of different employee groups, this study conducted grouped regression analyses based on gender, age, and job position. The detailed results are shown in Table 12.

Table 12 Heterogeneity Test Results

Group	Sample Size N	Regression Coefficient of Artificial Intelligence Application	t-value	p-value	R ²
Male Employees	158	0.35	4.887	0	0.156
Female Employees	102	0.093	0.796	0.428	0.093
Younger Group (≤ 30 years)	175	0.228	2.873	0.005	0.066
Older Group (≥ 31 years)	85	0.3	2.813	0.006	0.138
Non-managerial Employees	197	0.216	3.038	0.003	0.072
Managers	63	0.342	2.517	0.015	0.171

4.2.6 Structural Equation Modeling Analysis

Structural equation modeling (SEM) was used to further verify the robustness of the research conclusions. The model fit indices are shown in Table 13, and the path coefficient test results are shown in Table 14.

Table 13 Structural Equation Model Fit Indices

Index	χ^2/df	RMSEA	CFI	TLI	GFI	NFI
Recommended Criterion	<3	<0.08	>0.90	>0.90	>0.90	>0.90
Results of This Study	2.267	0.069	0.927	0.918	0.896	0.909

The results show that the overall fit of the structural model is good. The χ^2/df value is 2.267, which is less than 3; the RMSEA value is 0.069, which is less than 0.08; CFI, TLI and NFI all exceed 0.90, and GFI is close to the recommended threshold of 0.90, indicating that the structural model has a high degree of consistency with the data and the model specification is reasonably valid.

Table 14 Structural Equation Model Path Coefficient Test Results

Path	Standardized Coefficient	Standard Error	t-value
H1	0.241	0.072	3.347
H2a	0.512	0.064	7.984
H2b	0.386	0.059	6.542
H3a	0.447	0.068	6.573
H3b	-0.318	0.061	-5.213

The results show that all path coefficients are statistically significant. Artificial intelligence application has a significant positive effect on employee job performance ($\beta=0.241$, $p<0.001$), which revalidates the main effect hypothesis H1. Artificial intelligence application exerts a significant positive impact on proactive learning behavior ($\beta=0.512$, $p<0.001$), and proactive learning behavior in turn has a significant positive effect on job performance ($\beta=0.386$, $p<0.001$), indicating that proactive learning behavior plays an important mediating role between the two, which is consistent with the series of hypotheses H2. Artificial intelligence application also has a significant positive effect on job insecurity ($\beta=0.447$, $p<0.001$), whereas job insecurity has a significant negative effect on employee job performance ($\beta=-0.318$, $p<0.001$), suggesting that artificial intelligence application exerts an inhibitory effect on job performance by heightening employees' job insecurity, which is consistent with the series of hypotheses H3. The model fit indices are satisfactory. All path coefficients are consistent with the regression analysis results, indicating that the research conclusions are robust.

4.3 Summary of Hypothesis Testing Results

Based on the stepwise regression analyses, Bootstrap mediation tests, moderated regression analyses, and heterogeneity tests conducted in the preceding sections, this section provides a consolidated summary of all hypothesis testing results. Overall, nine of the ten proposed hypotheses received empirical support. Specifically, AI application was found to have a significant positive direct effect on employee job performance (H1 supported). Both mediating paths were confirmed: proactive learning behavior served as a positive mediator (H2a, H2b, H2c supported), while job insecurity functioned as a negative mediator (H3a, H3b, H3c supported). Regarding the moderating role of organizational support, the results showed that it did not significantly moderate the direct relationship between AI application and job performance (H4a not supported); however, it positively moderated the relationship between AI application and proactive learning behavior (H4b supported) and negatively moderated the relationship between AI application and job insecurity (H4c supported). The final summary of all hypothesis test results is presented in Table 15.

Table 15 Summary of Hypothesis Testing Results

Hypothesis No.	Hypothesis Content	Test Result
H1	Artificial intelligence application has a positive effect on employee job performance	Supported
H2a	Artificial intelligence application has a positive effect on employees' proactive learning behavior	Supported
H2b	Employee proactive learning behavior has a positive effect on employee job performance	Supported
H2c	Proactive learning behavior mediates the relationship between artificial intelligence application and employee job performance	Supported
H3a	Artificial intelligence application has a positive effect on employees' job insecurity	Supported
H3b	Employee job insecurity has a negative effect on employee job performance	Supported
H3c	Job insecurity mediates the relationship between artificial intelligence application and employee job performance	Supported
H4a	Organizational support positively moderates the relationship between artificial intelligence application and employee job performance	Not Supported
H4b	Organizational support positively moderates the relationship between artificial intelligence application and proactive learning behavior	Supported
H4c	Organizational support negatively moderates the relationship between artificial intelligence application and job insecurity	Supported

5. Conclusion

5.1 Main Conclusions

Through empirical analysis, this study systematically examined the mechanism by which artificial intelligence application affects employee job performance. The main conclusions are artificial intelligence application has a significant positive direct effect on employee job performance, indicating that artificial intelligence has become an important driver of individual productivity improvement in the workplace. Artificial intelligence application affects employee job performance through dual pathways: on the one hand, it promotes performance improvement by stimulating employees' proactive learning behavior; on the other hand, it inhibits performance by increasing employees' job insecurity. Organizational support plays an important moderating role by strengthening the positive relationship between artificial intelligence application and proactive learning behavior and weakening the positive relationship between artificial intelligence application and job insecurity. The effect of artificial intelligence application on job performance shows group heterogeneity, with more significant effects among male employees, older employees, and managers.

5.2 Theoretical Contributions

The theoretical contributions of this study are mainly reflected in the following aspects: This study overcomes the limitation of single-path analysis in existing research by constructing a dual-mediation model involving proactive learning behavior and job insecurity, thereby systematically revealing the dual mechanisms underlying the positive and negative effects of artificial intelligence. By introducing organizational support as a moderating variable, this study clarifies the boundary conditions of artificial intelligence effectiveness and enriches research on contextual factors in the field of artificial intelligence application. By integrating multiple theoretical perspectives, including the JD-R model, self-determination

theory, and job insecurity theory, this study provides a comprehensive analytical framework for understanding the impact of artificial intelligence on employees.

5.3 Practical Implications

The findings have important practical implications for enterprise digital transformation: Enterprises should actively promote the deep application of artificial intelligence technology, fully leverage its resource-enabling effect, and help employees improve work efficiency. Employee proactive learning capability should be emphasized, a sound training system should be established, and employees should be guided to view artificial intelligence as a tool for self-improvement. Employee mental health should be given attention, communication and transparency should be strengthened, and job insecurity caused by technological change should be reduced. A highly supportive organizational culture should be built to provide employees with sufficient resources and career development support, thereby maximizing the positive effects of artificial intelligence application. Differentiated management strategies should be implemented for different employee groups to ensure that all employees can benefit from artificial intelligence application.

5.4 Research Limitations and Future Prospects

This study has several limitations that need to be further addressed in future research: A cross-sectional research design was adopted, which cannot fully reveal the dynamic causal relationships among variables. Future research may use a longitudinal tracking design to explore the long-term impact of artificial intelligence application. All data were obtained from employee self-reports, which may involve common method bias. Future research may collect multi-source data, such as supervisor evaluations and objective performance indicators, to improve the accuracy of the results. The sample size is relatively small and mainly concentrated in economically developed regions. Future research may expand the sample size and geographical coverage to enhance the generalizability of the conclusions. The measurement of AI application in prior research has largely focused on broad usage frequency and overall dependence, without distinguishing across different types of AI tools. Future research may adopt more fine-grained measures to capture the heterogeneous effects of various AI applications, and specifically examine the distinct impacts of generative, analytical, and automated AI on employee performance.

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