The Impact of Job Design on Career Development Level in the Context of Human-Computer Interaction: The Mediating Effect of HCI Usability

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Abstract. In the era of deepening human-machine collaboration, job design is crucial for optimizing human resource management systems. Based on the context of Human-Computer Interaction (HCI), this study investigates the impact mechanism of job design on employees' career development, introducing HCI usability as a mediating variable. Through a questionnaire survey resulting in 393 valid responses, factor analysis was used to validate the measurement model, followed by regression and mediation effect analysis. The findings indicate that: (1) Under HCI conditions, job autonomy, task identity, and task significance within job design significantly and positively affect career development level. (2) HCI usability plays a significant mediating role in the impact of job design on career development.

Keywords: Human-Computer Interaction(HCI); Job Design; Career Development; HCI Usability; Mediating Effect

1 Introduction

1.1 Job Design in Human Resource Management

Job design, as a foundational concept in management, has undergone continuous theoretical evolution. With the proliferation of computers and the internet, the nature of work has changed dramatically, bringing renewed focus to job design theory[1].

1.2 The Impact of Job Design on Career Development

Career refers to an individual's professional life experience, involving roles, values, and attitudes—a dynamic and developmental process[2]. Job design, reflecting an organization-led planning path, influencescareer development by optimizing work autonomy, task identity, and task significance, thereby enhancing employees' career cognition and self-cognition[3].

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1.3 Usability in Human-Computer Interaction

In the era of the Internet of Everything, human-computer collaboration has become a common work scenario. HCI studies the interaction between systems and users, directly affecting employees' work content and task execution. Usability is a core indicator measuring whether an interactive system allows users to achieve goals efficiently, accurately, and satisfactorily[4,5].

2 Theoretical Analysis and Research Hypotheses

2.1 The Impact of Job Design on Career Development

From previous scholars' research, it can be observed that multiple dimensions of job design have a significant positive impact on the level of career resource management[6,7]. In the context of human-computer interaction, although people's job content, job form, and communication methods will undergo significant changes, the overall structure of work remains similar to before[8]. Based on this, we propose the following hypothesis:

H1: Job design under HCI conditions is conducive to improving career development level.

H1a: HCI job autonomy is conducive to improving career development level.

H1b: HCI skill variety is conducive to improving career development level.

H1c: HCI task identity is conducive to improving career development level.

H1d: HCI task significance is conducive to improving career development level.

H1e: HCI work feedback is conducive to improving career development level.

2.2 The Mediating Role of HCI Usability

Research suggests HCI drives work design toward higher-value dimensions. For example, AI assistants influence job reshaping through factors like self-efficacy. Therefore, we hypothesize:

H2: Job design under HCI conditions improvescareer development levels through HCI usability.

3 Research Method

3.1 Questionnaire and Sample

The questionnaire, based on mature scales adapted for the HCI context, collected demographic data and measured HCI job design, HCI usability, and career development level. 393 valid responses were collected. All scales' Cronbach's α exceeded 0.9, indicating excellent reliability.

3.2 Measurement

This study used Confirmatory Factor Analysis (CFA) to validate the stable factor structures:

HCI Job Design: Five factors: HCI Task Significance, HCI Job Autonomy, HCI Skill Variety, HCI Task Identity, HCI Work Feedback.

HCI Usability: Seven factors: Machine Empowerment, Collaboration Convenience, Control Accuracy, Operation Learnability, Machine Fault Tolerance, Task Adaptability, Interaction Limitations.

Career Development Level: Three factors: Occupational Cognition, Self-Cognition, Career Vision.

3.2.1 Job Design in the Context of Human-Computer Interaction.

The results of the Confirmatory Factor Analysis (CFA) for the five-factor structure of job design in the HCI context ("HCI Task Significance", "HCI Job Autonomy", "HCI Skill Variety", "HCI Task Identity", "HCI Work Feedback") are shown in Table 1 below.

Table 1. Results of Competitive Model Comparison for Factors (N=393)

Model	χ^2	χ^2/Df	RMSEA	SRMR	GFI	CFI	IFI	TLI	NFI
One-factor	1503.825	7.195	0.126	0.073	0.691	0.776	0.777	0.753	0.750
Two-factor	1241.313	5.968	0.113	0.066	0.729	0.821	0.822	0.802	0.794
Three-factor	1114.582	5.411	0.106	0.063	0.740	0.843	0.844	0.824	0.815
Four-factor	895.769	4.413	0.093	0.056	0.781	0.880	0.881	0.864	0.851
Five-factor	374.312	1.881	0.047	0.033	0.921	0.970	0.970	0.965	0.938

It is evident that job design in the HCI context encompasses these five factors, forming a stable five-factor structure with good construct validity and construct reliability.

3.2.2 Human-Computer Interaction Usability.

The results of the Confirmatory Factor Analysis (CFA) for the seven-factor structure of HCI usability ("Machine Empowerment", "Collaboration Convenience", "Control Accuracy", "Operation Learnability", "Machine Fault Tolerance", "Task Adaptability", "Interaction Limitations") are shown in Table 2 below.

Table 2. Results of Competitive Model Comparison for Factors (N=393)

Model	χ^2	χ^2/Df	RMSEA	SRMR	GFI	CFI	IFI	TLI
One-factor	2600.202	4.134	0.089	0.062	0.684	0.787	0.788	0.774
Two-factor	2537.973	4.041	0.088	0.062	0.688	0.794	0.794	0.781
Three-factor	2318.820	3.704	0.083	0.060	0.712	0.817	0.818	0.805
Four-factor	2210.697	3.548	0.081	0.058	0.722	0.828	0.829	0.817
Five-factor	2089.067	3.375	0.078	0.057	0.734	0.841	0.842	0.829
Six-factor	1846.081	3.007	0.072	0.056	0.764	0.867	0.868	0.856
Seven-factor	1187.394	2.047	0.052	0.044	0.855	0.934	0.935	0.925

It is evident that HCI usability context encompasses these seven factors, forming a stable seven-factor structure with good construct validity and structural reliability.

3.2.3 Career Management Level.

The results of the Confirmatory Factor Analysis (CFA) for the three-factor structure of the impact of HCI on career management ("Occupational Cognition", "Self-Cognition", "Career Vision") are shown in Table 3 below.

Table 3. Results of Competitive Model Comparison for Factors (N=393)

Model	χ^2	χ^2/Df	RMSEA	SRMR	GFI	CFI	IFI	TLI
One-factor	916.051	7.698	0.131	0.098	0.707	0.744	0.745	0.707
Two-factor	603.892	5.118	0.102	0.082	0.813	0.844	0.845	0.820
Three-factor	343.280	3.038	0.072	0.069	0.902	0.926	0.926	0.911

It is evident that the impact of HCI on career management context encompasses these three factors, forming a stable three-factor structure with good construct validity and structural reliability.

4 Analysis Results

4.1 The Impact of HCI Work Design On career Development

In the process of linear regression of career development, the first step is to introduce the regression equation with the demographic variables as the control variables, and the second step is to introduce the regression equation with the five dimensions of job design as the independent variables, and get the regression coefficients of each dimension and the change values of F and R2.

Table 4. Regression Results of Career Development Levels

	Occupational cognition (β)		Autognosis (β)		Career expectation (β)	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Sex	-.213	-.120	-.116	-.017	-.051	.036
Age	.280	.161	.275	.177	.224	.135
Educational status	-.135	-.097	.052	.096	-.040	.003
Nature of the organization	.053	.017	-.035	-.060	.023	.003
Current occupation duration	-.155	-.099	-.160	-.099	-.134	-.079
Unit size	-.005	-.031	.060	.050	-.003	-.008
Position	.001	.018	-.034	-.026	.009	.009
Autonomy of HCI		0.352***		0.255***		0.273***
Diversity of		-0.125		0.072		0.137

HCI skills						
Holistic HCI task		0.171**		0.076		0.052
The Im-portance of HCI Tasks		0.282***		0.169**		0.106
HCI work feedback		-0.084		0.195**		0.119
ΔF	10.231***	38.745***	4.375***	57.709***	2.706**	40.088***
ΔR2	0.157**	0.285***	0.074***	0400***	0.047	0.329

The regression analysis results presented in Table 4 indicate that:

• Career Cognition: HCI Work Autonomy (β=0.352, p<0.001), HCI Task Identity (β=0.171, p<0.01), and HCI Task Significance (β=0.282, p<0.001) had significant positive effects. HCI Skill Variety and HCI Work Feedback were not significant.

• Self-Cognition: HCI Work Autonomy (β=0.255, p<0.001), HCI Task Significance (β=0.169, p<0.01), and HCI Work Feedback (β=0.195, p<0.01) had significant positive effects.

• Career Vision: Only HCI Work Autonomy (β=0.273, p<0.001) had a significant positive effect.

• Conclusion: H1 is partially supported; H1a supported; H1b not supported; H1c, H1d, H1e partially supported.

4.2 The Mediating Effect of HCI Usability

Table 5 presents the results obtained from analyzing the mediating effect of the usability of human-computer interaction systems on the impact of job design on career development.

Table 5. Analysis of the Mediating Effect of HCI System Usability

	Step 1		Step 2		Step 3	
	Career development (Y)		Usability of HCI system (M)		Career Development (Y)	
Sex	-.174	-.067	-.192	-.079	-.174	-.033
Age	.318	.204	.253	.133	.318	.147
Educational status	-.067	-.026	-.063	-.019	-.067	-.017
Nature of the organization	.023	.006	.126	.108	.023	-.041
Current occupation duration	-.182	-.118	-.140	-.072	-.182	-.087
Unit size	.018	.011	-.006	-.013	.018	.017
Position	-.009	-.005	-.011	-.006	-.009	-.002
Usability of HCI system (M)						0.432***

Job Design (X)		0.673***		0.714***		0.364***
ΔF	8.035***	365.548***	7.694***	462.509***	8.035***	256.853***
ΔR^2	0.127	0.426	0.123	0.479	0.127	0.500

Regression analysis showed that job design (X) significantly predicted both career development (Y) (β=0.673, p<0.001) and HCI usability (M) (β=0.714, p<0.001). When HCI usability (M) was added to the model, the effect of job design on career development decreased but remained significant (β=0.364, p<0.001), indicating that HCI usability plays a partial mediating role. H2 is supported.

5 Conclusion and Discussion

5.1 Theoretical Contributions

This study, situated within the context of human-computer collaboration, reveals the differential impact mechanisms of job design on career development. It is the first to introduce HCI usability as a mediating variable, thereby expanding the application boundaries of traditional career development theory. The findings confirm that within HCI job design, work autonomy, task identity, and task significance significantly and positively affect career development levels, whereas the effects of skill variety and work feedback are not fully evident. This suggests that in human-computer collaboration scenarios, employees' career development relies more on systematic task structures, meaningful work design, and autonomous decision-making power.

5.2 Practical Implications

Based on the findings, this study offers the following concrete recommendations for organizational management and HCI system design. First, organizations should optimize job design for human-computer collaboration. This can be achieved by enhancing HCI job autonomy through granting employees adjustable parameters or decision-making authority within systems and workflows; improving HCI task identity by integrating fragmented operational tasks into coherent modules with clear objectives; and strengthening the perception of HCI task significance by clearly communicating how employees' HCI-mediated work creates value. Second, technology departments must focus on enhancing the usability of human-computer systems. During system development and iteration, regular usability testing should be conducted, prioritizing core dimensions such as Machine Empowerment, Collaboration Convenience, and Control Accuracy. Establishing feedback channels to collect employees' qualitative input on system "pain points" can directly inform optimizations. Finally, it is recommended to develop integrated intervention programs that synchronize work (re)design with HCI system upgrades. For instance, role-reshaping training tailored to a new platform should accompany its introduction. This approach combines "technology implementation" with "organizational empowerment" to maximize the positive impact on employee career development.

5.3 Research Limitations and Future Directions

This study has several limitations that point to directions for future research. First, the offline sample was primarily drawn from enterprises in the Sichuan-Chongqing region, which may limit the generalizability of the conclusions. Future studies could expand the sample scope to include data from diverse geographical locations and a wider range of industries to enhance the robustness of the model. Second, this study relied solely on quantitative methods. Future research could incorporate qualitative methods such as interviews or focus groups to gain deeper insights into employees' subjective experiences and the dynamic mechanisms of HCI job design. Third, while the overall mediating role of HCI usability was confirmed, a thorough examination of its specific dimensions was not conducted. Future work should perform a granular analysis of the sub-dimensions to identify the most critical elements[9]. Furthermore, the cross-sectional data limits causal inference. Future research should consider longitudinal designs to track the same employees over time, assessing the long-term effects of job design and system changes on career development. Finally, exploring potential moderating variables, such as types of human-computer collaboration or individual differences, could help clarify boundary conditions.

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