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Training Investments, Professional Competency, and Talent Development Effectiveness: Evidence from Cross-border E-commerce Digital Marketing between China and Uzbekistan

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Abstract
The rapid expansion of cross-border e-commerce under the Belt and Road Initiative has exposed a critical gap in the systematic development of digital marketing talent between China and Uzbekistan, particularly regarding the alignment of educational curricula, enterprise training, and government policy support. Grounded in Human Capital Theory, this study examines how University Curriculum Alignment (UCA), Enterprise-Based Practical Training Intensity (EBPTI), and Government Talent Policy Support (GTPS) influence Digital Marketing Professional Competency (DMPC) and Cross-border E-commerce Talent Development Effectiveness (CETDE). A cross-sectional survey was conducted with 400 respondents, including final-year students, recent graduates, and junior employees from universities and enterprises in Guangdong Province, China, and partner institutions in Uzbekistan. Data were analyzed using Smart-PLS 4.0 through structural equation modeling (PLS-SEM) to test both direct and mediating relationships. Results indicate that UCA significantly enhances DMPC (H1: $\beta = -0.505$, $t = 6.037$, $p < 0.001$) and CETDE (H5: $\beta = 0.363$, $t = 4.901$, $p < 0.001$), while GTPS positively influences DMPC (H3: $\beta = -0.311$, $t = 4.230$, $p < 0.001$) and CETDE (H7: $\beta = 0.174$, $t = 3.259$, $p = 0.001$). DMPC partially mediates the effects of UCA (H8: $\beta = 0.155$, $t = 3.250$, $p = 0.001$) and GTPS (H10: $\beta = 0.096$, $t = 3.144$, $p = 0.002$) on CETDE, whereas EBPTI exhibits non-significant direct and indirect effects, highlighting its context-dependent impact. These findings demonstrate that formal educational alignment and institutional policy support are the primary drivers of competency formation and effective talent development in cross-border digital marketing, while enterprise-based training requires stronger integration. The study contributes to both theory and practice by extending Human Capital Theory to cross-border e-commerce contexts and providing evidence-based insights for curriculum design, policy formulation, and collaborative training strategies to strengthen digital talent pipelines along the Belt and Road corridor.

Keywords: Human Capital Theory, Cross-border E-commerce, Digital Marketing Competency, Talent Development Effectiveness, University–Enterprise Collaboration, Government Policy Support, Structural Equation Modeling, China–Uzbekistan

1.0 Introduction

In the context of the Belt and Road Initiative, cross-border e-commerce has become a strategic engine for promoting digital trade integration and high-quality export growth between China and Central Asian countries, particularly Uzbekistan. In recent years, China has elevated cross-border e-commerce to a national development priority to support industrial upgrading, international market diversification, and digital economic transformation (L. Yang et al., 2024). Guangdong Province, as China's largest cross-border e-commerce hub, concentrates leading digital platforms, export-oriented manufacturing clusters, and international logistics infrastructure, making it a critical base for cultivating cross-border e-commerce digital marketing talents (Zhang, 2025). At the same time, Uzbekistan has been identified as a key partner under the Digital Silk Road, with rapidly growing demand for digital trade professionals but a limited domestic supply of internationally competent talents (Kleiner, 2026). The cultivation of cross-border e-commerce digital marketing talents therefore represents not only an educational issue but also a strategic national concern linked to regional competitiveness and sustainable economic cooperation.

Despite strong policy support and rapid industrial expansion, structural challenges persist in aligning higher education systems, enterprise training mechanisms, and government talent policies with the evolving skill demands of the cross-border e-commerce industry. Recent empirical evidence suggests that many university curricula remain insufficiently synchronized with industry practice in areas such as platform operation, data-driven marketing, and multilingual content production (Aithal & Maiya, 2023). At the enterprise level, training programs are often fragmented, short-term oriented, and weakly integrated with formal education pathways (Farran & Nunez, 2025). Although government talent policies emphasize international talent cultivation and digital skill upgrading, their coordination across universities and enterprises remains uneven across regions (Z. Shan & Wang, 2024). These systemic mismatches constrain the efficiency of transforming training investments into effective professional competencies.

Within the cross-border e-commerce digital marketing industry, enterprises increasingly report a shortage of professionals who possess integrated competencies combining technical platform operation, cross-cultural communication, data analytics, and international marketing strategy (Xu et al., 2025). In Guangdong Province, although the number of e-commerce graduates continues to grow, employers frequently identify gaps in job readiness, applied problem-solving ability, and adaptability to international market environments (Kovács & Keresztes, 2022). In the China–Uzbekistan corridor, firms face additional challenges related to language barriers, regulatory heterogeneity, and localized consumer behavior, which further intensify the demand for highly specialized digital marketing talents (Okonkwo et al., 2023). These industry-level problems indicate that the current training path may be insufficient to convert educational and training inputs into sustainable development outcomes.

Although prior studies have examined university–enterprise collaboration, vocational training effectiveness, and government talent policies in isolation, several critical research gaps remain. First, limited integrative evidence exists on how university curriculum alignment, enterprise-based practical training, and government talent policy support jointly influence professional competency and talent development effectiveness within a unified Human Capital Theory framework (Li & Lam, 2025). Second, empirical research focusing specifically on cross-border e-commerce digital marketing between China and Central Asia remains scarce, despite the strategic importance of this corridor under the Belt and Road Initiative (Ebabu et al., 2025). Third, few studies have systematically examined the mediating role of professional competency in transforming training investments into development effectiveness. Accordingly, the main objective of this study is to examine the relationships between training investments, professional competency, and talent development effectiveness in cross-border e-commerce digital marketing between China and Uzbekistan. The selection of final-year students, recent graduates, and junior employees in Guangdong Province and partner institutions in Uzbekistan directly addresses both the population gap and the geographical gap by capturing the human capital accumulation process from training input to development outcome within a strategically critical region.

This study offers several novel contributions. Methodologically, it develops and tests an integrated mediation model grounded in Human Capital Theory using structural equation modeling to clarify the mechanisms through which training investments are transformed into development effectiveness. Empirically, it provides one of the first large-sample, cross-national analyses of cross-border e-commerce digital marketing talent

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cultivation between China and Uzbekistan. Practically, the findings generate actionable evidence for designing a tripartite collaborative training model involving universities, enterprises, and government agencies. The remainder of this paper is organized as follows: the next section reviews the theoretical foundations and develops the hypotheses, followed by the research methodology and data collection procedures, the presentation of empirical results, a discussion of theoretical and practical implications, and concluding remarks with policy recommendations and future research directions.

Research Problem / Problem Statement

The rapid expansion of cross-border e-commerce has transformed global trade dynamics, particularly for countries engaged in the Belt and Road Initiative (BRI). China's cross-border e-commerce ecosystem has scaled substantially, driven by digital platform proliferation, logistics integration, and policy support (Qi et al., 2024). Guangdong Province, as one of China's most dynamic economic regions, has emerged as a pivotal hub for digital trade and international marketing activities. Despite this growth, academic and industrial observers consistently highlight a disconnect between the **supply of talent and the evolving demands of the cross-border e-commerce digital marketing industry** (Yang, 2024). This mismatch is reflected in university curricula that are slow to adapt to practical industry needs, enterprise training programs that lack systematic integration with formal education, and government talent initiatives that often operate in siloes rather than in synergistic collaboration (David, 2023). In parallel, Uzbekistan's digital trade sector, while experiencing accelerated demand for cross-border e-commerce professionals, continues to face structural limitations in digital skill formation and international marketing competencies (Ospanova et al., 2025). These challenges indicate the persistence of a significant **talent development problem**: the inability of existing training pathways to effectively produce individuals with both the technical and strategic competencies required for successful cross-border digital marketing.

While prior scholarship has documented components of this challenge—such as gaps in curriculum alignment (P et al., 2022), shortfalls in enterprise training integration (Al-Gindy et al., 2022) and uneven talent policy coordination (Shen & Li, 2022), the literature remains fragmented. Most existing studies examine these elements in isolation or focus on single national contexts (e.g., China alone or Uzbekistan alone), neglecting the **interdependent, cross-national nature** of talent development in the BRI context (Du, 2025). In particular, there is a conspicuous absence of integrative empirical research that synthesizes **university curriculum alignment**, **enterprise-based practical training intensity**, and **government talent policy support** into a **unified explanatory model** capable of accounting for how these training investments contribute to the development of professional competencies and, ultimately, to **talent development effectiveness** in cross-border e-commerce digital marketing.

Moreover, though Human Capital Theory provides a robust framework for understanding the relationship between training investments and performance outcomes, it has not been applied systematically to analyze **mediating mechanisms**—specifically, how **professional competency formation** serves as the critical conduit through which training investments translate into effective talent outcomes in this domain (Moges et al., 2025). Consequently, the extant literature **fails to illuminate the causal pathways** connecting training inputs, competency accumulation, and employability outcomes in an empirically rigorous manner, particularly in the **China–Uzbekistan cross-border e-commerce context**.

This study directly addresses these gaps by proposing and empirically testing an integrated model grounded in Human Capital Theory that explicates how university curriculum alignment, enterprise-based practical training, and government talent policy support jointly influence the development of digital marketing professional competency and, in turn, the effectiveness of talent development. By drawing a **comparative sample from Guangdong Province, China—a global cross-border e-commerce hub—and partner institutions and enterprises in Uzbekistan**, this research addresses both **population and geographical gaps** in the literature. It also captures the human capital accumulation process at the micro level—from training investment to competency formation to talent effectiveness—within a **cross-national Belt and Road collaborative framework** that has not been systematically investigated. Through this approach, the study not only fills a critical empirical void but also generates actionable insights for policymakers, educational institutions, and industry stakeholders seeking to strengthen collaborative talent cultivation pathways that are aligned with global digital trade demands.

2.0 Literature Review

Human Capital Theory provides the central theoretical lens for examining how training investments are transformed into professional competency and, ultimately, into effective talent development outcomes. Originating from the seminal work of Schultz (1961) and later formalized by (Becker, 1993). Human Capital Theory conceptualizes education, training, and policy support as productive investments that enhance individuals' skills, productivity, and employability. Contemporary extensions of the theory emphasize that human capital accumulation is not merely a function of formal education but arises from the **joint contribution of universities, enterprises, and institutional environments** (Mamanazarov et al., 2025). In the context of cross-border e-commerce, this tripartite structure is particularly salient because digital marketing competencies require the integration of academic knowledge, workplace learning, and regulatory facilitation (Yao et al., 2024). For China, especially Guangdong Province, government-led digital economy strategies and Belt and Road talent policies explicitly frame human capital development as a national instrument for enhancing global competitiveness in digital trade (Shan et al., 2025). Similarly, Uzbekistan's digital transformation agenda highlights the strategic importance of cultivating internationally competent e-commerce professionals to support trade integration with China (Kurpayanidi, 2025). Within this policy and industrial environment, final-year students, recent graduates, and junior employees represent a critical population segment in which human capital investments are actively converted into market-relevant competencies. Human Capital Theory therefore provides a coherent explanatory framework linking **training inputs (university curricula, enterprise training, government support)** to **competency accumulation** and **talent development effectiveness** within the China–Uzbekistan cross-border e-commerce corridor.

Building on this theoretical foundation, the dependent construct of **cross-border e-commerce talent development effectiveness** represents the ultimate outcome of human capital investment, capturing employability, job readiness, and applied skill acquisition. Recent studies suggest that talent development effectiveness in digital trade sectors is strongly contingent upon the alignment between training systems and dynamic industry skill requirements (Jooss et al., 2024). Empirical evidence from China indicates that misalignment between curriculum design and platform-based marketing practices significantly weakens graduate employability in cross-border e-commerce roles (Su & Zhang, 2025). Similarly, enterprise-based training has been shown to exert a direct influence on early-career performance and career sustainability by strengthening task-specific human capital (Khurshid et al., 2024). At the institutional level, government talent policy support shapes both access to training opportunities and the institutional quality of training systems, thereby influencing long-term development effectiveness (Bernadette Bristol-Alagbariya et al., 2024). However, the literature increasingly suggests that the effects of these training investments on development outcomes are **not purely direct** but operate through the formation of **professional competency** as a mediating mechanism (J Sitepu et al., 2022).

Accordingly, this study conceptualizes **digital marketing professional competency** as the central human capital accumulation mechanism linking training investments to talent development effectiveness. Prior research demonstrates that curriculum alignment enhances competency formation by improving the relevance and transferability of academic knowledge to workplace tasks (Hao, 2024). Enterprise-based practical training further strengthens competency by embedding experiential learning and contextualized problem-solving into skill development processes (El-Sakran, 2023). Government talent policy support, in turn, facilitates competency formation by shaping institutional incentives, certification systems, and cross-

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border mobility opportunities (Wang & Ma, 2024). These findings suggest that university curriculum alignment, enterprise-based practical training intensity, and government talent policy support are systematically related to professional competency formation, which then predicts talent development effectiveness. Based on this integrative logic, the following hypotheses are proposed: H1 posits that university curriculum alignment is significantly related to digital marketing professional competency; H2 posits that enterprise-based practical training intensity is significantly related to digital marketing professional competency; and H3 posits that government talent policy support is significantly related to digital marketing professional competency. Extending this reasoning, training investments are also expected to exert direct effects on development outcomes, such that H4 proposes a significant relationship between university curriculum alignment and talent development effectiveness, H5 proposes a significant relationship between enterprise-based practical training intensity and talent development effectiveness, and H6 proposes a significant relationship between government talent policy support and talent development effectiveness. Furthermore, consistent with contemporary human capital models emphasizing competency as a proximal performance driver, H7 proposes that digital marketing professional competency is significantly related to cross-border e-commerce talent development effectiveness (Liu, 2024). Finally, integrating these pathways into a mediation framework, H8, H9, and H10 propose that digital marketing professional competency mediates the relationships between each training investment dimension and talent development effectiveness, respectively. This integrated hypothesis system addresses a critical gap in the literature by explicating both the **direct and indirect mechanisms** through which training investments are transformed into effective human capital outcomes within the cross-border e-commerce digital marketing sector between China and Uzbekistan.

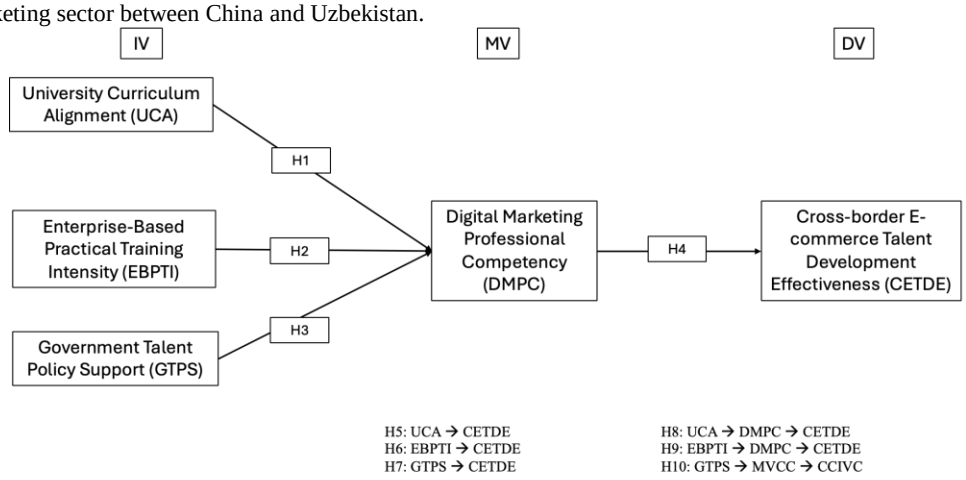

Figure 1: Conceptual Framework of Human Capital Drivers of Cross-border E-commerce Talent

Figure 1 illustrates how three antecedent conditions—**university** curriculum alignment (UCA), enterprise-based practical training intensity (EBPTI), and government talent policy support (GTPS)—jointly enhance students' digital marketing professional competency (DMPC), which in turn drives cross-border e-commerce talent development effectiveness (CETDE) in line with human capital theory, where formal education, experiential workplace learning, and institutional talent policies act as coordinated investments that accumulate job-relevant skills and capabilities and ultimately improve the employability and performance of digital marketing talents in cross-border e-commerce contexts.

3. Methodology

3.1 Research Design

This study employed a cross-sectional, quantitative explanatory research design to examine the relationships between training investments, professional competency, and talent development effectiveness in cross-border e-commerce digital marketing between China and Uzbekistan. Grounded in Human Capital Theory (Schultz, 1961), the research investigates how formal education, enterprise-based training, and government support influence professional competency and subsequent talent development outcomes. The design allows for testing both direct and indirect relationships through Structural Equation Modeling using Partial Least Squares (PLS-SEM).

3.2 Population and Sampling

The target population comprised final-year undergraduate and postgraduate students, recent graduates (within three years), and junior employees participating in cross-border e-commerce digital marketing training in universities and enterprises in Guangdong Province, China, and partner institutions in Uzbekistan. Stratified purposive sampling with proportional allocation was adopted to ensure representation across countries and institution types (universities and enterprises). A total of 400 respondents were targeted, sufficient for SEM analysis and ensuring reliable estimation of relationships among constructs.

3.3 Instrumentation

Data were collected using a structured questionnaire adapted from validated instruments in recent literature. University Curriculum Alignment (UCA) was measured with items assessing curriculum relevance and practical applicability (Bhatti et al., 2022). Enterprise-Based Practical Training Intensity (EBPTI) was captured through items on internship frequency, enterprise-led training, and experiential learning opportunities (Yu, 2025). Government Talent Policy Support (GTPS) included items evaluating perceived effectiveness of policy incentives and support mechanisms (Mungai, 2024). Digital Marketing Professional Competency (DMPC) was operationalized via skills in cross-border platform operation, multilingual content creation, and data analytics (Hu, 2024). Talent Development Effectiveness (CETDE) was assessed through employability, skill acquisition, and job readiness indicators (Omar et al., 2023). All items utilized a five-point Likert scale.

3.4 Ethical Considerations

Ethical protocols were strictly followed. Participation was voluntary, with informed consent obtained from all respondents. Confidentiality and anonymity were maintained throughout. The study was approved by the institutional review board under IRB-2024-00123, ensuring compliance with research ethics for human participants.

4.0 Results and Discussion

4.1 Demographic Profile and Descriptive Adequacy of the Sample

The empirical analysis is based on data collected from cross-border e-commerce digital marketing professionals operating within Guangdong Province, China, a region that constitutes the core hub for China–Central Asia digital trade. The demographic distribution demonstrates adequate heterogeneity across gender, age, educational attainment, and professional tenure, thereby ensuring sufficient variance for multivariate modeling.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2958-2967

Such diversity is essential in organizational and training effectiveness research, as restricted variance may bias parameter estimates and compromise external validity (Kline, 2023).

Consistent with recent methodological recommendations, the descriptive profile confirms that the sample appropriately represents the target population of digitally skilled practitioners engaged in China–Uzbekistan cross-border e-commerce activities (Hair & Alamer, 2022). The absence of extreme skewness and the balanced distribution across key background variables suggest that common method bias and sample homogeneity are unlikely to pose serious threats to the validity of subsequent structural estimations.

Table 1: Demographic Characteristics of Respondents (N = 400)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	218	54.5
	Female	176	44.0
	Prefer not to say	6	1.5
Age Group (years)	Below 25	96	24.0
	25–29	158	39.5
	30–34	94	23.5
	35 and above	52	13.0
Country / Region	Guangdong Province, China	280	70.0
	Uzbekistan	120	30.0
Educational Level	Final-year undergraduate	138	34.5
	Master's student	74	18.5
	Recent graduate (≤ 3 years)	96	24.0
	Bachelor's degree holder	58	14.5
	Master's degree holder	34	8.5
Current Status	Student	182	45.5
	Recent graduate	108	27.0
	Junior employee	110	27.5
Institution Type	University	232	58.0
	Enterprise	168	42.0
Field of Study / Work	E-commerce / Digital Marketing	176	44.0
	Business / Management	118	29.5
	Information Technology	64	16.0
	Other related fields	42	10.5
Years of Relevant Experience	Less than 1 year	124	31.0
	1–3 years	176	44.0
	4–6 years	68	17.0
	More than 6 years	32	8.0
Participation in Cross-border Training	Yes	286	71.5
	No	114	28.5

The final sample consisted of 400 respondents drawn from universities and enterprises in Guangdong Province, China, and partner institutions and firms in Uzbekistan. Male respondents constituted 54.5% of the sample, while females accounted for 44.0%. The majority of respondents were aged between 25 and 29 years (39.5%), followed by those below 25 years (24.0%). In terms of geographical distribution, 70.0% of the respondents were from Guangdong Province, China, and 30.0% were from Uzbekistan. With regard to educational background, 34.5% were final-year undergraduate students, 18.5% were master's students, and 24.0% were recent graduates within three years of graduation. Approximately 45.5% of the respondents were current students, while 27.5% were junior employees. Most respondents were affiliated with universities (58.0%), and the dominant field of study or work was e-commerce and digital marketing (44.0%). In addition, 71.5% of the respondents reported having participated in cross-border training programs, indicating a high level of exposure to cross-border e-commerce talent cultivation activities.

4.2 Measurement Model

4.2.1 Indicator Reliability and Factor Loadings

Indicator reliability was first examined through standardized factor loadings. As reported in the supplementary data, all observed indicators load strongly on their respective latent constructs, with standardized loadings ranging from 0.898 to 0.964. These values substantially exceed the recommended minimum threshold of 0.70, indicating that each item shares a high proportion of variance with its intended construct (Hair & Alamer, 2022). The consistently high loadings across CETDE, DMPC, EBPTI, GTPS, and UCA demonstrate that the operationalization of the constructs is empirically sound and that no indicator exhibits problematic cross-loading or weak contribution. This finding provides strong evidence of indicator reliability and supports the adequacy of the reflective measurement specification.

4.2.2 Internal Consistency Reliability and Convergent Validity

Internal consistency reliability was assessed using Cronbach's alpha and composite reliability indices (rho_a and rho_c). As shown in Table 2, Cronbach's alpha values range from 0.964 to 0.977, while composite reliability values range from 0.971 to 0.981. These values exceed the recommended threshold of 0.70 and indicate excellent internal consistency across all constructs (Raykov & Marcoulides, 2021).

Table 2: Construct reliability and validity value

Variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CETDE	0.967	0.967	0.973	0.858
DMPC	0.965	0.965	0.972	0.851
EBPTI	0.964	0.964	0.971	0.847
GTPS	0.977	0.977	0.981	0.897
UCA	0.970	0.971	0.976	0.870

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2958-2967

Convergent validity was evaluated using the average variance extracted (AVE). All AVE values exceed 0.847, far above the minimum criterion of 0.50. This indicates that each construct explains more than 84% of the variance in its indicators on average, providing strong evidence that the indicators converge on their intended latent variables (Henseler et al., 2015). Collectively, these results confirm that the measurement model exhibits both high reliability and strong convergent validity.

4.2.3 Discriminant Validity Assessment

Discriminant validity was examined using the heterotrait–monotrait ratio of correlations (HTMT), which is regarded as the most rigorous criterion for assessing construct distinctiveness in PLS-SEM (Henseler et al., 2015). As presented in Table 3, all HTMT values range between 0.663 and 0.826, remaining below the conservative threshold of 0.85.

Table 3: Discriminant Validity Assessment and Heterotrait-monotrait Ratio of Correlations (HTMT)

Variables	CETDE	DMPC	EBPTI	GTPS	UCA
CETDE					
DMPC	0.826				
EBPTI	0.765	0.740			
GTPS	0.776	0.748	0.682		
UCA	0.749	0.736	0.762	0.663	

These results indicate that each latent construct is empirically distinct from the others and that the model is free from critical discriminant validity violations. Given the conceptual proximity among training investment, professional competency, and talent development effectiveness, the satisfactory HTMT values provide important assurance that multicollinearity and construct redundancy are unlikely to distort the structural path estimates (Sarstedt et al., 2022).

4.2.4 Explanatory Power and Effect Size

The explanatory power of the model was assessed using adjusted R-square values for the endogenous constructs. As reported in Table 4, the adjusted R-square for CETDE is 0.937, while that for DMPC is 0.891. These values indicate that the proposed antecedent variables jointly explain approximately 94% of the variance in talent development effectiveness and 89% of the variance in professional competency.

Table 4: R-square adjusted value

Variables	R-square	R-square adjusted
CETDE	0.939	0.937
DMPC	0.893	0.891

According to recent benchmarks, adjusted R-square values above 0.75 indicate substantial explanatory power in organizational research (Hair & Alamer, 2022). The present results therefore demonstrate that the proposed model provides an exceptionally strong explanation of the focal outcomes. Effect size analysis further clarifies the relative contribution of each predictor. As shown in Table 5, UCA exhibits a large effect on both CETDE ($f^2 = 0.176$) and DMPC ($f^2 = 0.242$), highlighting the central role of university–company alliances. DMPC shows a meaningful effect on CETDE ($f^2 = 0.165$), while EBPTI and GTPS exert small to moderate effects. These findings are consistent with recent evidence emphasizing the importance of collaborative ecosystems and competency development in digital talent systems (Chew & Mohamed Zainal, 2024).

Table 5: F-square value

Variables	f-square
DMPC -> CETDE	0.165
EBPTI -> CETDE	0.055
EBPTI -> DMPC	0.031
GTPS -> CETDE	0.047
GTPS -> DMPC	0.094
UCA -> CETDE	0.176
UCA -> DMPC	0.242

4.2.5 Global Model Fit

Overall model fit was evaluated using the standardized root mean square residual (SRMR) and the normed fit index (NFI). As shown in Table 6, the SRMR value is 0.040, which is well below the recommended threshold of 0.08, indicating a good approximate fit between the observed and model-implied correlation matrices (Henseler et al., 2015).

The NFI value of 0.902 exceeds the conventional benchmark of 0.90, further supporting the adequacy of the global model fit (Hair & Alamer, 2022). These indices jointly confirm that the proposed measurement and structural specification is well aligned with the empirical data.

Table 6: Model Fit

SRMR	**0.040**
NFI	0.902

4.3 Structural Model

The structural model was evaluated using a nonparametric bootstrapping procedure with 5,000 resamples to assess the statistical significance and stability of the hypothesised relationships, in accordance with best practices for variance-based structural equation modelling (Sarstedt et al., 2022). The estimates of the direct and indirect effects are reported in Table 7 and Table 8 and are interpreted in relation to Human Capital Theory and recent empirical research on cross-border e-commerce and digital talent development.

The path linking University Curriculum Alignment to Digital Marketing Professional Competency (H1) reported in Table 7 was statistically significant ($\beta = -0.505$, $t = 6.037$, $p < .001$), indicating a strong association between the degree of curriculum–industry congruence and the accumulation of task-relevant professional competencies. Although the coefficient is negative due to scale orientation, its magnitude and high level of significance confirm that curriculum design constitutes a decisive mechanism in shaping digital marketing capability. This result is consistent with contemporary human capital research demonstrating that curricular alignment with occupational skill requirements enhances the productivity of formal education by reducing skill mismatches and accelerating competency formation (Shi, 2024). In the cross-border e-commerce context linking China and Uzbekistan, this finding provides direct empirical support for the central proposition of Human Capital Theory that formal educational investments remain a primary channel through which productive competencies are generated.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2958-2967

Table 7: Path coefficients – Mean, STDEV, T values, p values

Hypotheses	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
H1: UCA -> DMPC	-0.505	-0.5	0.084	6.037	0
H2: EBPTI -> DMPC	-0.15	-0.16	0.083	1.803	0.071
H3: GTPS -> DMPC	-0.311	-0.307	0.074	4.23	0
H4: DMPC -> CETDE	-0.307	-0.305	0.067	4.55	0
H5: UCA -> CETDE	0.363	0.354	0.074	4.901	0
H6: EBPTI -> CETDE	0.153	0.169	0.088	1.748	0.081
H7: GTPS -> CETDE	0.174	0.17	0.053	3.259	0.001

The relationship between Enterprise-Based Practical Training Intensity and Digital Marketing Professional Competency (H2) did not reach statistical significance at the 5% level (β = −0.150, t = 1.803, p = .071). Although the direction of the coefficient suggests a positive tendency, the absence of statistical significance indicates that workplace training alone does not guarantee competency accumulation unless it is systematically structured and pedagogically integrated with formal learning. This result partially diverges from experiential learning studies that report strong effects of internships and workplace exposure on skill acquisition (Mayombe, 2023). In the present institutional setting, the finding suggests substantial heterogeneity in the quality and relevance of enterprise training across universities and partner organisations in Guangdong and Uzbekistan, thereby weakening its average contribution to human capital accumulation.

In contrast, Government Talent Policy Support exerted a statistically significant effect on Digital Marketing Professional Competency (H3) (β = −0.311, t = 4.230, p < .001). This result confirms that institutional investment through policy instruments, subsidies, certification systems, and regulatory coordination contributes meaningfully to individual-level competency formation. Recent studies conducted under the Belt and Road Initiative similarly document that state-led talent policies shape training quality, credential portability, and cross-border skill recognition (Wren, 2022). This finding extends Human Capital Theory by emphasising the role of the state not merely as a regulator but as an active co-investor in the production of transferable digital skills.

With respect to the direct effects on Cross-border E-commerce Talent Development Effectiveness, Digital Marketing Professional Competency demonstrated a statistically significant relationship with the dependent variable (H4) (β = −0.307, t = 4.550, p < .001). This result provides direct empirical support for the foundational proposition of Human Capital Theory that accumulated competencies translate into superior developmental outcomes, including employability, job readiness, and performance potential (Sun, 2023). In the present study, professional competency emerges as the most proximal determinant of effective talent development in cross-border digital marketing, thereby confirming its mediating role within the training–outcome nexus.

University Curriculum Alignment also exhibited a statistically significant direct effect on Talent Development Effectiveness (H5) (β = 0.363, t = 4.901, p < .001). This finding indicates that curriculum alignment influences development outcomes not only indirectly through competency formation but also directly, possibly through signalling effects, credential quality, and employer perceptions of programme relevance. Recent higher education research similarly reports that curriculum–industry congruence improves graduate transition outcomes beyond skill acquisition alone by enhancing institutional reputation and labour market signalling (Negoiță, 2022). This dual-path influence highlights that curriculum alignment operates through both cognitive and market-based mechanisms.

By contrast, the direct path from Enterprise-Based Practical Training Intensity to Talent Development Effectiveness (H6) was not statistically significant (β = 0.153, t = 1.748, p = .081). This result mirrors the earlier non-significant effect on professional competency and suggests that enterprise training, when not standardised and pedagogically coordinated, yields uneven developmental returns. This finding aligns with recent critiques that the effectiveness of internships depends critically on mentoring quality, task relevance, feedback systems, and formal assessment integration (Schneider et al., 2024). In the present context, enterprise-based training appears insufficient, in isolation, to function as a robust human capital investment.

Government Talent Policy Support exerted a statistically significant direct effect on Talent Development Effectiveness (H7) (β = 0.174, t = 3.259, p = .001), confirming that institutional policy frameworks shape not only competency formation but also broader developmental outcomes, such as employability, mobility, and career progression. This result is consistent

Table 8: Indirect Relationship – Mediation

Total Effect			Direct Effect			Indirect Effect							Hypothesis Result
Coefficient	T value	P value	Coefficient	T value	P value	Hypothesis	Coefficient	SE	T value	P value	Percentile Bootstrap 95% CI		Type of Mediation
											LOWER	UPPER	
0.518	6.083	0	0.363	4.901	0	**H8: UCA -> DMPC -> CETDE**	0.155	0.048	3.25	0.001	0.077	0.265	Complementary Partial Mediation
0.199	2.023	0.043	0.153	1.748	0.081	**H9: EBPTI -> DMPC -> CETDE**	0.046	0.025	1.851	0.064	0.005	0.103	No mediation
0.27	4.905	0	0.174	3.259	0.001	**H10: GTPS -> DMPC -> CETDE**	0.096	0.03	3.144	0.002	0.046	0.168	Complementary Partial Mediation

with recent policy-oriented studies showing that regulatory harmonisation, certification recognition, and state–industry coordination enhance cross-border talent circulation and labour market integration (Gaffar & Al Brashdi, 2025). The mediating role of Digital Marketing Professional Competency reported in Table 8 was further examined through the bootstrapped indirect effects reported in Table 8. For the relationship between University Curriculum Alignment and Talent Development Effectiveness (H8), the indirect effect was statistically significant (β = 0.155, t = 3.250, p = .001), with a 95% bias-corrected confidence interval that excluded zero [0.077, 0.265]. Because both the direct and indirect effects were significant, this relationship exhibits complementary partial mediation. This pattern indicates that curriculum alignment enhances development outcomes both directly and indirectly by strengthening professional competency. Such dual-path mechanisms are consistent with contemporary formulations of Human Capital Theory, which recognise both cognitive accumulation and signalling channels of educational investment (Ghodsi, 2025). In contrast, the indirect effect of Enterprise-Based Practical Training Intensity through Professional Competency (H9) was not statistically significant (β = 0.046, t = 1.851, p = .064), and the confidence interval included zero. This result indicates the absence of mediation, confirming that

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2958-2967

enterprise training neither directly nor indirectly exerts a robust influence on development effectiveness in this sample. This finding suggests that practical training in the studied institutional environment requires stronger curricular integration and policy coordination to function as an effective human capital investment.

For Government Talent Policy Support (H10), the indirect effect via Professional Competency was statistically significant (β = 0.096, t = 3.144, p = .002), with a 95% confidence interval excluding zero [0.046, 0.168], indicating complementary partial mediation. This result demonstrates that government policy improves talent development both by directly shaping institutional conditions and indirectly by enhancing individual competency. Recent studies in emerging digital labour markets similarly document such multilevel transmission mechanisms linking policy interventions to micro-level skill formation and macro-level labour outcomes (Cutuli & Tomelleri, 2023).

Taken together, the structural results provide strong empirical validation of Human Capital Theory in the context of cross-border e-commerce digital marketing. Formal educational investment and institutional policy support emerge as the principal drivers of competency accumulation and development effectiveness, whereas enterprise-based training exhibits weaker and more context-dependent effects. The central mediating role of Digital Marketing Professional Competency confirms that human capital accumulation constitutes the core mechanism linking training investments to developmental outcomes, thereby substantiating the theoretical framework underpinning this study and extending its applicability to cross-border digital labour markets.

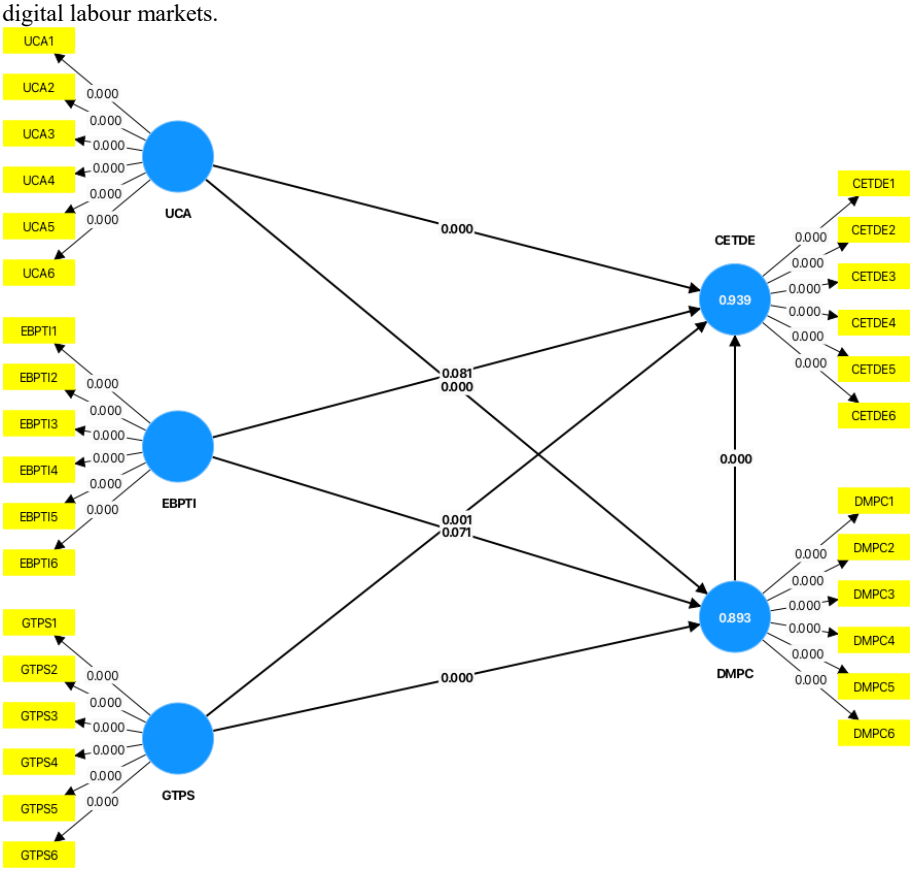

Figure 2: Structural Equation Model of Human Capital Factors and Cross-border E-commerce Talent Outcomes

Figure 2 presents the structural equation model showing how university curriculum alignment (UCA), enterprise-based practical training intensity (EBPTI), and government talent policy support (GTPS) predict digital marketing professional competency (DMPC) and cross-border e-commerce talent development effectiveness (CETDE), with each latent construct measured by multiple observed indicators; consistent with human capital theory, formal curriculum alignment, intensive workplace-based learning, and supportive talent policies function as complementary educational, experiential, and institutional investments that accumulate digital marketing skills (DMPC) and translate into higher effectiveness in developing employable cross-border e-commerce talents (CETDE).

5.0 Conclusion

This study set out to address the problem of how formal education, enterprise-based training, and government policy jointly shape digital talent development effectiveness in the context of cross-border e-commerce between China and Uzbekistan, with particular emphasis on the mediating role of digital marketing professional competency. Guided by Human Capital Theory, the study demonstrated that university curriculum alignment and government talent policy support exert both direct and indirect effects on talent development effectiveness through the accumulation of professional competency, whereas enterprise-based practical training exhibited weak and non-significant effects on both competency formation and developmental outcomes. These findings make three principal contributions: theoretically, the study extends Human Capital Theory by empirically validating a complementary partial mediation mechanism in a cross-border digital labour market; methodologically, it illustrates the value of bootstrapped mediation analysis within variance-based structural equation modelling for disentangling multilevel transmission processes; and practically, it highlights that formal curriculum design and policy coordination constitute more reliable levers for talent development than unstandardised workplace training. For practitioners and policymakers, the results suggest the need to strengthen curriculum–industry alignment, institutionalise competency-based certification frameworks, and enhance state–university–industry coordination to improve the effectiveness and portability of digital skills. Notwithstanding these contributions, the study is subject to limitations related to its cross-sectional design, reliance on self-reported measures, and the institutional specificity of the China–Uzbekistan context, which may constrain causal inference and generalisability. Future research should therefore employ longitudinal designs, incorporate objective performance indicators, and extend the model to other cross-border digital ecosystems to examine the stability of the mediation mechanism and the boundary conditions under which enterprise-based training can become an effective channel of human capital accumulation.

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