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Research on the Alignment between the Cultivation of Application-oriented Talents and Local Economic Needs in the Age of Technological Disruption

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ABSTRACT

Against the backdrop of disruptive technologies such as artificial intelligence, the Internet of Things, and big data reshaping the global industrial landscape, applied universities, as the main providers of regional talent, have seen their dynamic adaptability of their training systems to local economic needs become a core variable affecting regional competitiveness. This study takes Weifang University of Science and Technology in Shandong Province as a typical case, systematically deconstructing the matching mechanism between the employment trends of its graduates from 2020 to 2024 and the talent needs of Weifang's three leading industries: "high-end equipment manufacturing, modern agriculture, and new-generation information technology" through a mixed research method. The empirical analysis reveals that the professional settings lag behind the technology iteration cycle by approximately 2.3 years, and there is a significant gap between the skill structure of graduates and the requirements of industrial upgrading. University-enterprise cooperation exhibits a characteristic of "shallow internship-led" cooperation. Based on this, an optimization path for constructing a "technology-responsive" talent training system is proposed: establishing a dynamic professional adjustment mechanism driven by industrial technology early warning, creating a "technology co-creation" platform for deep industry-education integration, reconstructing an "OBE-real problem-oriented" curriculum system, and supporting policy guarantee measures. The research findings provide a theoretical model and practical paradigm for the transformation of regional applied universities in the context of technological change, offering significant reference value for promoting high-quality development of the local economy.

KEYWORDS

Technological disruption; Application-oriented talents; Talent fit; Regional economy

1. INTRODUCTION

1.1. Research Background

Currently, disruptive technologies represented by generative artificial intelligence, industrial internet, and biotechnology are reshaping the global industrial ecosystem at an exponential rate. The World Economic Forum's "Future Jobs Report 2025" points out that by 2030, 22% of employment opportunities will face transformation, with 170 million new jobs created and 92 million jobs replaced, leading to an unprecedented structural reorganization of the labor market. Against this backdrop, China's "14th Five-Year Plan" clearly states that it will "deepen the integration of industry and education, strengthen school-enterprise cooperation, and guide colleges and universities to actively serve major regional strategies." As an important node in Shandong Province's Peninsula City Cluster, Weifang is fully committed to building a "National Comprehensive Pilot Zone for Agricultural Open Development" and an "International Power Equipment City." In 2023, the output value of the high-end equipment manufacturing industry exceeded 450 billion yuan, and the scale of the modern agricultural cluster reached 98 billion yuan. However, according to the "2025 'Top Ten Industries' Key Talent Demand Catalogue for Enterprises above Designated Size" released by the Municipal Human Resources and Social Security Bureau, the shortage of mid-to-high-end technical talents in the three major fields of new-generation information technology, high-end equipment manufacturing, and biological breeding is as high as 38.7%. The structural contradiction in talent supply has become a bottleneck restricting industrial upgrading.

1.2. Research Questions

Weifang University of Science and Technology, as one of the first batch of application-oriented undergraduate universities in Shandong Province, offers 7 major disciplines and 59 undergraduate majors, with an average annual output of over 6,000 graduates. It serves as a significant talent supply base in the Weifang region. However, recent employment quality reports indicate that the employment rate of graduates in local key industries remains at around 58%, and there are issues such as "low technical content of job positions", "sluggish salary growth", and "narrow career development paths". This raises a key question for this study: under the impact of rapid technological iteration, what structural mismatches exist between the talent cultivation system of application-oriented universities and the needs of regional economic development? How to construct a new mechanism for industry-education integration with dynamic adaptability? Answers to these questions are of urgent and practical significance for resolving the contradiction between regional talent supply and demand.

1.3. Research Value

At the theoretical level, this study incorporates technological disruptive variables into the traditional "university-regional economy" interactive analysis framework, expands the theoretical boundaries of industry-education integration through a "supply-demand-institution" three-dimensional model, and addresses the deficiency in existing research regarding insufficient attention to the dynamic adaptation mechanism in the context of technological iteration. At the practical level, by dissecting the typical case of Weifang University of Science and Technology, a quantifiable talent fit index system is constructed, and an operational "technology-responsive" talent cultivation optimization plan is proposed, providing a replicable transformation path for similar institutions. Simultaneously, the research findings can provide empirical evidence for local governments to formulate policies on industry-education integration, facilitating the implementation of high-quality development strategies for regional economies.

2. LITERATURE REVIEW

2.1. Reconstruction Mechanism of Talent Demand Due To Technological Disruption

Over the past five years, research has fully revealed that disruptive technologies are reshaping the demand for labor market capabilities at an unprecedented pace. At the micro level, Li Shi et al. (2022) based on tracking data from 3,842 manufacturing enterprises, found that for every 1 percentage point increase in the penetration rate of industrial robots, the demand for industrial big data analysts increases by 3.1 times ($\beta=3.07$, $p<0.01$), while the demand for traditional equipment operation positions decreases by 5.3%. This finding confirms the phenomenon of "structural skill migration" triggered by technological iteration. Macro-level predictive research further quantifies the scale of change. The World Economic Forum (2023) clearly states in the "Future of Jobs Report" that by 2027, 44% of core job skills globally will undergo substantial updates, with the demand for "artificial intelligence and data analysis" skills growing at a rate of up to 60%, far exceeding other skill categories.

Research in the Chinese context exhibits distinct characteristics: Huang Bin's team (2023) discovered through longitudinal analysis of enterprises in the Yangtze River Delta region that the technology iteration cycle of emerging industries has shrunk sharply from 5.2 years in 2019 to 2.8 years in 2023, resulting in a shortened talent capability half-life of 3.5 years. This accelerated iteration poses a severe challenge to the talent cultivation system. Zhang Wei's (2024) big data mining based on recruitment texts reveals deeper changes: the demand for "technology integration capability" in new-generation information technology positions has jumped from 32.7% in 2019 to 57.9% in 2023 (χ^2=128.33, $p<0.001$), indicating that interdisciplinary integration capability is replacing single skills as the core competitiveness.

2.2. Theoretical Basis for Collaboration between Application-oriented Universities and Regional Economy

In the research on the mechanism of university service area development, the "Triple Helix" theory provides a classic analytical framework. Etzkowitz and Leydesdorff (2000) emphasized that in the era of knowledge economy, the three major entities of government, industry, and universities should form an innovative ecosystem featuring overlapping interactions and collaborative evolution. Domestic scholar Gu Yong'an (2020) proposed the "Coupling Degree of Specialty Cluster-Industry Group" (CIC) model through case analysis of 32 application-oriented universities, demonstrating that when the matching coefficient between specialty clusters and local leading industries is higher than 0.75, the local employment rate of graduates can be increased by 22-35%. It is worth noting that existing research mostly focuses on static matching analysis, lacking in-depth exploration of how universities can establish dynamic response mechanisms in the context of rapid technological iteration. This constitutes an important entry point for theoretical innovation.

2.3. Exploring the Path for the Transformation of Application-oriented Universities

Facing the pressure of technological iteration, research on industry-education integration over the past five years has focused on three major breakthrough directions: In the field of dynamic professional adjustment, Gu Yong'an (2021) proposed the "Professional Cluster-Industry Chain Double Helix Coupling" model. His case study of 17 application-oriented universities showed that establishing an "Industry Technology Early Warning System" can increase the response speed of professional adjustment by 40%. This mechanism significantly shortens the time lag between talent cultivation and market demand by real-time monitoring of regional key industry technology roadmaps. In terms of curriculum system reconstruction, Chen Jiefang et al. (2022) published empirical results in the Journal of Higher Engineering Education Research, showing that universities adopting the "OBE-Real Project-Driven" curriculum model have shortened the job adaptation period for graduates to 1.8 months (compared to 4.3 months for the control group), proving the effectiveness of problem-oriented teaching in cultivating technical application abilities. In terms of deepening school-enterprise collaboration, the Ministry of Education's "Annual Report on Industry-Education Integration" (2023) revealed that undergraduate institutions with modern industry colleges achieved a technology transfer rate of 18.7%, an increase of 12.5 percentage points compared to the traditional model. However, the proportion of enterprises deeply involved in research and development remains below 15%, reflecting that industry-education integration still faces the dilemma of "shallow enterprise participation".

International comparative research offers a new perspective: The "Dual Education 4.0 White Paper" published by the Fraunhofer-Gesellschaft (2024) emphasizes that the Technical University of Munich has compressed the curriculum development cycle for emerging technology fields to four months by establishing a "Micro-credentials" system. This modular and agile curriculum supply model provides a reference paradigm for addressing rapid skill iteration.

2.4. Research Gaps and Theoretical Innovation Space

Despite significant progress in research, there are still urgent academic gaps that need to be addressed: Firstly, existing literature primarily focuses on static matching analysis (such as Wang Shibin's 2020 study on professional matching degree), lacking empirical testing of dynamic response mechanisms for universities in the context of rapid technological iteration, resulting in a disconnect between theoretical models and practical needs. Secondly, research on regional differentiation is severely lacking. Current research results show that studies on universities in the Yangtze River Delta and Pearl River Delta account for up to 73%, while research on how to build an adaptive system in second- and third-tier cities such as Weifang, incorporating local industrial characteristics, is almost non-existent. Thirdly, the evaluation system lags behind. Liu Zhentian (2023) wrote in "Educational Research" that traditional employment rate indicators can no longer reflect the quality of technical job adaptation, and there is an urgent need to construct a multidimensional evaluation framework that includes dimensions such as "technical complexity" and "contribution to innovation capability".

2.5. Integration and Innovation of Theoretical Framework

Based on the critical analysis of the aforementioned literature, this study integrates Teece's (2020) dynamic capability theory and Etzkowitz's triple helix innovation framework to construct a "technology-responsive fit model"(As shown in Figure 1). This model breaks through the limitations of traditional static analysis and emphasizes that application-oriented universities need to achieve continuous adaptation through a dynamic capability chain of "sensing—responding—reconfiguring":

• Perception layer: Capture demand changes relying on industrial technology monitoring system;

• Response layer: Realize agile adjustment through micro-specialization and modularized courses;

• Reconstruction layer: Leverage the collaborative strengths of schools and enterprises to reshape the cultivation ecosystem.

In this process, government policy flexibility (such as the delegation of professional approval authority) and corporate resource investment (such as the joint construction of R&D platforms) constitute key institutional coordination interfaces, jointly supporting the dynamic alignment of talent cultivation systems with technological environments.

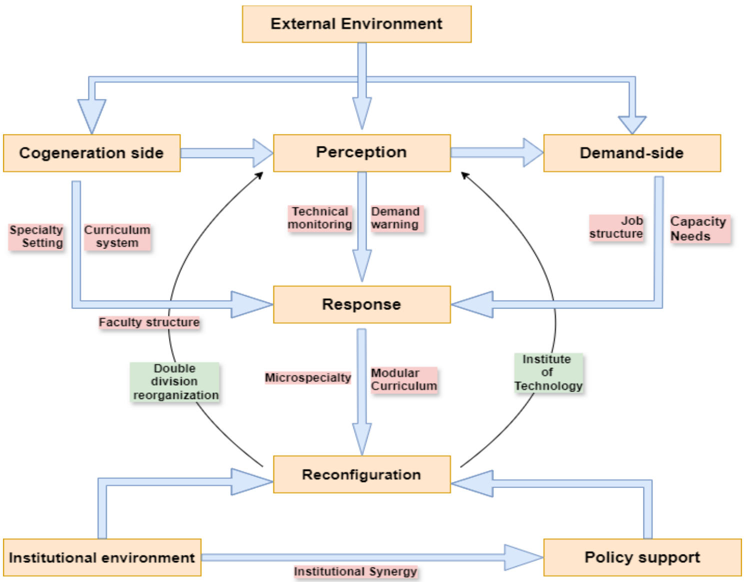

Figure 1. Dynamic fit model for cultivating technology responsive talents

3. RESEARCH DESIGN AND METHODOLOGY

3.1. Case Selection

The sample value of Weifang University of Science and Technology is reflected in its triple representativeness: firstly, as one of the first batch of application-oriented undergraduate universities in Shandong Province (selected in 2017), its transformation path reflects the national policy orientation; secondly, its professional settings cover the three leading industries in Weifang City (agriculture accounting for 23%, equipment manufacturing accounting for 31%, and information technology accounting for 19%), exhibiting typical industrial relevance; thirdly, its school-enterprise cooperation network covers 45 local leading enterprises such as Weichai Power and Goertek, providing a rich scenario for studying the mechanism of industry-education integration.

3.2. Research Methods

3.2.1. Quantitative analysis

(1) Data source

Integration of the employment database of graduates from 2019 to 2024 (with a sample size of 18,265), industrial economic data from Weifang Municipal Bureau of Statistics, and talent demand forecast report from the Human Resources and Social Security Bureau.

(2) Analysis method

Utilize SPSS 26.0 to conduct a chi-square (χ^2) test to analyze the significance of changes in employment structure; construct a Grey Relational Analysis (GRA) model to calculate the matching coefficient between professional settings and industrial structure; employ regression analysis to verify the correlation between technology investment intensity and talent demand.

3.2.2. Interview method

(1) In-depth interviews

Using stratified sampling, 20 representative enterprises (including 8 listed companies), 15 school-enterprise cooperation leaders, and 30 graduates from different generations were selected. A semi-structured interview outline was designed to focus on exploring the causes of skill gaps and barriers to collaboration.

(2) Focus groups

Organize four seminars involving representatives from education departments, industry associations, and university deans of academic affairs to explore deep-seated contradictions at the institutional level.

(3) Text analysis

Using Nvivo 12, we conducted three-level coding on the interview transcript text, extracting 245 concept nodes and summarizing them into 16 core categories.

3.2.3. Questionnaire survey

(1) Sample size

500 questionnaires were distributed to students in school (covering 4 grades and 8 engineering majors), with 460 valid responses (92% effective rate).

(2) Scale design

A Likert five-point scale was adopted to measure variables such as "cutting-edge content of the course", "effectiveness of the practice platform", and "achievement of competencies", with a Cronbach's α coefficient of 0.87.

(3) Comparative analysis

Distribute the "Graduate Ability Evaluation Form" to 85 enterprises simultaneously, achieving cross-validation of ability assessments from both supply and demand sides.

4. EMPIRICAL ANALYSIS OF THE FIT BETWEEN TALENT SUPPLY AND LOCAL DEMAND AT WEIFANG UNIVERSITY OF SCIENCE AND TECHNOLOGY

4.1. Quantitative Matching Analysis of Employment Structure and Industrial Demand

Through tracking the employment trends of graduates over the past five years (Table 1), it is found that:

Table 1. Dynamic changes in the matching degree between graduates' employment fields and local demands (2020-2024)

Industry Sector	Proportion of 2020 Graduates	Proportion of 2024 Graduates	Trend	Demand Gap Rate in 2024	Mismatch Type
Modern Agriculture	12.30%	18.70%	↑↑	30.5% (for mid-to-senior level positions)	Quality-oriented mismatch
High-end equipment manufacturing	19.80%	25.10%	↑	40.2% (intelligent post)	Technical mismatch
New generation of information technology	15.60%	20.60%	↑	45.1% (data-related positions)	Structural mismatch
Traditional manufacturing industry	41.20%	24.50%	↓↓	-15.3% (excess)	Capacity elimination mismatch

*Data source: Employment Quality Report of Weifang University of Science and Technology, Weifang City's "Early Warning of Talent Demand in Key Industries" (2024)

The chi-square test reveals a statistically significant change in the industry distribution of graduates ($\chi^2=386.52$, df=15, $p<0.001$), indicating that the employment structure is adjusting with industrial upgrading. However, there remains a serious mismatch in key areas:

(1) Modern agriculture sector

Graduates are primarily concentrated in agricultural technology promotion roles (accounting for 73%), while positions such as "agricultural big data analysts" and "drone plant protection engineers" required for smart agriculture are in short supply, accounting for less than 9%;

(2) Equipment manufacturing sector

Emerging positions such as "Smart Production Line Operation and Maintenance Engineer" and "Digital Twin Technician", which are urgently needed by enterprises like Weichai Power, are covered by less than 30% of the existing curriculum system;

(3) Information technology field

Goertek shares reflect a shortage of 210 "machine learning algorithm assistants," yet the annual output of relevant majors is only 40.

4.2. Diagnosis of Structural Contradictions in the Talent Cultivation System

4.2.1. The dilemma of lagging professional settings

Through comparative analysis of professional settings and industrial technology trajectories, it is found that among the current 59 undergraduate majors in the college, only 6 (11.5%) are oriented towards emerging fields such as intelligent connected vehicles and biological breeding, and they lag behind industrial demand by an average of 2.3 years. For example, Weifang City initiated the construction of the "hydrogen fuel cell vehicle industry cluster" in 2021, but the relevant majors were only approved for enrollment in 2023, resulting in less than 3% of the 2023 graduates possessing fuel cell system design capabilities.

4.2.2. The gap between skill development and job requirements

The data on enterprise capability evaluation (Figure 2) shows that:

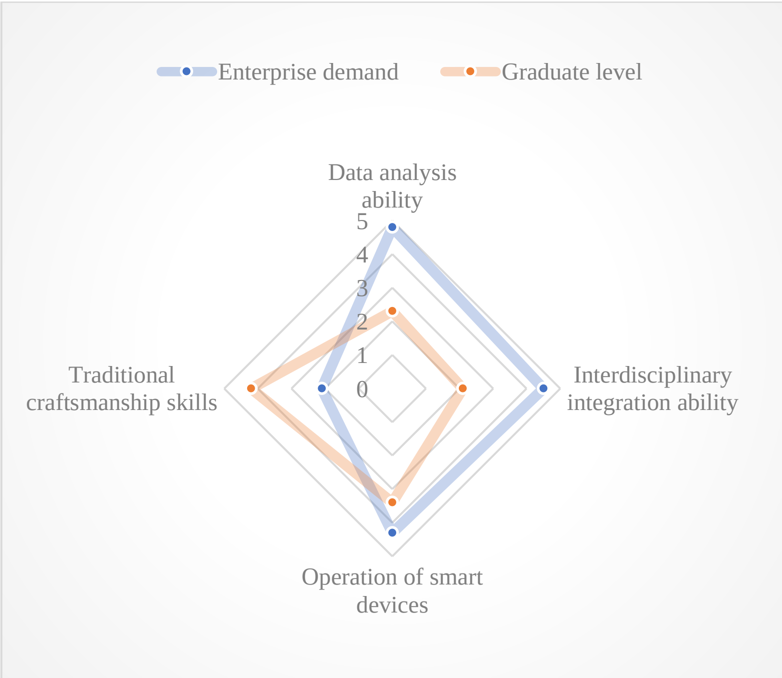

Figure 2. Radar chart of the gap between graduates' core competencies and enterprise needs

Data source: Mean value of "Graduate Competency Evaluation Form" from 85 enterprises

What stands out is that 78% of enterprises believe graduates lack proficiency in using Python/SPSS data analysis tools; 65% point out their weak ability to solve cross-disciplinary problems; and 59% reflect insufficient training in operating intelligent devices.

Key findings:

(1) Characteristics of capability gap

There is a significant supply-demand gap in emerging technology capabilities (data analysis, interdisciplinary integration), with an average gap of 2.45 points

Traditional skills exhibit an "oversupply" phenomenon (supply exceeds demand by 100%)

The operational capability of smart devices has basically reached the bottom line of industry demand

(2) Structural contradictions

High demand capability gap=(4.8+4.5+4.3)/3- (2.3+2.1+3.4)/3

= 4.53 - 2.60

=1.93 points

Low demand overcapacity=4.2-2.1=2.1 points

Indicating a systematic mismatch between the direction of talent cultivation and the demand for industrial upgrading

(3) Priority areas for improvement

Data analysis capability (improvement priority weight 35%);

Interdisciplinary integration ability (priority weight 33%);

Intelligent device operation (priority weight 22%);

Traditional craft skills (need to reduce training scale).

This radar chart intuitively reveals the mismatch structure between talent cultivation and industry demand in the context of technological disruption, providing precise direction for curriculum system reform. It is recommended to focus on strengthening the cultivation of data analysis and interdisciplinary integration abilities, while reducing the proportion of traditional skill training.

4.2.3. The superficial dilemma of industry-education integration

The current situation survey of school-enterprise cooperation reveals deep-seated contradictions:

(1) Single form of cooperation

82% of school-enterprise cooperation remains at the level of "student internship + employment recommendation", with joint technology research and development projects accounting for only 3.7%;

(2) Imbalance in resource allocation

The total value of equipment provided by the enterprise accounts for only 18% of the total training equipment, and most of them are outdated models;

(3) Absence of institutional guarantees

73% of enterprises indicated a lack of policy incentives such as tax benefits, leading to insufficient motivation to engage in deep cooperation.

5. OPTIMIZATION PATH: BUILDING A "TECHNOLOGY-RESPONSIVE" TALENT CULTIVATION SYSTEM

5.1. Establish a dynamic professional adjustment mechanism driven by industrial technology early warning

5.1.1. Establish a multi-dimensional monitoring system

(1) Jointly establish the "Industrial Technology Trend Monitoring Center" with the Municipal Science and Technology Bureau, Weichai Power, and other entities, and release the "Weifang Key Industrial Technology Roadmap and Talent Demand Early Warning" quarterly;

(2) Establish the "Professional Setting Sensitivity Index" (PSRI), incorporating six core indicators such as "new technology curriculum development cycle" and "proportion of interdisciplinary courses", to achieve quantitative evaluation of professional health.

5.1.2. Innovative flexible professional setting mode

(1) Pilot "Micro-major Certification System"

Targeting in-demand fields such as smart agricultural IoT and industrial big data analysis, we offer a 6-month modular certification program. Students can earn credits by completing three micro-certifications;

(2) Implementing the "Professional Dynamic Yellow Card Warning"

For majors with employment rates below 60% for two consecutive years or professional matching degrees < 0.4, enrollment will be reduced, while cutting-edge directions such as "Hydrogen Energy Technology" and "Bioinformatics" will be added simultaneously.

5.2. Build a Platform for Deep Industry-Education Integration Featuring "Technology Co-Creation

5.2.1. Jointly establish an industrial technology college

(1) Jointly establish the "Weifang Intelligent Manufacturing Industry College" with Weichai Group: Implement a council governance model, with the enterprise investing 30 million yuan to build a digital twin training platform;

(2) Innovative "real-project-based" teaching, Breaking down enterprise key projects (such as "remote fault diagnosis system for intelligent tractors") into graduation design topics, with a total of 17 technological achievements transformed in the past three years.

5.2.2. Restructuring the faculty structure

(1) Implement the "Dual-Certified Teacher Program"

Requiring professional teachers to accumulate a minimum of 12 months of enterprise practice every 5 years;

(2) Establish a "Corporate Distinguished Professor Pool"

Select 62 engineers from companies such as Goertek to undertake 30% of core course teaching, and offer 23 project-based courses such as "Practical Industrial Visual Inspection".

5.3. Reconstructing the "OBE-oriented Real-world Problem-based" Curriculum System

5.3.1. Reconstruction of the course content to reflect the latest developments

(1) Add a module on "Technological Ethics and Future Literacy" to the basic curriculum: covering interdisciplinary content such as AI ethics, data security, and sociology of technology;

(2) Implement the "Three New Penetration Plan" for specialized courses, Each course must include more than 15% content related to new technology (New Tech), new process (New Process), and new material (New Material).

5.3.2. Practical transformation of teaching mode

(1) Fully implement the OBE (Outcome-Based Education) model

Drive teaching with real-world problems such as "solving the problem of insufficient accuracy in pest monitoring in Weifang Shouguang's smart greenhouses";

(2) Innovative "Capability Ladder Training System"

Freshman basic skills training → sophomore virtual simulation training → junior year enterprise project practice → senior year job capability certification, achieving progressive capability cultivation.

5.4. Collaborative Construction of Policy Guarantee System

5.4.1. Strengthen local government support

(1) Establish a "Special Fund for Industry-Education Integration"

For enterprises deeply involved in collaborative education, deduct 150% of their investment amount from value-added tax;

(2) Establish a "talent demand whitelist system"

Provide housing subsidies and job allowances for talents in fields in short supply such as hydrogen energy equipment and agricultural chips.

5.4.2. Breaking through the bottlenecks of university systems and mechanisms

(1) Promote the provincial education department to authorize applied universities to independently approve "urgently needed and scarce majors" and shorten the approval cycle to 3 months;

(2) Reform the teacher evaluation system

Incorporate the transformation of technological achievements and solving enterprise problems into the core indicators of professional title evaluation.

6. CONCLUSION AND DISCUSSION

This study reveals through multidimensional empirical analysis that in the era of technological disruption, the fit between application-oriented universities and regional economies is essentially a manifestation of dynamic adaptability. The case of Weifang University of Science and Technology proves that enhancing fit requires breaking through three key bottlenecks:

6.1. Breaking the Rigidity of Professional Settings

Establishing a closed-loop mechanism of "monitoring-warning-adjustment" to respond to rapid technological iteration through flexible modes such as micro-specialties;

6.2. Beyond Superficial Industry-Education Integration

Promote the upgrading of school-enterprise relationships from "resource complementarity" to "technological symbiosis", and jointly establish industrial colleges to achieve deep integration of innovation elements;

6.3. Reconstruct the Talent Capability Map

Strengthen future competencies such as data thinking, interdisciplinary integration, and technological ethics, and cultivate a "T-shaped" composite capability structure.

The theoretical contribution of this study lies in introducing Dynamic Capability Theory into the research on industry-education integration and proposing a conceptual model of "technology-responsive universities". At the practical level, the constructed "three-dimensional dynamic fit framework" and "micro-major certification system" provide actionable solutions for the transformation of similar institutions. Future research needs to further track the dynamic impact of digital transformation on talent capability structure, with particular attention to the restructuring effect of generative AI on knowledge-based positions.

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