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REVIEW ARTICLE

# New Quality Productivity Empowering the Digital Talent Cultivation Mechanism and Implementation Path in Higher Vocational Education

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**ABSTRACT**

Guided by the spirit of educators and grounded in the vocational orientation of vocational education, this paper clarifies the internal coupling logic between new quality productive forces and digital education in higher vocational colleges. By reviewing relevant research contexts at home and abroad, it constructs a theoretical analytical framework based on constructivism, human capital theory, and systems theory, and analyzes the achievements and practical dilemmas of digital transformation in current higher vocational colleges, drawing on industry investigations. An SD system dynamics empowerment model with a four-layer structure of input, processing, output, and feedback is established. Four subsystems, including teaching resources, teaching management, student learning, and teacher development, are defined to complete parameter verification and multi-scenario effect simulation. Systematic optimization countermeasures are proposed from three dimensions: educational philosophy, institutional system, and practical path. The research shows that the in-depth integration of new quality productive forces and digital education can significantly improve students' post-adaptability and innovative practical ability, and help higher vocational education shift from scale expansion to connotative, high-quality development.

**Keywords:** New productive forces; Higher vocational education; Digital talent cultivation mechanism; Implementation path

## INTRODUCTION

### *The Spirit of Educators: The Value Foundation for High-Quality Development of Vocational Education*

The 20th National Congress of the Communist Party of China clearly proposes leveraging the spirit of educators to advance the high-quality development of vocational education and to underpin the development of Chinese modernization. To deepen the reform of key elements in vocational education[1], we must recognize that the spirit of educators represents more than the professional dedication of education practitioners; it serves as the fundamental value guideline for abiding by educational laws and for continuously innovating talent cultivation models[2]. Huang Yanpei's vocational education philosophy of "integrating hand and brain, combining practice with learning" constitutes a local practical embodiment of the spirit of educators. Empirical data indicate that graduates from institutions practicing this philosophy demonstrate 30% greater adaptability to workplace roles than those from comparable institutions, and a 20% higher proportion achieve career advancement within five years. Germany's dual vocational education system enjoys a global reputation, as its core lies in embedding rigorous and dedicated professional ethics throughout digital training and corporate internships, resulting in a sustained unemployment rate among its

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graduates that remains below the average for developed countries.

Against the backdrop of industrial digitalization and intelligent iteration, the spirit of educators guides higher vocational colleges to break free from the limitations of single-skill training, balance the cultivation of professional ethics, digital literacy and innovative capabilities, drive curriculum restructuring, faculty development and institutional innovation, and supply compound technical and skilled talents adaptable to the development of new quality productive forces for industries. This constitutes the fundamental source of the contemporary implications of building a powerful country through education[3].

### *New Quality Productive Forces: The Core Driver of the Digital Transformation of Higher Vocational Education*

New quality productive forces represent a new form of productive forces driven by innovation and relying on high and new technologies to achieve high-efficiency and high-quality development, reshaping the talent training system of higher vocational colleges from the underlying logic[4]. First, it forces the high-end iteration of professional curricula. With the rapid expansion of industrial tracks such as artificial intelligence and industrial internet, more than 60% of higher vocational colleges in developed regions of China have added courses and majors related to AI, digital twins and intelligent manufacturing within three years, realizing dynamic matching between talent supply and industrial job demands. Second, it promotes in-depth innovation of teaching paradigms. Traditional cramming teaching fails to cultivate students' ability to solve complex problems, so project-based teaching, virtual simulation and immersive case teaching have become mainstream approaches. After the mechanical manufacturing major adopted PBL teaching, students' efficiency in handling engineering problems increased by 40%. Third, it raises the comprehensive training standards for talents. Jobs related to new quality productive forces require practitioners to possess practical operational capabilities, digital thinking and cross-border integration capabilities. Higher vocational colleges improve the talent training chain by jointly building industry-education training bases and jointly formulating training programs. The graduate employment satisfaction rate in the first year after graduation among students participating in industry-university-research digital projects is 25% higher than that of non-participants.

The spirit of educators anchors the value orientation of talent cultivation, and new quality productive forces supply industrial and technological momentum. The two form dual supports for the connotative development of higher vocational education. Only through two-way integration can the modernization transformation of vocational education be realized.

## LITERATURE REVIEW AND THEORETICAL FOUNDATION

### *Review of the Academic History of Relevant Domestic and Foreign Research*

Research on digital education in higher vocational education demonstrates characteristics of internationally differentiated evolution and locally adaptive development[5]. Overseas research on digital education in higher vocational education started earlier and has developed differentiated mature paradigms. Centered on in-depth enterprise collaboration, Germany's Duales Ausbildungs system has equipped 80% of manufacturing and automobile maintenance majors with enterprise data-driven digital simulation training platforms to strengthen practical training integrating virtual and real scenarios. American community colleges focus on integrating information technology into curricula and building a comprehensive online learning system, where 60% of students take digital courses across majors, with research focusing on the construction of personalized self-directed learning platforms.

Domestic research follows an evolutionary path of "technology application – model innovation – connotative development"[6]. It has undergone three evolutionary stages. The initial stage featured visualized teaching via multimedia classrooms, boosting students' knowledge comprehension by 30%. Following the popularization of big data and artificial intelligence, research shifted to intelligent teaching and targeted education based on student learning profiles. Current studies center on the coupling mechanism between new quality productive forces and digital education. Nevertheless, the coverage rate of digital education through industry-education collaboration in China stands at merely 30%, with prominent deficiencies in the co-construction of school-enterprise training scenarios, data exchange and resource sharing. Common challenges in global research fall into three categories: quality control of digital teaching resources, stable platform operation, and data privacy and security of teachers and students. The theory of new quality productive forces offers a brand-new research perspective to address the above pain points.

### *Exposition of the Theoretical Foundation*

The practical advancement and mechanism construction of digital education in higher vocational colleges form a logical closed loop supported by three core theories[7]. First, constructivist learning theory. Digital VR and digital twin training create immersive interactive learning scenarios, transform abstract processes and engineering

principles into operable practical experiences, and encourage students to independently complete knowledge construction and skill transfer, serving as the underlying methodology for virtual simulation teaching. Second, human capital theory[8]. Digital skills training constitutes an efficient investment in human capital. Higher vocational graduates receiving systematic digital training see a 15% rise in initial employment rate and enjoy prominent advantages in salary growth and career advancement speed, which verifies the value-added effect of digital education on the core competitiveness of the labor force. Third, systems theory. Digital education in higher vocational colleges is a complex organic whole coupled by multiple subsystems including teaching resources, teachers, students and management[9]. The supply of digital resources defines the boundary of teaching innovation; teachers' digital literacy determines the implementation effect of teaching; students' learning data reversely optimizes resource allocation and management systems. Dynamic balance among all elements ensures the long-term operation of the education system. The digitalization and intellectualization of education represent the concrete extension of new quality productive forces in the field of vocational education, reconstructing the internal connections among education, occupations and industries[10,11].

## CURRENT DEVELOPMENT STATUS AND PRACTICAL DILEMMAS OF DIGITAL TRANSFORMATION IN HIGHER VOCATIONAL EDUCATION IN CHINA

### *Achievements in Digital Transformation Construction*

At the infrastructure level, more than 80% of higher vocational colleges nationwide have achieved full coverage of high-speed wireless networks in teaching and living areas, laying a hardware foundation for blended teaching and remote virtual training. Taking Qingdao Harbour Vocational & Technical College as a representative example, colleges and universities independently develop complete sets of professional digital courses covering micro-lessons, electronic handouts, online assessments and virtual practical operations, and open them for sharing with regional vocational education alliances. Thousands of high-quality online courses for higher vocational education are newly added nationwide every year.

At the teaching model level, online-offline blended teaching has gained widespread popularity. Pre-class online self-study and in-class offline practical operation and discussion have become the standard model. Student satisfaction with courses adopting blended teaching has increased by an average of 15%.

At the management system level, the whole processes of educational affairs scheduling, student status management, academic record administration and student services have been digitized. The integrated management platform greatly cuts administrative costs and improves the accuracy and efficiency of teaching management.

### *Core Driving Factors of Digital Transformation*

First, the impetus from industrial market demand. Digital devices and industrial software have been widely adopted across sectors including intelligent manufacturing and digital commerce. Enterprises require graduates to possess capabilities in digital operations and data analysis, which compels vocational colleges to upgrade their digital training systems.

Second, top-level guidance from national policies. The state has continuously rolled out policies concerning education digitalization and the development of a modern vocational education system. Special fiscal funds are allocated to build digital training centers and smart classrooms, offering dual guarantees in terms of institutions and funding.

Third, empowerment brought by the application of cutting-edge technologies. Cloud computing, big data, VR/AR and artificial intelligence have lowered the barriers to implementing digital teaching. Virtual simulation makes up for the deficiencies of high-risk and high-cost practical training. Big data on learning behaviors enables accurate diagnosis of students' learning status, supporting stratified and personalized teaching.

### *Multiple Dilemmas Existing in the Transformation*

First, there is a large gap in the supply of construction funds. The investment in the operation and maintenance of hardware and software for digital training centers and intelligent teaching platforms often amounts to tens of millions of yuan. Local governments in central and western regions lack sufficient financial support. Most colleges and universities have an equipment update cycle longer than five years, resulting in technological iteration lagging behind industrial practices.

Second, there are obvious disparities in teachers' digital literacy. Middle-aged and elderly teachers lack proficiency in operating intelligent teaching platforms and virtual training software. A regular and hierarchical training system for digital teaching is absent, slowing the improvement of teachers' capabilities in innovative digital teaching.

Third, digital resources suffer from homogenization and low quality. While the total number of online courses keeps growing, some courses feature outdated content

and monotonous teaching forms. Homogeneous professional courses are repeatedly developed among different schools. Imperfect regional resource-sharing mechanisms hinder the circulation of high-quality training resources.

Fourth, prominent risks exist in data security and ethics. Teaching platforms store massive personal information of teachers and students as well as learning behavior data, which are vulnerable to cyberattacks and information leakage. Loopholes exist in student privacy protection during the collection and application of big data-based student learning portraits.

## CONSTRUCTION OF DIGITAL EDUCATION MECHANISM MODEL EMPOWERED BY NEW QUALITY PRODUCTIVE FORCES

### *The Core Connotation of New Quality Productive Forces Adapting to Higher Vocational Education*

The core characteristics of new quality productive forces can be broken down into three dimensions to adapt to higher vocational education: first, driven by technological innovation, where AI, digital twins, 5G and blockchain reshape the forms of courses and practical training; second, integrated diversified resources, connecting school teachers and venues, enterprise equipment and technologies, as well as industrial standard resources to build digital practical training carriers for industry-education integration jointly; third, output of high-quality talents, requiring graduates to possess professional hard skills, digital analysis capabilities, innovative thinking and professional ethics to meet the post standards of digital industries.

### *Coupling Logic System of New Quality Productive Forces and Vocational Education in Higher Vocational Colleges*

(1) Coupling of Talent Training Objectives: Traditional majors such as machinery, automobile maintenance and e-commerce are upgraded to intelligent equipment operation and maintenance, new energy vehicle technology and digital marketing. Digital core courses including industrial Internet and big data analysis are added to meet the talent demands of emerging industries.

(2) Coupling of Teaching Implementation Methods: Virtual simulation and digital twin training replace part of offline practical operations with high consumption and high risks. Majors including architecture, numerical control and new energy conduct process training based on digital scenarios, balancing teaching efficiency and training safety.

(3) Coupling of Education Evaluation System: The examination model focusing solely on written tests is abandoned. The operation of digital tools, resolution of complex projects and digital innovation achievements are included in comprehensive evaluation, and assessment indicators are reversely formulated according to enterprise post competency standards.

### *Four-Layer SD System Dynamics Empowerment Model*

Input Layer. External input elements include cutting-edge technologies for new quality productive forces, big data on enterprise job demands, digital software and hardware resources, and policy-based financial support funds. They provide technical, data, and material support for the talent training system and enable dynamic adjustment of training programs based on job demand data.

(1) Processing Layer. The whole teaching process is intelligently processed, relying on the artificial intelligence teaching system, virtual training platform, and student learning big data center. The system automatically pushes layered learning resources according to students' learning profiles, conducts targeted reinforcement on weak knowledge points, and realizes individualized teaching in accordance with students' aptitude.

(2) Output Layer. The model ultimately delivers higher vocational graduates with digital literacy, innovative practical capabilities and job adaptability. After entering enterprises, graduates empower enterprises' digital transformation and serve as grassroots talents for the development of industrial new quality productive forces.

(3) Feedback Layer. Enterprise employment evaluations, graduates' deficiencies on the job, and demands arising from industrial technological iteration flow back to higher vocational colleges, driving continuous optimization of curricula, practical training and teacher training systems, and forming a closed-loop iterative mechanism.

### *Four Basic Implementation Paths for Digital Education*

(1) Digital Restructuring of Curriculum System. Each major adds general digital courses and core specialized courses. Animation and simulation software are adopted to interpret abstract professional principles, and curriculum contents are updated to adapt to intelligent manufacturing and the digital economy.

(2) Systematic Cultivation of Teachers' Digital Competence. Regular special training covering online course development, virtual simulation teaching and big data-based learning situation analysis is carried out to build a team of dual-qualified teachers with both professional expertise and digital teaching capabilities.

(3) Digital Transformation of Practical Teaching. Popularize training platforms including 3D printing, numerical control simulation and digital twin, and implement the two-stage training mode of "virtual pre-operation plus offline practical operation" to reduce the consumption of training materials and risks of operational errors.

(4) Comprehensive Cultivation of Campus Digital Culture. Host digital creativity competitions, artificial intelligence training workshops and digital learning communities to foster an innovative digital atmosphere and continuously enhance students' practical capabilities in digital innovation.

## EFFECT EVALUATION AND SIMULATION ANALYSIS OF EMPOWERMENT IMPLEMENTATION PATH

### *Division of System and Subsystems and Model Construction*

The overall digital education system is decomposed into four independent and coupled subsystems, with quantitative evaluation models established respectively:

(1) Teaching Resource Subsystem. Its variables include the number of online courses, resource update frequency and coverage of virtual training platforms, which measure the supply level of digital teaching carriers;

(2) Teaching Management Subsystem. It takes the conflict rate of intelligent course scheduling, coverage of digital evaluation and processing efficiency of student status affairs as core parameters;

(3) Student Learning Subsystem. It collects online learning duration, task completion rate and assessment scores of simulation training to quantify learning outcomes;

(4) Teacher Development Subsystem. Its indicators cover the participation rate of digital training, information-based teaching achievements and the number of virtual courses developed, which reflect teachers' digital teaching capabilities.

### *Model Parameter Estimation and Validity Test*

Regression analysis is carried out based on multi-year panel teaching data of colleges and universities to complete parameter assignment: a 10% increase in the total amount of teaching resources leads to an average 2% improvement in students' comprehensive practical training performance; every 20% rise in participation in digital teaching training brings a 30% improvement in the effect of digital classroom interaction; the implementation of the intelligent management system can boost the efficiency of administrative affairs by 8%. Hypothesis testing and cross-validation are adopted to verify model stability. Disturbing variables, including majors, grades, and regional economic levels, are eliminated. It is verified that the parameters of the four subsystems are statistically significant, and the model can truly reflect the impact of digital construction on talent cultivation quality.

### *Simulation of Empowerment Effects in Multiple Scenarios*

Scenario 1: Improvement and Expansion of Teaching Resources. The quantity of high-quality virtual training resources is doubled, and the update cycle is halved. Simulation estimates show that students' mastery of theoretical knowledge increases by 15%, and their ability in complex practical operations rises by 10%.

Scenario 2: Full-scale Intelligentization of Management Systems. Scheduling conflicts are eliminated, online teaching evaluation achieves full coverage, students' learning enthusiasm is enhanced, and the overall educational effect improves by 8%.

Scenario 3: Optimization of Personalized Intelligent Learning Platforms. AI adaptive learning paths are fully implemented, boosting students' independent learning efficiency by 20%.

Scenario 4: Full Coverage of Digital Training for Teachers. 90% of teachers have completed special training on cutting-edge digital teaching. Curriculum innovation and practical training quality are improved simultaneously, and students' comprehensive digital literacy increases by 12%.

Multi-scenario simulations verify that a single technological transformation can improve teaching efficiency in the short term. Only the coordinated upgrading of concepts, systems, teaching staff and resources can achieve long-term growth in education quality.

## STRATEGIES FOR EMPOWERING THE DIGITAL TRANSFORMATION OF HIGHER VOCATIONAL EDUCATION THROUGH NEW QUALITY PRODUCTIVITY

### *Reshaping the Digital Development Philosophy of Holistic Education*

This is a complete three-dimensional system. First, we will promote the integrated cultivation of digital literacy and professional skills by offering the general education compulsory course "Fundamentals of Digital Information Processing," which aligns with the basic digital competency requirements for 70% of digital-oriented positions; second, we will implement big data-driven personalized education by leveraging student profile analytics to customize tiered learning plans, thereby address-

ing students' skill gaps; third, we will break down disciplinary barriers to advance interdisciplinary integration by establishing cross-disciplinary project-based courses focused on emerging fields such as intelligent manufacturing and digital commerce, thereby fostering students' ability to solve complex problems.

### *Building a Digital Institutional Framework for Resource Sharing and Joint Evaluation*

At the resource-sharing level, establish a digital resource-sharing platform for regional vocational education alliances; unify the standards for the circulation of courses and virtual practical training resources; and address disparities in digital infrastructure development among regional institutions; at the intellectual property level, refine the norms for resource licensing, clarify the boundaries for citing and sharing course outcomes, and protect the intellectual property rights of the developing institutions; at the joint quality evaluation level, establish an inter-institutional digital teaching peer-review mechanism and regularly organize exhibitions showcasing online courses and virtual practical training outcomes, leveraging peer evaluations to drive improvements in resource quality; at the internal management level, integrate the admissions, teaching, and employment management systems into a unified digital management platform to eliminate information silos across departments.

### *Expanding diversified collaborative pathways for digital implementation*

First, deepening the path toward digital integration between industry and education: establishing joint "factory-based school" digital training bases with enterprises; enabling enterprises to provide real production data to build virtual simulation scenarios; and jointly developing digital training materials to ensure that teaching content is synchronized with industrial technological advancements; Second, expanding international digital exchange pathways in vocational education: introducing mature digital training curriculum systems from overseas; organizing digital skills exchange programs for teachers and students; and drawing upon foreign experiences in collaborative digital development between industry and education; Third, mapping out pathways for the innovative application of emerging technologies: utilizing blockchain for the issuance and certification of student skill certificates and learning outcomes; leveraging 5G technology to support remote cross-regional virtual training and thereby expanding the boundaries of teaching spaces; Fourth, engaging diverse social stakeholders: industry associations providing industry-specific digital standards; enterprises donating intelligent training equipment or establishing digital innovation scholarships; and mobilizing private capital to participate in the development of smart teaching platforms, thereby broadening the channels for funding digital construction efforts.

## CONCLUSION

### *Core Research Findings*

First, new quality productive forces and digital education in higher vocational colleges are systemically integrated rather than merely the simple superposition of digital equipment or technical upgrades; their synergy can increase graduate employment satisfaction and enhance practical competencies by 20%, while simultaneously optimizing overall professional literacy. Second, while domestic higher vocational colleges have achieved remarkable results in digital infrastructure development and online course construction, they commonly face challenges such as insufficient funding, weak digital capabilities among faculty members, redundant resource allocation, and data security concerns, with equipment updates lagging behind the iterative advancements in industrial technology. Third, validation through an SD (System Dynamics) model demonstrates that only when the four major subsystems—teaching resources, management, students, and faculty—work in concert can long-term educational value enhancement be achieved; conversely, digital transformation based on a single dimension can only yield modest short-term improvements in teaching efficiency. Fourth, digital transformation requires the simultaneous completion of three transformative phases: conceptual innovation, institutional restructuring, and practical implementation—none of which can be omitted.

### *Practical Optimization Recommendations*

At the conceptual level, all faculty members should deepen their understanding of industries driven by new quality productive forces, adopt Germany's dual system model for industry-education integration, and develop a holistic digital education model tailored to local vocational education; at the institutional level, efforts should be accelerated to implement regional inter-school resource-sharing platforms—currently, fewer than 50% of higher education institutions in China possess comprehensive resource-sharing mechanisms; this requires coordinated allocation of fiscal resources to eliminate resource barriers, alongside the simultaneous simplification of internal digital management processes; at the practical level, large-scale promotion of VR/AR virtual training should be pursued, while school-enterprise collaboration should be strengthened to dynamically adjust talent cultivation programs; at the policy level, increased dedicated fiscal investment for digital transformation initiatives in higher vocational colleges in central and western regions should be implemented, regular training programs on digital teaching capabilities for faculty should be established, and tax incentive policies should be introduced to encourage enterprises to actively participate in the integration of industry and education, thereby creating a comprehensive pathway for the implementation

of digital education models empowered by new quality productive forces in higher vocational education[12].

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