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Research on the reform of simulation-based experimental teaching in economics and management in the context of educational digital transformation

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Abstract

Against the backdrop of the deep integration of intelligent digital technologies—such as artificial intelligence, big data, and cloud computing—the digital transformation of education has emerged as a core driver for paradigm shifts in higher education. Focusing on simulation-based experimental teaching in economics and management disciplines, this study examines the ongoing transition of experimental teaching from a “tool-assisted” approach to a “data- and intelligence-driven infrastructure.” It further highlights the necessity of this transformation in aligning with national digital economy strategies, reshaping pedagogical paradigms, and advancing assessment reform. In response to prevailing challenges—including the “island effect” in resource allocation, misalignment between teaching content and digital-intelligent logic, deficiencies in faculty digital competencies, and the lagging development of evaluation systems—this study proposes a systematic reform framework. Specifically, four key pathways are advanced: (1) structural reconfiguration through the construction of digitally empowered “virtual–physical integrated” experimental platforms; (2) content reconstruction by developing interdisciplinary experimental systems that integrate business operations, finance, and data analytics (“business–finance–data” integration); (3) faculty empowerment via a competency-driven support mechanism facilitating role transformation; and (4) governance upgrading through the innovation of process-oriented, full-cycle evaluation models. The findings indicate that the proposed reform pathways can effectively address the mismatch between educational supply and industry demand, significantly enhance students’ digital competencies and higher-order decision-making capabilities in complex business environments, and provide robust practical support for cultivating high-quality, interdisciplinary talents in economics and management who are well-adapted to the demands of the digital economy.

Keywords: Educational Digital Transformation; Economics and Management Disciplines; Experimental Teaching; Teaching Reform

1. Introduction

Under the background of the deep integration of artificial intelligence, big data and cloud computing technologies, the digital transformation of education has evolved from merely technological empowerment to becoming the core engine for the reconfiguration of the higher education paradigm. At the national level, great attention is paid to the profound transformation of the talent cultivation model brought about by digital and intelligent technologies. The opinions of the Ministry of Education and other nine departments on accelerating the digitalization of education, in order to implement the "Education Powerhouse Construction Plan Outline (2024-2035)" (CPC Central Committee & State Council, 2025), Taking the digitalization of education as an important breakthrough point, we will open up new tracks for educational development and shape new advantages for development, and comprehensively implement General Secretary Xi Jinping's important expositions on education, especially his important instructions on the digitalization of education. We will deeply implement the national strategy for educational digitalization, adhere to application-orientation and

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governance as the foundation, uphold the principles of connectivity first, content-based, and cooperation as the key, focus on integration, intelligence, and internationalization, expand the coverage of high-quality educational resources, promote artificial intelligence to facilitate educational transformation, accelerate the formation of a ubiquitous and accessible lifelong education system, contribute to building a learning society where everyone can learn, everywhere is a place to learn, and learning is possible at any time, and provide strong support for effectively responding to the new round of technological revolution and industrial transformation, and accelerating the building of a leading country in education(MOE et al., 2025).

2. The Current Application Status of Digitalization in Education in Simulation Experiment Teaching of Economics and Management

With the in-depth advancement of the "Digital China" strategy and the full implementation of the digital transformation action in higher education, the simulation-based experimental teaching in economics and management in universities is undergoing a systematic transformation from an "auxiliary teaching tool" to a "core teaching foundation". Against the backdrop of the current "New Liberal Arts" construction and "digital intelligence empowerment", digital transformation is no longer merely an extension of space but is deeply integrated as a key production factor throughout the entire experimental teaching process. This transformation not only reshapes the logical boundaries of experimental teaching but also drives the teaching logic to leap from the superficial "replication of business processes" to the deeper "creation of business value" (Yang, 2018). Currently, Chinese universities have initially formed an application pattern in the field of economic and management simulation experiments characterized by "coupling of virtual and real training environments, digital intelligence integration of content, and data-driven evaluation"(Cheng et al., 2025). Through the deep integration of technology and education, it has effectively addressed the problem of the disconnection between theory and practice in traditional teaching.

2.1. Experimental Environment: Evolving from Simulation Training to a Hybrid Digital-Physical Intelligent Scenario

Under the strategic impetus of the digital transformation of education, the simulation experiment environment for economics and management is undergoing a paradigm shift from the traditional "closed computer room" to a "cloud-based, ubiquitous, and immersive" virtual-real integration space. Currently, universities generally rely on digital twin, cloud-native architecture, and mixed reality (MR) technology to break the constraints of time and space in economics and management experiment teaching. By building a highly realistic digital business field, it realizes the real-time simulation and dynamic mapping of macroeconomic operation, micro-enterprise decision-making, and complex market games. This digital intelligence experiment platform not only supports "anytime, anywhere, and any need" ubiquitous learning, but also integrates experimental software into a collaborative and interactive integrated platform through the interconnection of underlying data, providing students with in-depth simulation from single position operation to the entire industrial chain collaborative practice, and providing a strong guarantee for cultivating applied economics and management talents(Liu et al., 2025).

Table 1 Comparative Analysis of Traditional Experimental Teaching and Digital Experimental Teaching

Comparison dimension	Traditional experimental teaching	Digitalized experimental teaching
Space and Platform	Relying on fixed laboratories leads to the isolation of resources.	Based on the cloud platform, dynamic resource scheduling and real-time access
Environmental characteristics	Static and simplified simulation environment, focusing on local processes	An ecosystem that integrates reality and fiction, focusing on dynamic cross-temporal gameplays
Teaching content	Linear business orientation, limited to practical operations of a single discipline	Focusing on the integration of digital and intelligent elements, incorporating various complex contents such as big data and AI.
Student role	Passive executor, focusing on repetitive practice of preset steps	Digital and intelligent decision-makers conduct logical modeling in uncertain scenarios.

Teacher Role	Knowledge transmitter, focusing on software operation demonstrations and guidance	Experimental designer, focusing on high-level thinking guidance and data analysis
Learning Paradigm	Periodic and concentrated learning, centered on "teaching"	Adaptive and continuous learning, centered on "learning"
Evaluation mechanism	Summative evaluation relies on experimental reports and has a lag effect.	Process-based evaluation, precise evaluation based on the entire behavioral trajectory
Data value	Static result data, mainly used for assessing the completion degree	Productive factor data drives the continuous improvement of teaching quality.

2.2. Teaching Content: Transition from business simulation to the digital-intelligent integrated business logic

In response to the demand for comprehensive management and economic talents in the digital economy, the experimental teaching content has shifted from the traditional functional skills training to a cross-disciplinary system reconstruction centered on "digital and intelligent empowerment". The current application status exhibits distinct characteristics of "integration of business and finance" and "deep integration of industry and education" (Qin et al., 2022): Experimental design is no longer limited to mechanical simulations of accounting, finance or logistics in a single discipline, but instead, cutting-edge digital technologies such as big data analysis, artificial intelligence algorithms, and blockchain traceability are deeply integrated into the business processes of economics and management (Li et al., 2026). The core of teaching has focused on cultivating students' data-driven decision-making ability in a complex business ecosystem, that is, through simulating comprehensive projects such as supply chain finance, intelligent marketing, and digital human resource management, guiding students to conduct logical modeling, pattern exploration, and solution optimization in highly uncertain simulation environments (such as simulations of black swan events). This content reform effectively addresses the pain points of fragmented knowledge and the mismatch between the actual needs of industrial digital transformation in traditional teaching, and strengthens students' high-level thinking as "digital and intelligent decision-makers" (Wu et al., 2026).

2.3. Teaching evaluation: From outcome-oriented assessment to data-driven holistic evaluation

The deep application of digital technology in economic management simulation experiments has led to a transformation of the teaching evaluation system from a single, lagging result-based scoring to a comprehensive monitoring of the entire learning process. Relying on learning analysis technology and multi-dimensional data evaluation, the experimental platform can collect real-time and large amounts of basic data such as students' decision-making paths, operation durations, resource allocation efficiency, and team collaboration frequencies during the simulation game process (Zheng et al., 2022). By constructing AI algorithm models, the teaching system can precisely draw "digital ability portraits" for each student, achieving quantitative measurement of implicit indicators such as financial analysis ability, risk prevention awareness, leadership, and professional ethics. This situation marks that the experimental evaluation has entered a new stage of "process-oriented", providing teachers with real-time teaching feedback and personalized guidance basis. Moreover, through the closed-loop of evaluation results, it drives the dynamic iteration and continuous optimization of experimental teaching quality, demonstrating the core value of digitalization in economic management experimental teaching (Wang, 2026).

Table 2 Evaluation Index System for Experimental Teaching in Business and Management Disciplines

Evaluation dimension	Specific indicators	Data source	Evaluation method
Knowledge acquisition	Theoretical application ability	Experimental Report	Qualitative + Quantitative
Operational ability	System operation proficiency	Platform records	Data analysis
Decision-making ability	Rationality of decision-making path	Behavior trajectory	Model analysis
Collaboration ability	Frequency of team interaction	System log	Quantitative indicators
Innovation capability	Degree of innovation in the plan	Project outcome	Expert evaluation

3. The Necessity of Transforming Experimental Teaching in Economics and Management Disciplines in Universities

3.1. In line with the strategic requirements of the digital economy, it is an inevitable choice to solve the mismatch between production and education.

In the broad context of the country's comprehensive promotion of the digital economy strategy and the construction of "new liberal arts", the underlying logic of the commercial society has shifted from "experience-driven" to "data-driven and intelligence-driven". Currently, related industries have highly relied on big data and artificial intelligence in decision support, risk prevention and control, and value chain reconfiguration. However, traditional experimental teaching in economics and management still remains in the process simulation and static modeling of the industrial era, which is bound to lead to a serious "technological gap" and "cognitive divide" between talent cultivation and industrial demands. Therefore, the urgency of educational digital transformation lies in enabling the deep integration of blockchain, cloud computing, AI agents and other cutting-edge technologies into the entire teaching process through digital empowerment, and constructing a virtual simulation experimental environment that is highly synchronized with the digital and intelligent business ecosystem. This not only responds to the strategic measures of the country regarding the quality requirements for autonomous talent cultivation, but also realizes the essential leap from "tool simulation" to "ecological restoration" of the experimental content through the digital reorganization of teaching elements. Through this transformation, it can effectively shorten the "ability adaptation period" from campus to the workplace, resolve the structural contradictions in the supply and demand of industry and education in the dynamically evolving simulation scenarios, and provide digital China with a group of compound talents who possess both practical skills and strategic foresight("Academic 'Hot Spots' and 'Cold Spots'", 2026).

3.2. Drive the reconfiguration of the business management teaching paradigm, and enhance students' higher-order thinking and decision-making abilities

The practical nature of the management discipline requires that the teaching system be able to deeply reproduce the games and random events in the complex social and economic systems. Traditional experimental teaching is often limited by pre-set rule-based operations, and students often remain at the "business executor" cognitive level, making it difficult for them to cultivate strategic decision-making skills in highly complex environments. The necessity of digital transformation lies in its reliance on digital twins and multi-agent simulation technology (MAS), which maps out a multi-variable coupled and highly uncertain real market environment within the physical space of the laboratory. This paradigm reconfiguration forces students to shift from passive "experimental verification" to active "exploratory decision-making", guiding them to conduct logical modeling, trend analysis, and risk hedging in the massive data flow. During this process, students shift from simple knowledge acquisition to systematic interpretation of complex problems, achieving a leap from "operational skills-oriented" to "digital and intelligent management-oriented". This deep-level logical reconfiguration not only enhances students' critical thinking and systematic decision-making high-order abilities, but also provides a solid underlying support for the transformation of management discipline experimental teaching from "instructive learning" to "instructive learning".

3.3. Empowering the evaluation reform of experimental teaching to achieve the core means of precise capture and resource equity

The experimental teaching in economics and management is confronted with several bottlenecks such as the lack of process monitoring, delayed feedback evaluation, and fragmented high-quality resources over time. These issues severely restrict the continuous improvement of teaching quality. The core value of digital transformation lies in leveraging data collection throughout the entire lifecycle and deep learning algorithms to establish a multi-dimensional and intelligent evaluation system. By continuously capturing students' decision paths, behavioral characteristics, and interaction trajectories in simulated games, the system generates precise "student ability profiles", achieving a paradigm shift from "terminal grades" to "developmental feedback", providing empirical basis for achieving individualized teaching and precise intervention (Zhou,2026). Digital means have broken through the barriers of geographical distance and school-level hierarchies, promoting the cloud-based intensive and efficient sharing of high-level national virtual simulation experimental resources and industry-leading cases. It has optimized the allocation efficiency of educational resources, constructed a new experimental teaching ecosystem of open collaboration and value creation, and has profound strategic significance for promoting the balanced development of higher education and achieving precise capture of the entire experimental teaching process and the experimental loop (Xun et al., 2026).

4. Challenges Faced by Experimental Teaching in Economics and Management Disciplines in Universities in the Digital Age

4.1. The "island effect" in resource allocation and the profound limitations of the integration of reality and virtuality

Currently, under the impetus of educational digital transformation, universities have initially completed the infrastructure construction of virtual simulation platforms. However, in terms of resource integration and ecosystem construction, they still face significant "islandization" challenges. The existing experimental resources in the field of economics and management are mostly scattered and distributed among different departments or disciplines, lacking unified data interface standards and underlying architecture protocols. As a result, the data of capital flow, information flow, logistics, and commercial flow are difficult to achieve deep integration across platforms, and the complex business ecosystem logic in the global context cannot be restored (Yu et al., 2026). Some platforms' digital scenarios exhibit a bias towards "emphasizing form but not spirit": in interface design, they pursue extreme visual realism, but in the simulation of economic operation laws at the bottom level, the dynamic response of multi-variable games, and the deep mapping of digital twin technology, they are still weak. This "weak interaction, strong visualization" limitation makes the simulation environment often only be able to replicate fixed business processes, and is unable to map the systematic linkage effects of "one move affects the whole" in the real market, weakening the scientificity and authenticity of the experiments.

4.2. Digital and Intelligent Logical Deviations in Teaching Content and the Visualization of Interdisciplinary Integration

There is a significant lag between the reconfiguration of experimental content in the field of economics and management and the evolution speed of the digital economy. The core contradiction lies in the fact that the integration of "digital intelligence technology" and "economic and management logic" is still at the initial stage of tool application. In most experimental projects during the development process, traditional offline business processes are simply "electronically transformed" without deeply embedding the digital and intelligent characteristics such as big data mining, artificial intelligence decision-making, and blockchain consensus mechanisms throughout the entire process of business management. At the same time, the construction of new liberal arts emphasizes interdisciplinary integration, but in teaching practice, the cross-disciplinary interaction often remains superficial, manifested as the simple stacking of different professional software or "assemblage-style" combinations, lacking substantive deconstruction and reorganization of the knowledge system based on the underlying logic of digital intelligence. This leads students to often find themselves in a predicament of "knowing the result but not the reason", being able to proficiently operate digital tools, but unable to establish data-driven strategic judgment and systematic decision-making thinking in highly uncertain and information-overloaded simulation scenarios.

4.3. Shortcomings in the digital literacy of the teaching staff and the mismatch between their roles and the required transformation

As the key role driving the digital transformation of education, the structural shortage of digital literacy among teachers has become the main problem restricting the improvement of the quality of experimental teaching in economics and management. Although some young and middle-aged teachers have a solid theoretical foundation, their understanding of the underlying technologies of digitalization (such as algorithm logic, cloud-native architecture, etc.) is still at the application level, making it difficult for them to transform the logic of cutting-edge technologies into practical experimental teaching cases in teaching design. In actual guidance, teachers mostly focus on the demonstration of "how software is clicked" in terms of skills, but lack logical guidance on "how data empowers business". Moreover, during the transformation from the traditional role of "knowledge transmitter" to "experiment guide" and "data analyst", the teacher group generally faces the practical challenges of insufficient transformation motivation and scattered energy investment (Yang et al., 2026). This lag in teaching staff capabilities and role misalignment has led to the reduction of high-level simulation experimental resources, making it difficult to support the deep and advanced digitalization teaching paradigm reform.

4.4. The institutional nature and data-driven logic gap of the evaluation system

Big data and learning analysis technologies provide a solid technical reference for the "full behavioral trajectory portrait" of the experimental process. However, at the level of institutional implementation, the traditional "result-centered" terminal assessment system is still deeply rooted, forming a significant institutional dependence. The current educational administration evaluation and teaching quality monitoring system often struggle to be compatible with such high-frequency, multi-dimensional and dynamic data evaluation models, resulting in an awkward situation where

massive experimental behavior data is "easy to collect, difficult to transform and lagging in application". The core value of experimental data in feedback teaching, assisting decision-making, and personalized guidance has not been fully explored, resulting in the waste of data resources. The governance system for experimental data is still not sound. Institutional barriers such as data privacy boundaries, data asset ownership, and mutual recognition of the reliability of evaluation results among different schools still objectively exist (Zheng et al., 2026). This mismatch between the evaluation logic and the inertia of the institutional environment makes it difficult for teaching governance to form a digital and intelligent closed loop of "precise feedback - continuous improvement", restricting the leap of reform from "local pilot projects" to "deep governance".

5. Exploration of Experimental Teaching in Economics and Management in Colleges and Universities under the Background of Digital Transformation

Under the backdrop of digital transformation, Zhejiang University of Finance & Economics Dongfang College has been committed to cultivating high-level applied technical talents that meet the demands of local economic development. Since the establishment of the "Interdisciplinary Comprehensive Training Center" in 2010, the college has continuously delved into the exploration and practice of virtual simulation experimental teaching in economics and management. Through in-depth cooperation with Yonyou Newroad, the college, as a national prototype user, has developed digital teaching resources, promoting the transformation of experimental teaching from the traditional "demonstration and verification" model to a new paradigm characterized by "data-driven, scenario simulation, process tracking, and intelligent evaluation". Taking the "Virtual Simulation Experiment of Raw Material Procurement Management for Haining Leather Garment Manufacturing" as an example, the project closely aligns with the characteristics of Haining's leather industry, relying on 3D simulation, 2D animation, and HTML5 technologies to realistically replicate diverse scenarios such as manufacturing enterprises, workshops, and trade shows. This effectively addresses the practical pain points in traditional teaching, such as the difficulty of accessing real scenarios, the irreversibility of business processes, low error tolerance in experiments, high costs and significant safety risks associated with enterprise visits. The project adheres to the integration of knowledge, ability, and emotion in teaching objectives, converting abstract procurement logic and inventory balance into visual, interactive, and repeatedly practicable digital content. By constructing a new teaching paradigm featuring "data-driven, scenario simulation, process tracking, and intelligent evaluation", it has profoundly restructured the experimental teaching ecosystem in economics and management. Relying on a cloud-native technology foundation and multi-cloud deployment capabilities, a virtual simulation platform integrating digital empowerment, intelligent integration, and practical scenarios has been built. Through systematic digital reconstruction of teaching scenarios, processes, and resources, it has broken through the constraints of time and space, creating a complete learning loop for students from cognition to decision-making and feedback optimization, significantly enhancing their innovative awareness and comprehensive practical abilities in dealing with complex business scenarios in the digital intelligence era.

5.1. Architectural Reorganization: Building an "Integrated Virtual and Real" Digital Intelligence Experiment Platform Ecosystem Empowered by Cloud-Native Technology

In response to the predicament of resource isolation and insufficient depth of virtual-real coupling, reform practices should first shift from the underlying logic of experimental teaching to the reconfiguration of the digital middle platform architecture. Universities should rely on cloud-native technologies to pool heterogeneous experimental software, data resources, and computing capabilities, breaking the constraints of physical space and traditional software architectures. In terms of practical approaches, digital twin technology should be utilized to create a high-fidelity mapping of the real business environment, establishing a digital and intelligent experimental field that integrates "macro-environment simulation, meso-industry collaboration, and micro-enterprise decision-making". The profound significance of this architectural reorganization lies in the fact that laboratories are no longer static teaching venues but dynamic digital twins that can be connected in real-time to real enterprise data and simulate market random games. Through this ubiquitous cloud ecosystem, students can achieve cross-temporal and spatial, high-frequency, and in-depth interactions, providing a solid technical foundation and environmental support for the cultivation of "practical" capabilities of business and management talents.

5.2. Content Reengineering: Deeply Cultivating a Cross-disciplinary Advanced Experimental System for the Deep Integration of Business, Finance, and Data

In the supply-side reform of teaching content, we should abandon the primary logic of "electronic business processes" and focus on building a high-level experimental content system centered on "empowering decision-making with data assets". We should deeply explore the application logic of big data analysis, artificial intelligence algorithms, blockchain traceability, and knowledge graphs in business management practices, and take them as the core of the experimental process rather than merely as auxiliary tools. For instance, in supply chain management simulations, we can introduce

demand forecasting models based on machine learning, and in audit simulations, we can embed anomaly detection mechanisms based on big data mining. By designing "interdisciplinary, cross-professional, and highly competitive" digital intelligence projects, we can promote the transformation of teaching content from "single job operation" to "global value creation". This content reconstruction aims to guide students to conduct logical modeling and strategic optimization in highly uncertain and information-overloaded simulation scenarios, thereby evolving their digital intelligence survival skills and critical decision-making thinking in the process of solving complex system problems.

5.3. Team Empowerment: Establishing a Support Mechanism for Teacher Development Based on "Competency-driven and Role Transformation"

As a vital force in the digital transformation of education, the role transformation and competence improvement of teachers are the key to the success of the reform. Universities should establish a new type of teacher development community featuring "human-machine collaboration and digital intelligence coexistence", and implement a special project for enhancing teachers' digital intelligence competence. Through specialized training under the framework of subject teaching knowledge integrated with technology, mutual dispatch and rotation training between universities and enterprises, and digital intelligence teaching competitions, teachers should be driven to make a substantive role transition from traditional "knowledge transmitters" to "experimental scenario architects" and "learning data analysts". Teachers should not only possess acute digital insight but also, based on the massive process data generated by simulation platforms, provide students with precise logical inspiration and decision feedback. A corresponding incentive system for digital intelligence experimental teaching and a mutual recognition mechanism for scientific research should be established to stimulate teachers' intrinsic motivation to engage in teaching paradigm innovation from the perspective of evaluation orientation, thereby forming a virtuous cycle of synchronous resonance between talent cultivation and technological evolution.

5.4. Governance Enhancement: Innovation of the "Evidence-Oriented" Whole-Process Evaluation and Precise Governance Model

In the dimensions of evaluation and governance, the deep value of educational big data as a production factor should be fully explored to promote the transformation of experimental teaching from a "result-oriented assessment" model to one that is "process-driven, data-enabled, and precisely governed". The key point of the experiment lies in the full quantitative collection of students' decision-making paths, resource allocation efficiency, risk preferences and team collaboration trajectories during the experimental game process by using behavior monitoring technology and deep learning algorithms. By constructing a multi-dimensional "ability digital intelligence portrait", a paradigm leap in evaluation logic from qualitative description to quantitative measurement is achieved, providing precise empirical evidence for teachers to teach students in accordance with their aptitudes. By establishing a dynamic governance mechanism for teaching quality based on data feedback, intelligent decision-making can be achieved for the allocation of experimental resources, the logical iteration of courses, and the optimization strategies of platforms. The innovation of this evaluation system can not only significantly enhance the quality of teaching output, but also drive the experimental teaching system of economics and management to move towards the peak of intelligent, personalized and modern governance (Deng et al., 2026).

6. Conclusion

The digital transformation of education is not only a technical adjustment for higher education to adapt to the digital and intelligent era, but also reflects a systematic reconstruction of the logic, organizational form and evaluation methods of experimental teaching. Under the background of digital transformation, in response to the practical constraints faced by simulation experiment teaching in economics and management in terms of technological iteration, disciplinary boundaries, evaluation mechanisms, and faculty qualities, an exploratory transformation path has been proposed, which takes "digital intelligence empowerment" as the foundation, "interdisciplinary collaboration" as the core, and "personalized evaluation" as the orientation. Practice has proved that by building a new experimental teaching ecosystem that combines virtual and real elements and integrates culture and business, the problem of the disconnection between theory and practice in the cultivation of applied talents can be effectively solved, and students' digital competence and comprehensive decision-making ability in complex business environments can be significantly enhanced. However, the digital reform of experimental teaching is a complex systematic project. Although this study has achieved certain results in the reconstruction of the teaching system and resources, there is still room for improvement in areas such as the standardized protocol for the co-construction and sharing of cross-school experimental resources, as well as the deep adaptation of generative artificial intelligence (AIGC) in experimental teaching. Looking ahead, with the in-depth penetration of smart twin and metaverse technologies, experimental teaching in economics and management will move towards a higher stage of digital and intelligent governance. Future

research should further focus on building a more open, flexible, and lifelong smart training system to provide a solid guarantee for cultivating high-quality, compound talents that can meet the needs of the future digital economy.

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