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Research on the Path Construction for Empowering the Digital and Intelligent Transformation of Undergraduate English Education in Shandong Province by New Quality Productive Forces

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Abstract

The development of new quality productive forces has imposed an urgent imperative for the digital and intelligent transformation of undergraduate English education. Taking undergraduate English education in Shandong Province as the research object, this study first elucidates the inherent logical connection between new quality productive forces and the digital-intelligent transformation of English education. Drawing on literature and institutional practice reports, it further identifies the practical challenges currently encountered, including superficial technological integration, insufficient digital literacy among teachers, lagging supply of high-quality resources, and imbalanced regional development. The study constructs a "Technology-Resources-Ecology" three-dimensional synergistic empowerment pathway: leveraging artificial intelligence technologies to establish personalized learning and adaptive assessment systems to drive pedagogical model reform; constructing a multimodal digital resource repository characterized by Shandong's regional cultural features to achieve precise resource supply; and reshaping the industry-education integration ecosystem to collaboratively cultivate interdisciplinary talent equipped with "Foreign Language + Digital Skills + Professional Expertise." The study concludes that the digital and intelligent transformation of undergraduate English education empowered by new quality productive forces constitutes a systemic reform process. The pathway construction delineated herein aims to provide both theoretical reference and practical guidance for language education reform in Shandong Province and comparable higher education institutions.

Subject Areas

Higher Education Studies, Educational Technology

Keywords

New Quality Productive Forces, Undergraduate English Education, Digital and Intelligent Transformation, Shandong Province, Pathway Construction, AI Empowerment

1. Introduction

Since 2023, China has stressed multiple times that new quality productive forces should be developed, a new kind of productive forces due to technology, new factor distribution, and industrialisation. Within the sphere of higher education, new quality productive forces not only impose elevated demands upon talent cultivation—specifically calling for a substantial cohort of interdisciplinary talents equipped with a global vision, digital literacy, and cross-cultural communication competence—but also infuse the modernization of education itself with renewed momentum derived from artificial intelligence, big data, and next-generation computing power networks.

As an integral foundational and general component of higher education, undergraduate English education bears the significant mission of bolstering the nation's capacity for international communication. However, in the context of a language learning revolution propelled by generative artificial intelligence, the traditional pedagogical model, which remains predominantly anchored in "knowledge transmission and skill training," has progressively laid bare deep-seated contradictions. These include the homogenization of educational supply, the oversimplification of evaluation mechanisms, and an increasing detachment from authentic, real-world language application scenarios. Consequently, the question of how to harness the technological momentum of new quality productive forces to propel the advancement of undergraduate English education toward a more sophisticated digital and intelligent form stands as a pressing contemporary issue.

As a prominent educational province and one of the inaugural pilot regions for educational informatization in China, Shandong Province has engaged in proactive explorations within the domain of "Artificial Intelligence + Education" in recent years. Leveraging the provincial smart education platform and the educational computing power alliance, the province has established a robust material foundation for the digital and intelligent transformation of its higher education institutions. Nevertheless, an analysis of publicly available policy documents issued by the Shandong Provincial Department of Education (2023-2025), provincial education yearbooks, and institutional teaching quality reports reveals that undergraduate English education in Shandong continues to confront salient "structural bottlenecks" in its pursuit of digital and intelligent advancement. On one

hand, certain universities have reduced the concept of digital transformation to the mere procurement of hardware or the superficial transplantation of generic teaching platforms, engendering a dissonance wherein technological application diverges from the intrinsic principles of language pedagogy. On the other hand, the regional digital divide among institutions of varying tiers, a structural deficit in faculty digital competencies, and the sluggish development of high-caliber foreign language corpus resources imbued with distinctive Shandong cultural heritage collectively impede the profound progression of this transformation. These dilemmas converge upon a core inquiry: under the impetus of emerging technological conditions, how can the essential productive factors of undergraduate English education—namely faculty, pedagogical resources, and the learning environment—achieve qualitative enhancement through optimized recombination?

Against this backdrop, the present study adopts the theoretical perspective of new quality productive forces and selects undergraduate English education in Shandong Province as its object of inquiry. It endeavors to systematically explore the construction of pathways for empowering digital and intelligent transformation through the agency of these new productive forces. Adhering to a logical progression from "theoretical foundation" through "challenge identification" to "pathway design" and "implementation considerations," the research first elucidates the intrinsic coupling mechanism between new quality productive forces and educational digital-intelligent transformation, thereby constructing a tripartite analytical framework of "technology-driven impetus—factor restructuring—ecosystem reconfiguration." Subsequently, it conducts an in-depth analysis of the prevailing status quo and impediments characterizing the transformation of undergraduate English education in Shandong Province. Building upon this foundation, the study proposes systematic pathways for transformation across three dimensions: technological empowerment, resource construction, and ecosystem reconfiguration, complemented by the design of corresponding institutional and supportive mechanisms. This paper aspires to furnish a theoretical reference for the high-quality development of regional undergraduate English education in the era of new quality productive forces, while simultaneously offering actionable guidance for educational administrative bodies and frontline practitioners within universities.

Research Design and Methodology

This study is a theoretical and policy analysis grounded in literature review, policy interpretation, and analytical framework construction. The research follows a logical chain of "theoretical deduction—challenge identification—pathway construction. The research design follows a logical chain of "theoretical deduction—current situation analysis—pathway construction." The materials examined primarily consist of three levels:

Policy documents: The analysis focuses on the Shandong Province "Artificial Intelligence + Education" Implementation Plan, the planning documents of the

Shandong Education Computing Power Alliance, and the guiding documents on the digital transformation of higher education issued by the Shandong Provincial Department of Education over the past three years.

Academic literature: Peer-reviewed journal articles and review papers concerning new quality productive forces and educational transformation, the application of artificial intelligence in second language acquisition, and frameworks for teacher digital literacy, both domestically and internationally, are systematically reviewed (see References for details).

Practical cases: Through publicly available reports and university teaching quality reports, the study examines pilot experiences and phased data feedback from selected higher education institutions in Shandong Province (e.g., Qilu Normal University, Shandong University, Ocean University of China) regarding the construction of smart foreign language teaching platforms and AI-empowered curriculum reform.

2. Theoretical Grounding and Current Context

2.1. The Theoretical Coupling Logic of New Quality Productive Forces and Educational Transformation

The new quality productive forces theory presented above applies to education in three ways: teachers' digital skills are the active student, AI and big data is the new source of labor, and students' learning needs are individual. In the field of education, the theoretical applicability of new quality productive forces is manifested in a threefold reconstruction of factors: teachers' digital literacy as the active subject, artificial intelligence and big data platforms as new means of labor, and students' individualized learning needs as the characteristics of the object of labor. This dynamic gives rise to a coupling relationship of mutual empowerment between new quality productive forces and educational transformation. Specifically, within undergraduate English education, the intervention of generative artificial intelligence is disrupting the traditional triadic structure of "teacher-textbook-student," propelling English education to transition from an extensive development model centered on knowledge transmission to an intensive development model characterized by human-machine collaboration and data-driven methodologies [1]. This shift is precisely a quintessential manifestation of the qualitative upgrading of educational production factors driven by new quality productive forces [2]. Consequently, the theory of new quality productive forces must be adopted as the fundamental analytical framework for examining the pathways of digital and intelligent transformation in undergraduate English education [3].

2.2. Connotation Definition and Analytical Framework of the Digital and Intelligent Transformation of Undergraduate English Education

The digital and intelligent transformation of undergraduate English education is not a mere upgrade of digitization; rather, it is a systemic transformation that in-

troduces artificial intelligence technologies atop a digital foundation to achieve data-driven decision-making, intelligent-assisted instruction, and ecological collaborative innovation. Its core connotation encompasses four progressive dimensions: the ubiquity and immersion of the teaching environment, the precision and intelligence of teaching resources, the human-machine collaboration of teaching models, and the process-oriented and multimodal nature of educational evaluation. Based on this connotative definition, this study constructs a three-dimensional analytical framework of "technology-driven impetus—factor restructuring—ecosystem reconfiguration." The technology-driven dimension focuses on how technologies such as artificial intelligence and big data are transforming the modes of content supply and interaction forms in language learning. The factor restructuring dimension focuses on the repositioning of teachers' digital roles, the intelligent planning of learners' personalized learning pathways, and the evolution of teaching resources toward dynamically generated content. The ecosystem reconfiguration dimension examines how universities, language intelligence enterprises, and cultural communication institutions can construct a new ecosystem of industry-education integration to jointly serve the cultivation of interdisciplinary language service talents. This framework provides a structured theoretical instrument for the subsequent construction of transformation pathways.

2.3. Development Foundation and Practical Challenges of the Digital and Intelligent Transformation of Undergraduate English Education in Shandong Province

As a major educational province, Shandong has already established a relatively solid foundation for promoting the digital and intelligent transformation of higher education. It has successively promulgated policy documents such as the Implementation Plan for "Artificial Intelligence + Education" in Shandong Province,(Lu Jiao Shu Zi [2025] No. 2, which explicitly proposes to construct a full-chain "AI + Education" ecosystem, establish approximately 15 AI-education innovation research bases, develop 300 AI application pilot schools, and build 30 exemplary virtual simulation training bases), initiated the construction of an educational computing power alliance, and preliminarily established an integrated digital and intelligent infrastructure based on a "cloud-network-edge-end" architecture. As of 2026, Shandong Province has undertaken two national-level pilot programs—the comprehensive deepening application pilot of the National Smart Education Platform and the regional pilot for AI-empowered education initiatives—and has established 38 provincial pilot regions and 31 pilot universities, including Shandong University, Shandong Normal University, Shandong Jianzhu University, Shandong Vocational College, and Shandong Water Conservancy Vocational College. Several universities have conducted pioneering explorations in areas such as AIGC-empowered English instruction and the construction of knowledge graph-based curricula. However, when measured against the intrinsic requirements of educational transformation driven by new quality productive forces, the digital

and intelligent transformation of undergraduate English education in Shandong Province still confronts multiple practical challenges. First, there exists a structural misalignment between technological application and the specific needs of language pedagogy, resulting in a relatively low utilization rate of intelligent tools. Second, there is a structural shortage of teachers' digital competencies [4], specifically a dearth of faculty proficient in both English pedagogical methodologies and intelligent technology applications. Third, the development of multimodal English corpora and intelligent learning resources for English for Specific Purposes (ESP) that embody Shandong's distinctive regional cultural characteristics—such as the Confucian cultural heritage and maritime silk road commerce language—remains severely lagging. Fourth, there is an imbalance in the level of digital and intelligent development between institutions affiliated with central ministries and local universities, posing a risk that the "Matthew effect" will exacerbate disparities in educational quality. The aforementioned challenges indicate that the digital and intelligent transformation of undergraduate English education in Shandong Province urgently requires a shift from fragmented technological application toward systematic pathway construction.

3. Construction of the Three-Dimensional Synergistic Empowerment Pathway: Technology-Resources-Ecology

The digital and intelligent transformation of undergraduate English education in Shandong must move toward a systematic, synergistic pathway. Aligning with the "Technology-Resources-Ecology" framework announced in the abstract, this section constructs a three-dimensional empowerment model to reshape pedagogical paradigms, optimize content supply, and reconfigure the cultivation ecosystem.

3.1. Technological Empowerment: AI-Driven Reconstruction of Pedagogical Models and Assessment

Technology constitutes the primary impetus for educational transformation. This dimension focuses on AI integration to transform language instruction and evaluation.

First, institutions should leverage the provincial educational computing power alliance to establish personalized learning and adaptive assessment systems. For example, Shandong University's pilot of iFLYTEK's AI-based speaking evaluation has shown that real-time phonetic diagnosis significantly improves oral proficiency. Generative AI-assisted writing platforms further provide instant feedback on logic and discourse, shifting instructional focus toward critical thinking.

The mechanism linking AI tools to competency enhancement operates through a "feedback-cognition-practice" loop: AI analyzes learner behavior [1] to deliver tailored content, while VR simulations of international conferences enable immersive practice. This data-driven process accelerates the internalization of pragmatic competence, transforming AI from a tool into a cognitive partner [5].

Second, evaluation reform must align with transformation goals. A multimodal

assessment system—incorporating intelligent speech evaluation, NLP-based writing analysis, and blockchain-recorded competency trajectories—should integrate international communication capacity as a core dimension. This exerts backward pressure to ensure teaching aligns with authentic communication demands.

3.2. Resource Restructuring: Multimodal Digital Repository with Shandong Characteristics

Educational content requires a qualitative upgrade in the digital era. This dimension addresses the precise supply of regionally grounded, high-quality resources.

Shandong's English education must move beyond textbook digitization to construct a multimodal digital repository featuring Qilu culture, Confucian thought, and maritime heritage. Resources such as the "Confucius Institute Online Collaboration Platform" and Shandong Museum digital exhibitions can be integrated into ESP courses, enabling students to accumulate transmissible cultural knowledge while acquiring language skills.

Knowledge graph technology can semantically link cultural resources with core vocabulary and grammar, enabling a shift from linear instruction to intelligent, network-based content exploration. This restructuring embodies the factor optimization logic of new quality productive forces.

3.3. Ecosystem Reconfiguration: Industry-Education Integration for Interdisciplinary Talent

Transformation ultimately requires reconfiguring the educational ecosystem across universities, enterprises, and society. This dimension focuses on collaborative cultivation of "Foreign Language + Specialization + Digital Competence" talent.

Institutions should promote cross-disciplinary integration between English and fields such as digital media and international business through modular curricula and micro-credentials. Virtual teaching studios and cloud collaboration platforms should be established with overseas partners and local enterprises like Double-Fly Translation and Inspur Group. Students engage in authentic tasks—simultaneous interpretation shadowing at the Qingdao Multinationals Summit or cross-border e-commerce live-streaming—while using big data tools to analyze international social media feedback [5].

This ecosystem reconfiguration bridges the gap between university cultivation and national communication demands, shifting talent production from standardized mass output to precision-oriented interdisciplinary shaping.

4. Implementation Considerations

4.1. Continuous Optimization of Infrastructure and Technical Support Systems

The primary implementation condition for empowering the digital and intelligent transformation of undergraduate English education through new quality productive forces lies in constructing a ubiquitously interconnected technical support ar-

chitecture that spans the entire region. Although Shandong Province has preliminarily established a provincial educational computing power alliance and a smart education platform, considerable room for improvement remains regarding the construction of specialized infrastructure tailored to the unique demands of language pedagogy. Concretely, efforts should be prioritized in the following areas. First, the deployment of dedicated computing power nodes for language intelligence should be accelerated, with specialized computing resources allocated for core language intelligence tasks—such as natural language processing, speech recognition and generation, and machine translation—thereby mitigating the efficiency losses incurred when applying general-purpose computing power to scenarios involving language model training and inference. Second, a provincial digital and intelligent cloud platform for undergraduate English education should be developed, integrating modules such as intelligent lesson preparation systems, virtual language laboratories, adaptive learning engines, and learning analytics dashboards. This platform would furnish a unified digital and intelligent instructional base for all higher education institutions across the province, thereby lowering both the technical access barriers and operational maintenance costs for small and medium-sized universities. Third, data standards and interface specifications should be refined, establishing protocols for the collection, storage, and exchange of data pertaining to English learning behaviors, speech corpora, and teaching resource metadata. This standardization would dismantle inter-institutional data silos and establish a robust data foundation for pedagogical diagnostics and precision resource delivery at the regional level. The continuous optimization of infrastructure should not devolve into the indiscriminate accumulation of hardware but must instead remain tightly aligned with the scenario-specific demands of language instruction. It should adhere to the principle of "appropriately forward-looking yet precisely adaptable," ensuring a bidirectional convergence between technological supply and pedagogical application.

4.2. Enhancement and Refinement of Institutional Supply and Collaborative Governance Mechanisms

The in-depth advancement of digital and intelligent transformation is contingent upon systematic institutional safeguards; fragmented project-based initiatives are insufficient to generate a sustainable and cohesive reform momentum. From the macro-perspective of provincial educational governance, Shandong should construct an institutional supply system that integrates the four dimensions of policy guidance, standard setting, fiscal assurance, and evaluation supervision. At the level of policy guidance, it is recommended that the Provincial Department of Education formulate the Special Action Plan for the Digital and Intelligent Transformation of Undergraduate English Education in Shandong Province, which would delineate phased objectives, key tasks, and designated responsible entities. The effectiveness of this transformation should be incorporated into the classified evaluation index system for higher education institutions, thereby generating both in-

stitutional pressure and incentive. At the level of standard setting, expert committees should be organized to develop normative documents such as the Guidelines for the Construction of Digital and Intelligent Undergraduate English Curricula and the Standards for English Teachers' Digital Competency, [2] providing a referential action framework for the transformational practices of grassroots institutions. At the level of fiscal assurance, a dedicated fund for the digital and intelligent transformation of undergraduate English education should be established, adopting an allocation model that combines "foundational guarantees with competitive project grants." This approach ensures a baseline level of investment for less privileged institutions while simultaneously incentivizing pioneering exploration among more advanced ones. At the level of evaluation and supervision, a dynamic monitoring mechanism for tracking transformation effectiveness based on big data should be instituted, with periodic regional development reports published to facilitate the timely identification of issues and strategic recalibration. Concurrently, active efforts should be made to construct a pluralistic and collaborative governance landscape characterized by government coordination, university leadership, enterprise participation, and industry guidance. Shandong should fully leverage the agglomeration advantages of its language service and information technology industries to promote the orderly supply of industry-education integrated digital and intelligent teaching resources and services.

4.3. Teacher Development Support Systems and the Cultivation of a Change-Oriented Culture

The ultimate efficacy of any educational reform hinges upon the endorsement, capabilities, and actions of the teaching faculty, and this holds particularly true for digital and intelligent transformation. Faculty members engaged in undergraduate English education in Shandong Province currently confront a dual predicament: insufficient digital competency coupled with technological anxiety [2]. There is an urgent need to construct a comprehensive teacher development support system that encompasses the entire faculty body and permeates all stages of their professional trajectory. In terms of competency enhancement, the provincial teacher development centers and institutional teaching advancement bodies should be leveraged to implement the "Digital Intelligence Competency Enhancement Project for English Teachers," which would provide modular, stratified, and categorized training. This would involve: popularizing foundational principles of artificial intelligence and instructional tool application among all faculty members; deepening competencies in data-driven pedagogical design and intelligent assessment methodologies among key instructors; and cultivating capabilities in digital and intelligent curriculum development and interdisciplinary collaboration among leading teachers [4]. In terms of incentive mechanisms, achievements in digital and intelligent pedagogical reform should be incorporated as core indicators within faculty title evaluation, performance appraisal, and commendation processes. Awards for pedagogical innovation in the digital and intelligent realm

and designations for exemplary courses should be established to galvanize intrinsic motivation for reform among the faculty. In terms of support services, two-tiered (university and college-level) digital and intelligent teaching support teams should be established, staffed with instructional designers and technical support specialists who possess backgrounds in both educational technology and English language disciplines. These teams would provide faculty with one-on-one consultation on curriculum design and guidance on technical application, thereby preventing instructors from facing the challenges of pedagogical reform in isolation. More fundamentally, concerted efforts should be directed toward fostering a university teaching culture that embraces change and tolerates trial and error. Faculty members should be guided to transition from "anxiety over technological substitution" to "confidence in human-machine collaboration," recognizing that the intrinsic purpose of digital and intelligent technologies lies in liberating educators to engage in more creative pedagogical endeavors rather than diminishing their professional value. Only when the faculty body genuinely becomes co-constructors and beneficiaries of the digital and intelligent transformation can the reform attain enduring vitality.

5. Conclusion

Adopting the theoretical perspective of new quality productive forces, this study has systematically explored the construction of pathways for the digital and intelligent transformation of undergraduate English education in Shandong Province. The research posits that a profound, mutually reinforcing coupling relationship exists between new quality productive forces and the digital and intelligent transformation of undergraduate English education. The former provides the driving mechanisms of technological impetus, factor restructuring, and ecosystem reconfiguration for English education through artificial intelligence, big data, and next-generation computing power networks, while the latter furnishes essential human capital support for the sustained development of new quality productive forces by cultivating interdisciplinary talents equipped with digital literacy and cross-cultural communication competence. Through an examination of the foundational realities in Shandong Province, the study elucidates the structural predicaments currently confronting the transformation process, including the misalignment of technological applications, a shortage of faculty digital competencies, the lagging development of high-quality resources, and regional developmental disparities [3]. On this basis, the study constructs a strategic pathway framework whose core dimensions encompass consolidating the foundation through digital and intelligent language services, innovating interdisciplinary talent cultivation models, expanding the practical field of international communication, and leveraging digital and intelligent evaluation reform as a driving force. Furthermore, it proposes systematic implementation considerations across three levels: infrastructure, institutional supply, and teacher development. The primary contribution of this study lies in extending the theory of new quality productive forces from macro-level industrial analysis to the micro-domain of language education, thereby providing

an analytical framework for the digital and intelligent transformation of regional undergraduate English education that possesses both theoretical explanatory power and practical operability. Admittedly, the digital and intelligent transformation constitutes a long-term and complex systemic endeavor; the tempo and emphases of transformation will inevitably vary across higher education institutions of differing tiers and types. Future research could further concentrate on the design of differentiated pathways for specific institutional categories, as well as the empirical evaluation of transformation outcomes and the mechanisms for dynamic optimization. Looking ahead, as the deep integration of generative artificial intelligence and language learning continues to evolve, undergraduate English education must proactively embrace technological change and achieve a creative reconfiguration of its pedagogical paradigm while steadfastly preserving the essence of language cultivation. Only thus can it better fulfill the contemporary mission of serving the construction of an educational powerhouse and enhancing the nation's capacity for international communication.

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Conflicts of Interest

The authors declare no conflicts of interest.

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