Research on the Construction of Digital-Intelligence Resources in Basic Education: A Case Study of Exemplary Courses in Basic Education

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Abstract

[Purpose] Against the backdrop of building China into an educational powerhouse, this study aims to facilitate the alleviation of dilemmas in intelligent educational resource construction and promote the digital-intelligent transformation of education. [Methods] By comprehensively employing text analysis and empirical research methods, the study analyzes official documents on high-quality courses in basic education and 17,773 national high-quality courses, sorts out the evolution of selection rules for high-quality courses, and examines their sources and design strategies. [Results] The findings indicate that the institutional framework for high-quality courses has been largely established, with simultaneous improvement in both the total volume and the quality of courses. However, problems remain, including insufficient operability in the details of selection rules, imbalances in production capacity across school levels, regions, urban-rural areas, and schools, as well as inadequate motivation for integrating technology. [Limitations] Future research needs to further conduct structured analyses of course resource documents and teaching videos, or carry out interviews and surveys involving multiple stakeholders such as designers, teachers, and students, in order to more accurately assess the implementation of resources and identify diverse needs. [Conclusion] The construction of digital-intelligent educational resources should follow the main thread of "mechanism-ecosystem-function," and continuously and systematically optimize their structure and technological integration.

Research on the Development of Digital-Intelligence Resources in Basic Education: Taking Demonstration Courses in Basic Education as an Example

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Abstract

[**Objective**] Against the backdrop of building an education powerhouse, this study aims to address the dilemmas in digital-intelligence resource construction and promote the digital-intelligence transformation of education. [**Methods**] The research employs a comprehensive approach combining text analysis and empirical research methods, analyzing official documents for demonstration courses and 17,773 national-level exemplary courses to trace the evolution of selection criteria and examine the origins and design strategies of these courses. [**Results**] The study reveals that while the institutional framework for demonstration courses has essentially taken shape with synchronized improvements in both quantity and quality, challenges persist in the operational details of selection rules, imbalances in production capacity across school levels, regions, urban-rural areas, and schools, as well as insufficient motivation for technology integration. [**Limitations**] Further structured analysis of course resource documents and instructional videos, along with interviews and surveys of diverse stakeholders including designers, teachers, and students, are needed to more accurately assess resource implementation and identify multifaceted needs. [**Conclusions**] Digital-intelligence resource construction should follow a "mechanism-ecosystem-function" framework to systematically optimize structure and integrate technology.

Keywords: digital-intelligence resources, basic education, National Smart Education Platform for Primary and Secondary Schools, digital transformation of education, demonstration courses

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Introduction

Generative artificial intelligence technologies (such as DeepSeek, ChatGPT, Sora, etc.) are profoundly transforming human production, lifestyles, and learning patterns [1]. Traditional basic education, characterized by prescribed curricula, static resource allocation, and binary teacher-student interaction, struggles to meet learners' personalized and autonomous development needs. Consequently, promoting the digital-intelligence transformation of education has become an imperative of the era for educational reform [2]. The *Outline for*

Building an Education Powerhouse (2024-2035) emphasizes the need to improve the mechanism for coordinating and allocating basic education resources in response to demographic changes, deeply implement the national education digitalization strategy, and strengthen the enabling role of artificial intelligence in educational transformation, aiming to establish China as an education powerhouse by 2035 [3]. In this context, exploring resource development models that deeply integrate digital-intelligence technologies, precise allocation mechanisms, and innovative application pathways to stimulate the vitality of all educational elements and promote balanced, high-quality development of resources across regions and schools has become a focal issue in the digital-intelligence construction of basic education.

As a crucial vehicle for advancing the digital-intelligence transformation of basic education, the National Smart Education Platform for Primary and Secondary Schools (hereinafter referred to as the "National Platform") has continuously aggregated, integrated, and shared high-quality digital-intelligence education resources nationwide while expanding platform functionalities, achieving remarkable results in resource construction and application [4]. However, the National Platform faces development bottlenecks such as insufficient user engagement, low willingness to apply resources, and imbalanced resource allocation across regions [5]. In response to the deepening construction needs of the National Platform, the Ministry of Education integrated the Demonstration Courses in Basic Education (hereinafter referred to as "Demonstration Courses")—a digital-intelligence resource design activity for all primary and secondary school teachers—into the National Platform in May 2023 [6]. Demonstration Courses represent the most important and highest-quality digital-intelligence resources in basic education and form the foundation for the digital-intelligence transformation of basic education. Under the impact of generative artificial intelligence technologies and the wave of pedagogical paradigm reforms, how to mobilize broader participation from educators in Demonstration Course construction and how to develop digital-intelligence resources that meet contemporary requirements are critical issues requiring exploration.

Based on this context, this study focuses on existing Demonstration Course construction practices, analyzing the iterative evolution of selection rules, resource origins, and course design strategies throughout their development. By examining the challenges in Demonstration Course construction, the study dissects the underlying dilemmas in digital-intelligence resource development and proposes optimization strategies. The aim is to promote Demonstration Courses as a benchmark project for digital-intelligence resource construction in basic education, alleviate dilemmas in digital-intelligence resource development, enhance National Platform effectiveness, and provide reference points for the steady development of educational digitalization amid the dual opportunities of AI technological innovation and education powerhouse construction.

2.1 Research Objectives

This study focuses on the construction of Demonstration Courses on the National Platform, conducting analysis across three dimensions: selection rules, resource origins, and course design.

2.2 Research Sample

The research sample comprises production requirements for Demonstration Courses from 2021-2025, provincial recommendation quotas, evaluation criteria, and a total of 17,773 courses selected from 2021-2024. Document samples were obtained from annual "Demonstration Courses in Basic Education" selection notices and attachments on the Ministry of Education' s official website. The course samples cover 23 provinces, 5 autonomous regions, and 4 municipalities directly under the central government, encompassing multiple school levels including primary school, junior high school, primary school (5-4 学制), junior high school (5-4 学制), senior high school, primary school for the blind, junior high school for the blind, primary school for the deaf, junior high school for the deaf, and schools for children with intellectual disabilities. The sample includes 2,422 subject courses in 2021 and 3,598 subject courses in 2022.

2.3 Research Methods

By comparing production requirements, provincial recommendation quotas, and evaluation criteria for Demonstration Courses from 2021-2025, this study analyzes the selection procedures, course types, production requirements, and evaluation indicators to track changes in selection rules. Based on the list of awarded courses from 2021-2024, the study examines the origins of Demonstration Courses, clarifying production patterns across different school levels, economic regions, selection tiers, and school types (public vs. private). Drawing on Demonstration Courses displayed on the National Platform from 2021-2024, the study investigates trends in course design, with particular focus on pre-class and post-class learning tasks and the integration of information technology.

3.1 Changes in Demonstration Course Selection Rules

(1) Selection Procedures Remain Essentially Consistent

The selection cycle for Demonstration Courses gradually extended from 7 months to 1 year between 2021 and 2025, with procedures remaining essentially unchanged, comprising five stages: self-nomination, school recommendation, county-level preliminary selection, provincial/municipal selection, and ministerial-level selection.

(2) Course Types Continuously Refined

Course types are generally categorized based on content and target audience. Before 2023, no explicit distinction was made among course types, with all Demonstration Courses uniformly classified as subject courses. In 2023, course types were differentiated into three categories: subject courses, experimental teaching, and special education (for schools for the blind, deaf, and children with intellectual disabilities). By 2025, two new categories were added—AI education (compulsory education stage) and reading courses—bringing the total to five types. For each course type, a course catalog is provided according to teaching functions. For instance, in 2025, subject courses and special education courses specify teaching content down to the granular level of school level, subject, textbook version, grade, volume, chapter, and course node. Experimental teaching, after classification by school level and subject, establishes multi-level themes based on disciplinary realities for course node division. For example, high school biology uses curriculum structure modules from the curriculum standards as first-level themes and big ideas as second-level themes, while high school geography divides first-level themes into compulsory and selective compulsory courses, with textbook editions as second-level themes. AI education (compulsory education stage) is divided into four first-level themes: AI foundations, AI applications, AI implementation, and AI ethics, comprising ten second-level themes including basic AI knowledge, three core elements of AI, AI application fields, core AI principles, data collection and processing, basic machine learning processes, AI algorithms, AI system design, AI and humanity, and AI and society. Reading courses establish six themes: literary classics, ideological and moral education, history and culture, popular science knowledge, legal common sense, and health and hygiene, followed by school level and grade division, with corresponding thematic module interpretations provided.

(3) Production Requirements Refined Annually

Competing entries face corresponding production requirements for videos, courseware, and other documents (instructional design, learning task sheets, study guides, homework exercises, etc.), with minimal changes—primarily detailed refinements based on previous participation. For example, in 2022, minor supplements were made to the 2021 subject course requirements, mandating that paper-and-pencil exercises in homework assignments include answer keys. In 2023, with the addition of new course types, subject course production requirements continued using the 2022 version, while separate requirements were established for experimental teaching and special education. In 2024, the 2023 requirements for each course type were slightly enriched: suggestions for homework exercise formats in subject courses were removed, replaced with instructions to “upload homework exercises according to National Platform requirements” ; special education micro-lesson videos were required to clearly specify the special education category; instructional designs were required to include student situation analysis; experimental teaching was encouraged to conduct interdisciplinary collaboration and enhance exchanges with universities, research institutes, and high-tech enterprises. In 2025, with the addition of new course types, production requirements for subject courses, special education, and experimental teaching continued to be refined based on the 2024 version, while requirements for AI education (compulsory education stage) and reading courses were merged into subject courses, as shown in Table 1 . Evidently, production requirements vary by course type and are modified and optimized alongside information technology development, changing pedagogical needs, and accumulated competition experience.

Table 1 2025 Production Requirements by Course Type

Subject Courses, AI Education (Compulsory Education Stage), Reading Courses	Experimental Teaching	Special Education
1. Format: Teacher explanation + multimedia	**1. Format:** Complete experimental class recording; encourages teachers to conduct interdisciplinary collaboration, apply innovative teaching models on the platform, utilize scientific research and engineering design paradigms, collaborate with universities, research institutes, and high-tech enterprises, and assign practical homework	**1. Format:** Teacher explanation + multimedia
2. Duration: 35-45 minutes	**2. Duration:** 35-45 minutes	**2. Duration:** Primary school 10-15 minutes, secondary school 15-20 minutes
3. Content: 5-second opening title including subject, grade, course name, instructor, school, etc.; some subjects require 3-minute safety precautions covering all experimental procedures	**3. Content:** 5-second opening title including subject, grade, course name, instructor, school, etc.; some subjects require 3-minute safety precautions covering all experimental procedures	**3. Content:** 5-second opening title including textbook version, demonstration course category, special education type, grade, course name, instructor name, etc.

Subject Courses, AI Education (Compulsory Education Stage), Reading Courses	Experimental Teaching	Special Education
4. Format: Video aspect ratio 16:9, size $ 3GB, encodingH.264/25fps, resolution1920×$1080P, bitrate 8Mbps, audio AAC encoding, bitrate 128Kbps, editable as needed	**4. Format:** Video aspect ratio 16:9, size $ 3GB, encodingH.264/25fps, resolution1920×$1080P, bitrate 8Mbps, audio AAC encoding, bitrate 128Kbps, editable as needed	**4. Format:** Video aspect ratio 16:9, size $ 1GB, encodingH.264/25fps, resolution1920×$1080P, bitrate 8Mbps, audio AAC encoding, bitrate 128Kbps
Courseware: Clear content, concise interface design, reasonable layout, highlighted key points; font size and color scheme compliant with standards	**Courseware:** Clear content, concise interface design, reasonable layout, highlighted key points; font size and color scheme compliant with standards	**Courseware:** Clear content, concise interface design, reasonable layout, highlighted key points, unified style
Maps: Paper and electronic maps, globes, etc. must be products approved by competent natural resources authorities; emphasize experimental safety	**Maps:** Use textbook maps with source citations	**Maps:** Use textbook maps with source citations
Instructional Design: Includes teaching objectives, content, and process	**Instructional Design:** Includes competency objectives, experimental resources, experimental design and innovation points, experimental teaching process, teaching reflection, practical homework	**Instructional Design:** Includes teaching objectives, student situation analysis, teaching content, and teaching process
Learning Task Sheet: Includes learning objectives, tasks, methods and procedures, recommended supporting resources (including textbook content and other resources)	**Study Guide:** Submit at least 3 scanned copies of completed student study guides, requiring consistency with classroom practice, authenticity, and typicality	**Learning Task Sheet:** Includes learning objectives, tasks, preparation, methods and procedures, recommended supporting resources (including textbook content and other resources)

Subject Courses, AI Education (Compulsory Education Stage), Reading Courses	Experimental Teaching	Special Education
Homework Exercises: Diversified tasks uploaded according to platform requirements; AI education includes practical assignments; reading courses may omit homework	**Homework Exercises:** Diversified tasks uploaded according to platform requirements; AI education includes practical assignments; reading courses may omit homework	**Homework Exercises:** Diversified tasks uploaded according to platform requirements; AI education includes practical assignments; reading courses may omit homework

(4) Evaluation Criteria Vary by Course Type

Evaluation criteria serve as crucial foundations for both Demonstration Course production and selection, varying by course type with different emphases. Subject courses emphasize rational teaching process design and effective resource utilization; experimental teaching focuses on documenting student and teacher activities during instruction; special education stresses designers' grasp of special students' learning situations and selection of targeted strategies; AI education (compulsory education stage) emphasizes smooth and complete teaching process design; reading courses prioritize the appropriateness of teaching activity methods and technical optimization of reading experiences. Comparative analysis shows that evaluation criteria for each course type have been used continuously with minor adjustments in recent years. In 2024, special education added a secondary indicator "language and script usage norms" under the primary indicator "normative requirements," with both "resource complete submission norms" and "language and script usage norms" weighted at 5%. In 2025, subject courses adjusted the weight of secondary indicator "effective information technology integration" to 10%, added secondary indicator "resource completeness" under primary indicator "teaching resources," and modified secondary indicators under primary indicator "technical norms" to "filming norms" ; experimental teaching elevated the original secondary indicator "experimental teaching resources" under "experimental teaching design" to a primary indicator with secondary indicator "resource norms" and optimized indicator descriptions, as shown in Table 2 .

Table 2 2025 Evaluation Criteria Comparison by Course Type

Subject Courses	Experimental Teaching	Special Education	AI Education (Compulsory Education Stage)	Reading Courses
1. Scientific and rational teaching objectives	1. Experimental teaching objectives (10)	1. Scientific and rational teaching objectives	1. Competency-based education goals	1. Educational goals and competency achievement
2. Scientifically organized teaching content	2. Experimental teaching design (10)	2. Scientifically organized teaching content	2. Rational and scientific teaching objectives	2. Rational and scientific teaching objectives
3. Smooth and compact teaching procedures	3. Experimental teaching process (30)	3. Precise and reasonable student situation analysis	3. Cognition-compliant teaching content	3. Cognition-compliant teaching content
4. Appropriate teaching methods and strategies	4. Experimental teaching effectiveness (20)	4. Clear and prominent key/difficult points (10)	4. Authentic and perceptible teaching scenarios	4. Authentic and perceptible teaching scenarios
5. Effective information technology integration	5. Disciplinary characteristics and innovation (20)	5. Smooth and compact teaching procedures	5. Complete and smooth teaching procedures	5. Complete and smooth teaching procedures
6. Clear and appropriate instructional design	6. Experimental teaching resources (10)	6. Appropriate teaching method application	6. Appropriate teaching method application	6. Appropriate teaching method application
7. Standardized and scientific homework exercises	7. Technology and equipment innovation (10)	7. Standardized and scientific homework exercises	7. Standardized and scientific homework exercises	7. Standardized and scientific homework exercises

Subject Courses	Experimental Teaching	Special Education	AI Education (Compulsory Education Stage)	Reading Courses
8. Effective and standardized technology integration	8. Standardized task sheet (10)	8. Effective and standardized technology integration	8. Effective and standardized technology integration	8. Effective and standardized technology integration
9. Resource completeness	9. Standardized resource submission (5)	9. Ethical and safety considerations	9. Ethical and safety considerations	9. Ethical and safety considerations
10. Language and script usage norms (5)	10. Filming norms	10. Filming norms	10. Filming norms	10. Filming norms

3.2 Analysis of Demonstration Course Origins

(1) Quantities Increase Annually with Significant Participation Disparities Across School Levels

The number of Demonstration Courses increased annually from 2021-2024, reaching 6,235 courses in 2024—2.57 times the 2021 figure. However, distribution across school levels remains unbalanced, with participation vitality in junior and senior high school levels requiring further stimulation. Since the initiative' s launch, course numbers across school levels (excluding special education) have grown annually, closely related to national policy support [7]. The primary school level consistently demonstrated outstanding performance, accounting for over 40% of total courses each year. In the first three years, junior high school output slightly exceeded senior high school, but senior high school surpassed junior high school in 2024, as shown in Figure 1 [Figure 1: see original paper]. Since special education only serves primary and junior high schools for the blind, deaf, and children with intellectual disabilities, and some schools for children with intellectual disabilities are difficult to classify by level, they are excluded from this statistic. Nevertheless, expanding Demonstration Course coverage to more special populations remains an important issue.

Figure 1 2021-2024 Demonstration Course Selection by School Level (Excluding Special Education)

(2) All Economic Regions Show Annual Growth with Highest Participation in Eastern Regions

China’ s Demonstration Course output across economic regions demonstrates an annual growth trend, yet regional distribution differences are significant, primarily concentrated in eastern regions, followed by western, central, and northeastern regions [8]. From 2021-2024, eastern regions consistently ranked first nationally, accounting for approximately half of all annual Demonstration Courses, while northeastern regions contributed the smallest share at only about 10% annually, showing a declining trend. Western regions slightly outperformed central regions, with the gap gradually widening, as shown in Figure 2 [Figure 2: see original paper].

Although economically less developed western regions ranked second annually with rapid growth rates, this may be related to their broad provincial coverage and national support. Western regions encompass 12 provinces, more than eastern (10 provinces), central (6 provinces), and northeastern (3 provinces) regions. National policies such as the “Strong Teacher Plan” emphasize increased support for resource allocation, teacher 队伍建设, and education informatization in western regions, resulting in western regions’ annual recommendation quotas being approximately 1.7 times those of central regions and 3.5 times those of northeastern regions [9]. However, western regions’ actual selected courses as a proportion of their recommendation quotas were the lowest, while the northeastern region, with the fewest provinces and quotas, demonstrated outstanding performance, though its 2024 capacity decreased from previous years, as shown in Figure 2. Evidently, Demonstration Course capacity is influenced by regional economic development levels, with relatively lagging performance in central and western regions requiring focused attention. Additionally, the capacity decline in northeastern regions should receive timely support.

Figure 2 2021-2024 Demonstration Course Origins by Economic Region
(a) Course Quantity Distribution (b) Courses as Percentage of Recommendation Quotas

(3) Urban Districts Dominate with Insufficient Momentum in County-Level and Below Areas

Analysis based on the Demonstration Course tiered selection procedure reveals significant disparities between urban districts (provincial capitals, municipalities directly under the central government, and prefecture-level cities) and county-level and below areas, presenting a single-level dominance phenomenon. From 2021-2024, provincial capitals, municipalities, and prefecture-level city districts collectively accounted for approximately 80% of annual Demonstration Courses, while county-level and below areas contributed only about 20%, as shown in Figure 3 [Figure 3: see original paper]. Although the combined share of provincial capitals and municipalities declined annually while prefecture-level cities showed steady growth, provincial capitals and municipalities (32 cities) consistently outperformed prefecture-level cities (>300 cities), indicating strong capacity in provincial capitals and municipalities while prefecture-level city capacity urgently requires stimulation [10]. Evidently, insufficient grassroots promotion of the Demonstration Course competition, inadequate digital-intelligence resource development capabilities, and incomplete resource technology 配备 in vast prefecture-level cities and county-level and below areas represent pain points for advancing Demonstration Courses and deepening platform construction, requiring urgent resolution.

Figure 3 2021–2024 Demonstration Course Selection by Administrative Level

(4) Polarization: Public Schools Dominate while Private Schools Face Significant Barriers

China' s basic education system centers on public schools as the core with private schools as important supplements [11]. By 2023, including special education schools, private basic education institutions totaled 166,300, accounting for approximately 33.60% of all basic education schools nationwide, with private schools comprising 7.65% of senior high school, compulsory education, and special education institutions [12-13]. Influenced by these proportions, Demonstration Course output from public and private schools shows polarization, with public schools holding absolute dominance and private schools experiencing clear marginalization [14]. From 2021–2024, public schools' contribution rate exceeded 95% annually, while private schools' contribution remained minimal, as shown in Figure 4 [Figure 4: see original paper]. Therefore, while continuously strengthening public schools' leading role in Demonstration Course construction, active support and assistance should be provided to private schools to help them fully realize their complementary function.

Figure 4 2021–2024 Demonstration Course Origins: Public vs. Private Schools (Excluding Experimental Teaching)

Note: Experimental teaching Demonstration Courses from 2021–2023 did not indicate school origins and are therefore excluded from this statistic.

3.3 Demonstration Course Design Strategies

Learning tasks are learning activities in which learners directly participate to achieve learning objectives, helping learners enhance motivation, facilitate knowledge construction, support transfer, and improve comprehensive competencies. According to learning flow, they can be divided into pre-class, in-class, and post-class learning tasks [15]. In recent years, pre-class and post-class learning task designs for Demonstration Courses have shown digital and information technology development trends. For instance, some courses incorporate tasks such as scanning QR codes for materials, mini-program exercises, software learning, AI-assisted problem-solving, AI-based information retrieval, virtual experiments, online cloud visits, mini-program interactive questioning, and APP-based learning records. Although digital-intelligence content remains relatively simple with insufficient comprehensive application, this reflects designers' growing awareness of digital-intelligence technology use and the inevitable trend of technology integration into Demonstration Courses.

(1) Pre-Class Tasks Focus Primarily on Preview

Sorted by usage frequency in Demonstration Course designs, annual pre-class learning tasks predominantly consist of preview, information retrieval, and reviewing prior knowledge, with low requirements for practical activities and digital-intelligence technology application, as shown in Figure 5 [Figure 5: see original paper]. Although online tasks such as information retrieval show growth trends, information technology' s role remains singular and 虚化, 停留在 simple tool attributes of search engines, lacking utilization of information technology to innovate task contexts, support task deepening, enrich life practices, enable cross-regional exchanges, or facilitate asynchronous evaluation and interaction.

(2) Post-Class Tasks Focus Primarily on Exposition

Research results indicate that post-class learning tasks predominantly involve viewpoint exposition and exercise drills, with practical tasks such as creative hands-on activities, idea exchange, and information accounting for less than 20%, as shown in Figure 5. While focusing on viewpoint exposition and exercise drills helps students review classroom knowledge and develop personal perspectives, it does not favor cultivating innovation capabilities. The lack of digital-intelligence technology integration and interdisciplinary limitation makes it difficult to stimulate learning enthusiasm and restricts learning transfer. Utilizing digital-intelligence technologies for information retrieval, multimedia production, and experimental activities represents a direction for continued teacher development.

Figure 5 2021–2024 Demonstration Course Learning Task Design
(a) Pre-Class Learning Tasks (b) Post-Class Learning Tasks

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4 Dilemmas and Optimization Strategies for Digital-Intelligence Education Resource Construction

As a crucial component of the national education digitalization strategic action, education resource construction represented by Demonstration Courses is demonstrating systematic, high-quality, and digital-intelligence development trends. A dynamically updated digital-intelligence education resource system framework has been initially established, with synchronized improvements in resource quantity and quality and continuously expanding technology application scenarios. However, efficient collaborative linkages among multiple stakeholders and supporting elements (national policies, economy, technology, resources, concepts, mechanisms, etc.) have not yet been achieved in the resource construction process, resulting in insufficient systematic support, imbalanced resource supply and demand, and superficial technology integration that constrain high-quality, sustainable resource development [16]. Therefore, based on collaborative linkage mechanisms among multiple stakeholders and supporting elements, profoundly analyzing the practical dilemmas in digital-intelligence resource construction and proposing targeted optimization strategies to stimulate multi-stakeholder vitality, alleviate resource flow obstacles, and enhance resource application effectiveness holds significant importance for building a high-quality digital-intelligence education resource system [17-18].

4.1 Analysis of Digital-Intelligence Resource Construction Dilemmas

(1) Insufficient Systematic Support Constrains Stakeholder Vitality in Resource Construction Current resource construction exhibits a problem of "heavy selection, light design, weak application,"leaving resource designers trapped in dilemmas of "material accumulation without systematization,""generalized methods lacking characteristics,"and "abundant creativity but insufficient technical implementation." Moreover, the lack of effective resource promotion and transformation mechanisms makes it difficult to implement advanced educational concepts, inadequately promotes locally distinctive resources across regions, and limits the application of digital-intelligence technologies in frontline teaching. Additionally, most policies do not precisely match support directions, methods, and intensity with the real needs of multiple stakeholders, resulting in uneven vitality in resource construction and low overall effectiveness [19].

(2) Resource Supply-Demand Imbalance Constrains Ecosystem Optimization in Resource Construction Some regions and schools with educational advantages continue to output resources, yet the content and functional designs of these resources show serious homogenization tendencies, creating insufficient supply of generative resources for differentiated teaching, adaptive learning, and creative application. This exacerbates structural 臃肿 in the resource system and marginal costs of application promotion, leading to inefficient resource waste and insufficient innovation momentum. Furthermore, internal barriers between eastern and western regions, urban and rural areas, and schools hinder effective radiation of high-quality resources to disadvantaged areas due to significant differences in resource acquisition capabilities and application conditions [20].

(3) Superficial Technology Integration Hinders Innovation Effectiveness in Resource Construction Current resource designs exhibit problems of forcibly embedding advanced teaching technologies without considering adaptability to real classroom contexts, creating hollow designs with "technology but no teaching." Simultaneously, resource supply generally lacks supporting application support systems for technology, placing high costs on teachers for application and exploration, leading to phenomena of being “unable to use, afraid to use, unwilling to use” digital-intelligence resources. Additionally, China’ s digital-intelligence education infrastructure and human resource construction still show obvious shortcomings. Nearly half of schools face funding shortages for digital-intelligence construction, low maturity of tools and platforms, and difficulties in normalized teaching applications. Teacher training systems have not kept pace, with collaborative research and knowledge-sharing platform construction lagging, resulting in teachers generally lacking awareness and capability to apply advanced educational technologies [21].

4.2 Optimization Strategies for Digital-Intelligence Resource Construction

(1) Improve the “Design-Selection-Application” Coordination Mechanism to Stimulate Multi-Stakeholder Co-Construction Vitality Digital-intelligence education resource construction requires multi-stakeholder collaboration to enhance vitality [22]. Efforts should focus on building coordination mechanisms covering the entire resource lifecycle to transform resource construction models from 单向 supply to multi-stakeholder governance. Simultaneously, cross-boundary collaboration should be encouraged to attract universities, research institutions, and enterprises, creating an open and innovative resource construction 格局. In the design phase, continuously improve design standards, strategic guidelines, and update norms, actively guiding designers to utilize artificial intelligence and other technologies to develop diverse resource forms including videos, teaching aids, and documents.

In the selection phase, leverage big data to collect and establish multi-stakeholder demand network platforms, promoting refined policy formulation and implementation and deepening multi-stakeholder participation willingness. Establish a dual-review mechanism of data-driven machine pre-screening and expert re-evaluation, clarifying authority boundaries among educational administrative departments, educational technology institutions, platform experts, and schools to ensure normative and transparent selection processes [23]. In the application phase, break through single display modes by integrating short-video platforms, education clouds, and other new media channels to build resource dissemination matrices, enhancing personalized intelligent resource 推送 functions based on learner profiles.

(2) Build a “Support-Linkage-Training”Portfolio Strategy to Optimize Resource Supply Ecology In the process of educational digital-intelligence transformation, constructing a healthy ecology for digital-intelligence education resource supply structure is a key issue [24]. Implement precise support by providing policy, funding, and technology triple 倾斜 to central and western regions, guiding universities to participate in local teacher training and resource co-construction through the “Strong Teacher Plan,” supporting the development of curriculum resources integrating local characteristics and ethnic cultures, and improving experimental and practical resource quality [25]. Simultaneously, encourage original design and iterative optimization of existing resources to achieve organic unity of resource capacity expansion and practical adaptability improvement. Construct cross-regional and cross-school resource collaboration networks through carriers such as cross-regional synchronized classrooms and virtual teaching research communities, promoting transformation of high-quality resources from static display to two-way interaction and dynamic application, amplifying the 辐射推广 effect of advanced educational achievements [26]. Focus on building a batch of resource construction demonstration zones to form replicable, scalable, and sustainably iterative typical practice cases that fully leverage their leading and guiding role. Strengthen internal drivers by building sustainable training systems. Form composite training teams comprising university experts, technical personnel, and outstanding teachers to conduct layered and categorized training around core modules such as teaching theory and educational technology, combined with resource design and application examples, focusing on cultivating a batch of local digital literacy seed teachers to form regional self-regeneration and continuous optimization capabilities.

(3) Deepen "Technology-Teaching-Competition" Integration Innovation to Enhance Resource Service Effectiveness Improving resource service functions requires promoting coordinated advancement of technology, teaching, and competition to achieve transformation from shallow tool application to deeply integrated resource services. Advance adaptability upgrades of digital-intelligence technologies in teaching scenarios. Cultivate composite teams with teaching understanding and technical maintenance capabilities to provide normalized technical application guidance for teachers, systematically collect teaching feedback data, continuously maintain and optimize the teaching usability of technology platforms, and promote iterative evolution of key technologies such as intelligent resource collection, multimodal interaction, and learning analytics toward functional integration, operational friendliness, and teaching adaptability. Build an ideological and political education-led, theory-practice integrated teacher development path. Rely on virtual teaching research platforms to construct teacher professional learning communities, promoting deep integration of advanced teaching concepts such as interdisciplinary and project-based teaching into resource design and application through case discussions, instructional design workshops, and other forms, enhancing primary and secondary school teachers' professional capabilities and competencies [27]. Improve competition-based continuous resource optimization mechanisms, transforming competitions into core arenas for developmental teacher evaluation. Based on systematic analysis of teachers' comprehensive competition performance, precisely identify their core strengths and development blind spots, generate personalized diagnosis reports, and provide targeted support for teacher capacity enhancement. Simultaneously, deeply integrate advanced concepts, exquisite techniques, and innovative spirits distilled from competitions into disciplinary 梯队 construction and daily teaching research practices, achieving 落地应用 of high-quality outcomes in frontline teaching and efficient transformation of academic resources.

Amidst AI technological innovation and education powerhouse construction, educational digital-intelligence transformation is reshaping educational environments, teaching models, resource allocation, and educational governance with tremendous transformative potential [28]. Empowering education resource system construction with digital-intelligence technologies has become a critical path for China to open new tracks in education development, shape new competitive advantages in education, and cultivate new quality productive forces in the education sector [29-30].

This study, from the perspective of educational digital-intelligence transformation, comparatively analyzed the selection of Demonstration Courses on the National Platform over the past five years. The findings reveal issues such as insufficient operability of selection rules, imbalanced production capacity across school levels and regions, and weak technology integration in task design. The root causes lie in deep dilemmas of insufficient systematic support, structural supply-demand imbalance, and superficial technology integration in digital-intelligence resource construction. The study proposes a systematic optimization path following a “mechanism-ecosystem-function”framework, providing theoretical reference and practical guidance for resolving resource construction dilemmas and promoting resource supply system reconstruction.

Future research will strengthen structured analysis of resource documents and instructional videos to deeply understand the design logic and implementation effectiveness of digital-intelligence resources. Simultaneously, multi-stakeholder interviews and field investigations covering designers, teachers, students, and other relevant parties will be conducted to examine resource implementation and precisely identify diverse needs, thereby promoting the construction of a benign development mechanism across the entire resource construction chain, enhancing quality and efficiency in digital-intelligence resource construction, and continuously injecting momentum into China’ s education modernization and high-quality development.

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Author Contribution Statement

Tang Yue, Hao Xiaoran: Conceived research ideas and designed research methodology;
Tang Yue, Gan Qingfeng, Ji Runjuan, Zhou Yanrui: Collected and cleaned data;
Tang Yue, Hao Xiaoran: Analyzed data and text content;
Tang Yue: Drafted the manuscript;
Tang Yue, Gan Qingfeng, Ji Runjuan, Zhou Yanrui: Revised the manuscript;
Tang Yue, Hao Xiaoran: Revised the final version.

Note: Figure translations are in progress. See original paper for figures.