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AI-Empowered Digital Textbook Development: Multidimensional Value, Logic Shifts, and Practical Pathways

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Abstract

This paper examines the value, logic, and pathways of AI-empowered digital textbook development. AI empowerment entails a threefold value: underpinning an autonomous textbook system, cultivating well-rounded talents, and driving the digital transformation of teachers. The development of textbooks is undergoing three constructive shifts—namely, a goal shift from knowledge centeredness to learner centeredness, a modality shift from one-way transmission to two-way construction, and a content shift from closed rigidity to open integration. The practical pathways encompass four dimensions: top-level design, content development, social environment, and teacher empowerment. In essence, AI-empowered digital textbook development represents a structural reshaping of the educational ecosystem, serving as a critical pillar for fulfilling the fundamental mission of fostering virtue and cultivating talent and for promoting high-quality educational development.

Keywords: digital textbooks; artificial intelligence; powerful educational nation; talent strong nation

1. Introduction

Textbooks serve as a vital vehicle for advancing educational development; they must address the authentic developmental needs of learners across all age groups and function as a critical bridge for communication between teachers and students (Zhang, Zhao, 2025). Professor Huang Ronghuai of China posits that digital textbooks are a novel form of learning resource that exists in digital format, can be stored on portable digital terminals, supports timely content updates, and enables real-time recording of interactive trajectories (Huang, 2022). Concurrently, Professor Li Lin characterizes digital textbooks as “electronic books employed in curriculum instruction, which present subject-specific knowledge content through multimedia technologies, integrate various learning interactions and tools in accordance with pedagogical activities, and are published in compliance with specified cover standards”. Professor Li further classifies digital textbooks into three types: new-form textbooks, digital textbooks that depart from printed counterparts (such as MOOCs), and digital textbooks derived from print-based originals (Li, Lin, Chen, 2021). At present, against the backdrop of China's educational informatization and digitalization, there is a strong emphasis on leveraging advanced technological means to drive the digital transformation of education, thereby offering students richer and more intuitive educational content (Ye, Xu, 2025). The Compulsory Education Curriculum Plan (2022 Edition) underscores the need to "fully harness technological advantages and explore the development of digital textbooks," indicating that the digitalization of education is not only an imperative of our time but also a global trend and a shared aspiration of both teachers and students (Huai, 2024). In 2025, the Ministry of Education issued the Opinions of the Ministry of Education and Nine Other

Departments on Accelerating the Digitalization of Education. With the aim of advancing digital reforms in China's education sector and steadily promoting the construction of digital textbooks (Luo, Zhang, 2026). High-quality digital textbooks constitute both the foundation and a pivotal instrument for facilitating the digital transformation of education; consequently, digital education and digital textbooks are entrusted with the fundamental mission of fostering virtue and cultivating talent (Jin, Wang, He, 2024). Furthermore, the Outline of the Plan for Building a Powerful Educational Nation (2024–2035), promulgated by the Central Committee of the Communist Party of China and the State Council in 2025, explicitly calls for the creation of "high-quality textbooks that cultivate roots, forge the soul, enlighten wisdom, and enhance intellect," and also outlines the roadmap for constructing China's textbook system, thereby providing directional guidance for the development of digital textbooks (Jin, Zhang, 2025). The research framework is shown in Figure 1.

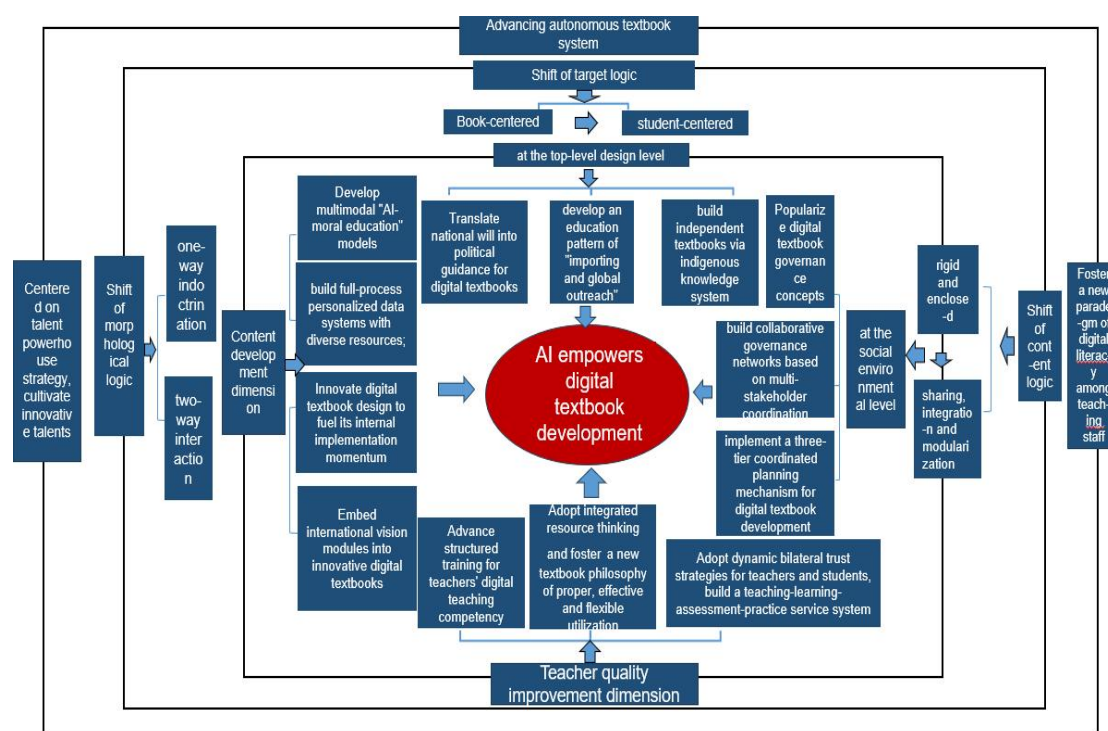


Figure 1. Logical Framework of the Paper

This paper, anchored in the strategic deployments outlined in the 15th Five-Year Plan for building a strong education nation, elucidates the value of AI-enhanced digital textbooks, contrasts the distinctive advantages of digital textbooks relative to traditional ones, and proposes pathways for their development. The ultimate objective is to harness digital textbooks as a catalyst for constructing a high-caliber educational system and nurturing

skilled personnel, thereby furnishing both intellectual and human resources to underpin modernization endeavors.

2. The Multidimensional Value of AI-Empowered Digital Textbook Development

Against the contemporary backdrop that emphasizes a "macro-education" paradigm, the development of digital textbooks can effectively embed education into the information society of the new era, persistently deepen structural reforms in education, promote the comprehensive development of students, and ultimately contribute to the realization of China's goal of becoming a powerful educational nation (Liu, QU, Cao, 2024).

2.1 Promoting Steady Progress in the Construction of the Autonomous Textbook System

The Proposal of the Central Committee of the Communist Party of China on Formulating the 15th Five-Year Plan for National Economic and Social Development explicitly stipulates that we should "intensify the implementation of the digital strategy for education, optimize public services for lifelong learning," and "comprehensively carry out the 'AI+' initiative." "Creating high-quality textbooks that cultivate roots, forge the soul, enlighten wisdom, and enhance intellect" is not only a central tenet of China's new round of comprehensive educational reform but also a strategic mission set forth in the Outline for Building a Powerful Educational Nation. As a novel modality emerging from the ongoing evolution of textbooks, digital textbooks can facilitate the continuous improvement of disciplinary knowledge systems across various fields, thereby manifesting the "autonomous" essence of the textbook system (Guan, Fang, Cao, 2025). The paramount priority in constructing China's autonomous textbook system lies in firmly upholding the "soul" of Marxism and the "roots" of traditional Chinese culture, so as to drive the high-quality development of education and textbook development in China (Zhang, 2026). In April 2025, the Ministry of Education convened the Deployment and Promotion Meeting on the Development of Original Textbooks in Philosophy and Social Sciences in Higher Education Institutions in the New Era, which made comprehensive arrangements for advancing original textbook development. This implies that Chinese theories should be leveraged to propel the original development of China's autonomous knowledge system (Gu, Tan, Zeng, 2025), ultimately culminating in the establishment of a comprehensive autonomous textbook system for the country.

First, constructing a localized knowledge graph. By leveraging knowledge graph technology within artificial intelligence to conduct in-depth mining of China's outstanding

traditional culture, revolutionary culture, and advanced scientific and technological achievements, a distinctly Chinese “localized” knowledge graph can be established. Empowered by AI, this enables digital textbooks to serve China's educational contexts more effectively, while simultaneously avoiding both the fragmentation of knowledge and an overreliance on imported conceptual frameworks. Second, intelligent generation and adaptive customization of teaching content. Artificial intelligence, in accordance with China's curriculum standards across various disciplines, can generate instructional content tailored to different regions and diverse learning conditions. Meanwhile, through generative artificial intelligence (AIGC), intelligent content management systems, and reinforcement learning (RL), dynamic updates to textbook content can be realized, thereby ensuring the contemporaneity and relevance of the materials. Third, fostering the development of interdisciplinary themes. By employing natural language processing and knowledge graph techniques, raw source materials can be transformed into textbook content that aligns with students' cognitive levels, thereby safeguarding both the timeliness and cutting-edge nature of the textbooks. Furthermore, guided by the principle of adapting Marxism to the Chinese context and the contemporary era, we may construct an autonomous knowledge system; integrate China's fine traditional culture into textbooks through localized practices and original expressions; and generate an autonomous textbook system characterized by Chinese features, originality, systematicity, scientific rigor, and localization (Yu, 2024). Through such autonomous textbooks, China's voice can be effectively disseminated, thereby contributing to the endeavor of building a world-class powerhouse in education.

2.2 Cultivating Innovative and Versatile Talents Grounded in the Construction of a Talent-Strong Nation

The Proposal of the Central Committee of the Communist Party of China on Formulating the 15th Five-Year Plan for National Economic and Social Development explicitly calls for "strengthening the alignment of planning, synergy of policies, integration of resources, and linkage of evaluations, so as to promote positive interaction between independent scientific and technological innovation and the independent cultivation of talents" (The 2025). Cultivating talents for the Party and the nation constitutes the fundamental objective of China's educational enterprise, which not only meets the exigencies of socialist modernization but also represents a high degree of integration of the political attributes of education and its role in human development (Jiang, Jiao, 2025).

First, it can effectively fulfill the fundamental mission of fostering virtue and cultivating talent. By employing knowledge graph technology to construct a "knowledge graph of resources for fostering virtue and cultivating talent" from China's diverse advanced cultures and heroic deeds, and by extracting and presenting corresponding content based on students' ages and cognitive levels, digital textbooks can achieve the goal of "delivering the right content to the right person at the right time through the right means." Moreover, through technologies such as VR and AR, students can gain profound insights from immersive experiences, enabling the "experiential internalization" of values, while steadfastly adhering to the original mission of "education-oriented and service to the nation." Second, it can manifest the value of cultivating roots and forging the soul. By integrating China's distinctive patriotic spirit, sense of national identity, and other fine traditional cultural elements into digital textbook development through artificial intelligence, students can perpetually inherit the "red gene" through these unique contents. Empowered by AI, China's excellent traditional culture becomes the spiritual nourishment for digital textbook construction (Hao, Wang, 2022), thereby achieving the value pursuit of cultivating roots and forging the soul. Third, it reflects a student-centered value orientation. Digital textbooks, grounded in Vygotsky's Zone of Proximal Development (ZPD) theory, place greater emphasis on a "student-oriented" approach. They intelligently analyze various data and provide timely feedback to identify a unique learning plan suitable for each student. Meanwhile, Gardner's Theory of Multiple Intelligences also serves as a theoretical foundation for this student-centered approach (Chen, 2004), enabling every student to invest their passion for learning in their preferred domains, thereby promoting talent development. Fourth, it embodies a profound educational value. By employing Reinforcement Learning (RL) to analyze dynamically changing social environments, digital textbooks provide accurate explanations and guidance for students. At the textbook level, they cultivate students' ability to adapt to and transcend their environments. This profoundly transforms the entire chain of "cultivating, discovering, utilizing, and developing" talents, thereby consolidating the foundation of a talent-strong nation.

2.3 Fostering a New Paradigm of Digital Literacy for the Teaching Workforce

In 2023, with a view to thoroughly implementing the guiding principles of the 20th National Congress of the Communist Party of China, and against the backdrop of emphasizing digital technologies, the Ministry of Education issued the professional standard Digital Literacy for Teachers to enhance teachers' capabilities, awareness, and responsibilities in transforming educational and teaching practices (Xu, 2025). In January 2025, the Outline

of the Plan for Building a Powerful Educational Nation (2024–2035) underscored the necessity to "formulate and refine digital literacy standards for both teachers and students, and deepen the integration of artificial intelligence to facilitate the development of the teaching workforce" (The 2025).

First, transforming the traditional teaching model. The integration of artificial intelligence enables teachers to build higher-quality classroom ecosystems, leverage the internet to gather vast teaching resources, ensure that curriculum content aligns with disciplinary and contemporary developmental trends, construct modern teaching philosophies, and facilitate innovation in classroom instruction. Second, further broadening the boundaries of teachers' work. By employing AI technologies, teaching processes can be streamlined, and the collection and integration of complex student information can be accomplished. This enables precision teaching and ideological guidance based on various student data, promoting the "collaborative cultivation" of knowledge and values, thereby better fulfilling the teacher's fundamental duty of "imparting knowledge and educating people," and providing more diverse and effective pedagogical pathways for instruction. Third, meeting the demands of cultivating innovative and versatile talents. With the development of digital textbooks, teachers' roles evolve into learning guides and resource integrators, while students can engage in autonomous, inquiry-based learning through exploration-oriented tasks assigned by teachers. This cultivates students' abilities to propose, discover, and solve problems, as well as their practical skills and innovative thinking. Fourth, enhancing teachers' teaching capabilities. Empowered by AI, the classification and integration of resources through artificial intelligence enable a broader range of high-quality teaching materials to be accessed by teachers, transcending temporal and spatial limitations. This continuously enriches teachers' resource reserves for lesson preparation and pedagogical methods, nurturing a new generation of educators who possess both teaching proficiency and digital competence.

3. Logical Shifts in AI-Empowered Digital Textbook Development: From Traditional Print to Digital

Traditional paper-based textbooks have long constituted an integral part of the trajectory of educational development. However, amid technological advancement, the evolution of pedagogical philosophies, and the advent of the digital era, these conventional textbooks have gradually revealed their structural limitations. This signifies that digital textbooks have emerged as a critical driving force in shaping new instructional paradigms, featuring

organizational and media formats that are fundamentally distinct from those of their paper-based counterparts.

3.1 Goal Shift: From Textbook Centeredness to Student Centeredness

As a core component of the educational process, textbooks encompass a range of objective elements, including illustrations, texts, and exercises (Zhang, 2021). Within this context, an inherent tension arises between "standardized content" and "individualized students"—namely, the same textbook content often struggles to accommodate the cognitive levels of every learner. Chinese scholar Zhang Zhi posits that static paper-based textbooks tend to become disconnected from a dynamic worldview, resulting in students' knowledge lagging behind and rendering them ill-equipped to cope with a rapidly evolving world (Zhang, 2021). Furthermore, a trend toward "utilitarianism" has emerged in the use of textbooks, with students generally inclined to accept ready-made explanations and case studies provided within the texts (Boxte, 2000). Chinese scholar An Guiqing points out that spending relatively little time on comprehension and interpretation leads to low processing efficiency in student learning, ultimately devolving into a mode of rote memorization that neglects students' emotional attitudes and affective engagement (An, Li, 2020).

Digital textbooks empowered by artificial intelligence can effectively facilitate the formation of a virtuous, student-centered teaching cycle, enabling self-paced learning progress and real-time feedback, constructing personalized knowledge graphs for individual students, and ultimately realizing scalable personalized instruction. First, with the assistance of generative artificial intelligence (AIGC), routine teaching processes can be streamlined, shifting the emphasis from the mere memorization and comprehension of conceptual knowledge toward the cultivation of students' higher-order thinking skills. Meanwhile, the nurturing of students' emotional dispositions and value orientations is incorporated into instructional objectives, thereby more effectively fulfilling the goal of fostering virtue and cultivating talent. Second, Richard E. Mayer's principle of "timely feedback" provides theoretical support for integrating AI into textbooks (Mayer, 2016); that is, generative AI, by analyzing various student learning data, can deliver immediate and humanized pedagogical guidance in an approachable and empathetic manner that is widely acceptable to students. Third, artificial intelligence is also capable of identifying real-time social contexts and integrating the latest technological advancements and pedagogical concepts into digital textbooks. Through reinforcement learning (RL), outdated or erroneous conceptual

knowledge within digital textbooks can be rectified, ensuring the dynamic, authentic, and real-time nature of the content presented.

3.2 Pedagogical Modality Shift: From Unidirectional Imparting to Bidirectional Interaction

Chinese scholar Wang Huili points out that traditional paper-based textbooks, characterized predominantly by linear text and static images, possess an inherent static nature. They lack dynamic processes, three-dimensional structures, vivid explanations of abstract concepts, and authentic situational contexts, often resulting in a one-way transmission of information from author to student (Wang, Lai, Yang, 2024). Additionally, Lei Hao notes that teachers, serving as the dominant figures in the instructional process, may become absolute authorities due to the fixed frameworks and predetermined content of textbooks, thereby neglecting students' own developmental needs (Lei, Yang, 2024).

First, the novel human–computer interaction model places greater emphasis on the "dialogue" between students and tools. Large language models, in conjunction with reinforcement learning, integrate student data and generate "human-like" responses (Feng, Lv, 2025), shifting instruction from a search-based mode to a dialogue-based one. By leveraging Chatbots, this approach reenacts the interactive logic of Confucius's heuristic pedagogy and Socrates' maieutic method, enabling students to acquire personalized, comprehensible answers effortlessly through natural language. Second, generative artificial intelligence and XR technologies provide critical support for students' immersive learning. Generative AI can create diverse instructional materials—such as charts and background narratives—based on given themes, thereby establishing immersive learning environments that actively engage students in deep exploration. Moreover, augmented reality (AR) can superimpose 3D models onto real-world scenes, while VR technology allows students to experience authentic physical laws, chemical reactions, and decomposed sports movements, facilitating immersive learning experiences. Third, student learning evolves from formalized to individualized development. Under the traditional paper-based textbook environment, learning tends to become outcome-oriented, neglecting the affective and cognitive transformations that occur during the learning process (Sang, Hu, Wen, 2026). However, with the integration of artificial intelligence, multimodal student data can be collected to generate personalized educational support, thereby constructing individualized developmental pathways for each student.

3.3 Form Shift: From One-Way Transmission to Two-Way Interaction

With the advent of the digital era, textbook development is no longer confined to traditional approaches, but places greater emphasis on integrating the textbook system with multimodal digital educational resources, thereby enabling educational resources to transition from static distribution toward dynamic and fluid presentation (Ye, He, 2021). Zhang Zhi contends that traditional textbooks suffer primarily from update delays, resulting in students acquiring outdated knowledge (Zhang, 2021). Furthermore, Shi Wenlong argues that conventional textbooks, constrained by paper and limited space, exhibit slow update cycles, lack abundant multimedia and interactive resources, and fail to integrate with high-quality resources both within and beyond the discipline. Consequently, students are deficient in cross-resource integration abilities, making it difficult to cultivate their comprehensive competencies (Shi, 2025).

First, achieving dynamic updates of digital textbook knowledge. Wang Qiang points out that the revision cycle of traditional paper-based textbooks typically spans three to five years, significantly increasing both production costs and temporal expenses (Wang, 2019). By employing natural language processing (NLP) and web information extraction technologies, the latest research findings and emerging perspectives relevant to textbook content can be identified, ensuring that students gain timely access to cutting-edge knowledge. Meanwhile, through knowledge graphs and reinforcement learning, outdated knowledge points within textbooks can be automatically revised based on world-leading scientific advancements, thereby guaranteeing the accuracy and knowledge coherence of the content. Second, enriching textbook resources and promoting open sharing. Through NLP techniques, each subject-related educational resource can be analyzed and automatically tagged according to its content. Subsequently, by integrating disciplinary knowledge with these tags via knowledge graphs, barriers to resource scarcity can be effectively dismantled. Furthermore, with the assistance of blockchain technology, high-quality teaching resources are assigned unique "digital identities" and uploaded to online platforms, transcending geographical limitations and socioeconomic constraints (Chen, Lv, 2026), thereby accelerating the advancement of educational equity. Third, realizing interdisciplinary knowledge integration. A disciplinary framework is constructed using knowledge graphs, while AI is harnessed to uncover cross-disciplinary connections—for instance, associating the mathematical concept of "parabola" with the "arc of a basketball shot." NLP is then employed to generate accessible language that facilitates knowledge transfer, while AIGC dynamically integrates these associations into

coherent narratives. Coupled with AR/VR technologies, this approach creates immersive interactive environments, ultimately forming an interdisciplinary knowledge network characterized by Fourth, enabling modular instruction. Xu Guoqing contends that the coherent layout of traditional textbooks makes it difficult for students to extract arbitrary sections for targeted learning, and this two-dimensional reading mode constitutes a notable deficiency in the use of paper-based materials (Xu, 2024). A fine-grained knowledge network can be constructed based on knowledge graphs, while reinforcement learning and user profiling are combined to analyze learning states and generate optimal learning pathways. Generative AI then customizes personalized instructional content, dynamically creating teaching modules that enhance students' comprehensive thinking and problem-solving abilities. y hypertextuality and interactivity.

4. Practical Pathways for AI-Empowered Digital Textbook Development

4.1 Top-Level Design: Embedding National Will, Openness, and Autonomy into the Construction of the Autonomous Textbook System

Chinese leaders, when addressing the development of textbooks, have remarked that "textbooks are the primary carriers of knowledge dissemination and embody the value systems of a nation and a people" (Xi, 2024). This statement provides the correct orientation for the top-level design of digital textbook development in China.

Translating national will into the political orientation of digital textbook development. First, guided by General Secretary Xi Jinping's important instructions on textbook development, the principle of "One Adherence and Five Reflections" shall serve as the fundamental guideline for the construction of digital textbooks. The basic stances, viewpoints, and core essence of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era shall be systematically integrated into digital textbooks (Tan, Wang, 2025). Second, digital textbooks shall fully and accurately incorporate the Party's theories, with rigorous oversight over their political and ideological orientation. Efforts shall be made to advance immersive ideological and political education across all disciplines and school stages in order to strengthen the function of value guidance. The actual outcomes of textbooks in fostering virtue and shaping character shall be tracked throughout the whole process; the latest theoretical achievements of the Party shall be incorporated in a timely manner, and the development of students' ideological awareness shall be dynamically monitored. An evaluation system for educational outcomes shall be formulated and implemented from three

dimensions: ideal and conviction, practical conduct, and value cognition (Yang, Li, Luo, 2026).

Second, establishing a development pattern of "introducing advanced practices and going global" in the field of education. First, we may draw upon the world's high-level textbook publishing experience (Liu.Y.J, Liu, 2025). In terms of publishing philosophy, academic quality should serve as the primary evaluation criterion, with a steadfast commitment to providing new technologies and new ideas for various sectors of society. In terms of publishing models, review standards should be enhanced to ensure textbook quality, and advanced international publishing models should be adopted to expand the influence of China's digital textbooks. In terms of collaboration models, suggestions from experts in the educational field should be fully incorporated to assist publishing departments in conducting rigorous quality reviews, thereby promoting the high-quality development of digital textbooks across different disciplines. Second, government efforts should comprehensively advance the internationalization of digital textbooks (Liu.Y.J, Liu 2025). Closely aligned with the Belt and Road Initiative, the goals and pathways for digital textbooks to go global should be clearly defined; through inter-institutional cooperation, international resources can be introduced while China's textbooks are exported, achieving global co-construction and sharing. Finally, against the backdrop of international promotion, China's digital textbooks should be integrated with the cultures and educational systems of other countries to better adapt to their national conditions and levels of educational development. Moreover, effective publicity and promotion efforts should be undertaken to provide Chinese solutions for global education governance, thereby highlighting the advantages and roles of China's digital textbooks (Li, 2017).

Third, advancing the development of an autonomous textbook system grounded in an autonomous knowledge system. The development of digital textbooks should be firmly rooted in Chinese civilization, breaking free from overreliance on Western paradigms, interpreting Chinese narratives through original Chinese theories, and disseminating China's voice through Chinese textbooks. Proceeding from national educational strategies and leveraging artificial intelligence, we should generate landmark and pioneering innovative outcomes that enhance the effectiveness of building China's autonomous textbook system and foster a Chinese-style academic ecosystem. By transforming Chinese cultural resources into knowledge embedded in digital textbooks, the inherent potential for goodness in students can be stimulated, allowing virtue to steadily flourish in their hearts while simultaneously

enabling them to distance themselves from harmful influences before developing bad habits—thereby manifesting the educational value of digital textbooks (Gao, 2019).

4.2 Content Development: Sustaining Digital Textbook Construction through a Novel "Four in One" Educational Model Integrating Moral Cultivation, Resource Aggregation, Pedagogical Design, and Global Perspective

As a novel form of textbooks, digital textbooks place content development at the core of AI-empowered textbook construction. Such content should center on students' holistic development and comprehensive competencies, ultimately cultivating well-rounded individuals for the new era.

First, constructing a multimodal "AI + moral cultivation" paradigm. From a practical perspective, the current understanding and grasp of the laws governing students' moral development and the principles of fostering virtue and cultivating talent across various types of schools in China remain largely in an "opaque state" (Ren, 2020). Against this backdrop, the instructional model of "artificial intelligence + fostering virtue and cultivating talent" has emerged. AI can collect data on students' ideological, behavioral, and value orientations, generate educational content tailored to individuals' moral development needs, and leverage XR technologies to enable students to activate emotional and moral cognition through immersive "first-hand" experiences, thereby fostering deep emotional engagement and mechanisms for value internalization, while enhancing the effectiveness of moral cultivation. Simultaneously, greater efforts should be directed toward strengthening the construction of an "empowerment-oriented moral cultivation" system, with a focus on addressing core contradictions and underlying issues. Relying on AI, the digital transformation of moral cultivation can be realized, endowing it with renewed contemporary significance, while deeply integrating the moral resources embedded in traditional Chinese culture and core socialist values into the content of digital textbooks.

Second, constructing a full-process personalized data application mechanism underpinned by diverse resources. By aggregating outstanding domestic and international digital textbook achievements in a multi-source, heterogeneous manner, a digital textbook database can be established to ensure high-quality cross-platform resources and interactive experiences. Through refined management of multiple resource types, interconnection and interoperability among various platforms can be achieved, thereby forming an extensible resource network (Zhang, Liu, 2026). With artificial intelligence as the central hub, a companion-style teaching experience spanning the three phases of pre-class, in-class, and

post-class can be created. Before class, diverse resources are provided, and personalized learning analytics are generated, furnishing data support for instruction (Ding, 2025). During class, through dialogue employing the Socratic maieutic method, students are guided toward autonomous inquiry, while data such as learning efficiency, dwell time, and error rates are collected in real time to generate targeted instructional feedback. After class, leveraging resource heterogeneity technologies to integrate learning data, differentiated learning tasks, and remedial plans are generated, enabling precision guidance. Finally, based on big data analytics of teaching and learning, knowledge graph technologies and user profiling are utilized to conduct learning status assessments, chart learning pathways, and perform unique scientific evaluations for students' future studies, thereby maximizing the value of available resources.

Third, constructing a novel design for digital textbooks to stimulate endogenous impetus for their practical implementation. The instructional design of digital textbooks should adhere to students' cognitive patterns and technology usage habits, embody human-centered principles, integrate the strengths of digital and print textbooks while circumventing the limitations of purely digital formats, thereby creating adaptive teaching entities that facilitate the transition of learning from "knowledge accumulation" to "competency cultivation." In terms of content presentation, the integration of technology and instructional content should be strengthened, leveraging AI's capacity to restructure knowledge and promoting a shift in knowledge production from unidirectional transmission to distributed development, while learning scenarios expand from a single classroom to open environments, thereby realizing AI's multidimensional empowerment of digital textbooks. In terms of spatial reconfiguration, a trinity educational field of "family school community" should be constructed to create an immersive learning environment that transcends temporal and spatial constraints, offering diverse learning modalities and resources. In terms of media synergy, print textbooks serve as the foundation, while digital textbooks provide extension; the complementary advantages of both are combined to build a learning ecosystem that integrates the virtual and the real.

Fourth, integrating an international perspective component into the novel digital textbooks. AI-empowered digital textbooks transform global real-time information into living resources, and through immersive contexts such as cross-national data comparisons and Model United Nations simulations, enable students to deepen their identification with China's development path through comparative learning, hone their critical thinking and cross-cultural communication skills in practice, and ultimately realize a systemic transformation in the

cultivation of international perspectives—shifting from mere content provision to active cognitive construction.

4.3 Social Environment: Collaborative Efforts of All Sectors to Foster a Sound Ecosystem for Digital Textbook Development

A favorable development environment for digital textbooks can facilitate the smooth implementation of textbook construction and ensure both quality and effectiveness. To cultivate a sound developmental ecosystem for digital textbooks, efforts should be advanced in three key areas: promoting public-oriented governance concepts for digital textbooks, shaping a co-creation network for digital textbook management, and establishing a three-tier planning coordination mechanism for digital textbook development. The methodological logic is illustrated in Figure 2.

First, promoting public-oriented governance concepts for digital textbooks. The governance of digital textbooks should avoid centralization, overreach, and disorder, and steadfastly adhere to a public-oriented approach to governance. The government should gradually delegate authority, allowing social science institutions to exercise professional managerial functions in accordance with the law, while simultaneously strengthening citizens' legitimate rights of management. This will foster an open and shared governance philosophy, facilitate collaborative co-governance among various stakeholders with defined rights and responsibilities, and ultimately build a public governance framework that is shared by the people, thereby safeguarding the legitimacy of high-quality digital textbook development (Yang, Liu, Luo, 2026).

Second, building a collaborative governance network underpinned by multi-stakeholder synergy to enrich the modernization system of digital textbook governance. Textbook governance constitutes a systematic endeavor that requires all rights-bearing and responsibility-bearing parties—including administrative, social, and educational actors—to clearly define their roles and delineate their respective responsibilities. Through the establishment of a rights-and-responsibilities list, a governance framework can be constructed to collaboratively dismantle structural barriers and resolve ambiguities in accountability. Efforts should be made to break down silos among government, schools, enterprises, publishing houses, and research institutions. With government leadership, a co-governance platform for digital textbooks should be established to provide a basis for addressing vulnerabilities, updating content, and refining functionalities. Simultaneously, a cross-regional governance network should be developed to facilitate the transformation of

governance from a broad, extensive approach to a refined, connotation-driven one, thereby achieving an integrated synergy of execution, coordination, and innovation across all stakeholders (Wu, Wang, Zhu, 2026).

Third, advance the three-tier planning coordination mechanism for digital textbook development. At the national level, ideological and political elements and core socialist values should be integrated to strengthen ideological guidance, while supporting the development of high-quality digital textbooks that span all educational domains. At the local level, approval and filing procedures should be tightened, cooperation with publishing houses and research institutions should be deepened, and the integration of industry and education as well as school-enterprise collaboration should be enhanced. In accordance with national award regulations, local textbook reward mechanisms should be established to promote the development of digital textbooks with distinctive regional characteristics. At the school level, comprehensive construction plans encompassing compilation, revision, and topic selection should be formulated, fostering teacher collaboration and achieving intensive, full-cycle development. Furthermore, the outcomes of textbook compilation should be incorporated into the teacher professional title evaluation system, thereby incentivizing teachers to actively participate in the development of high-quality digital textbooks.

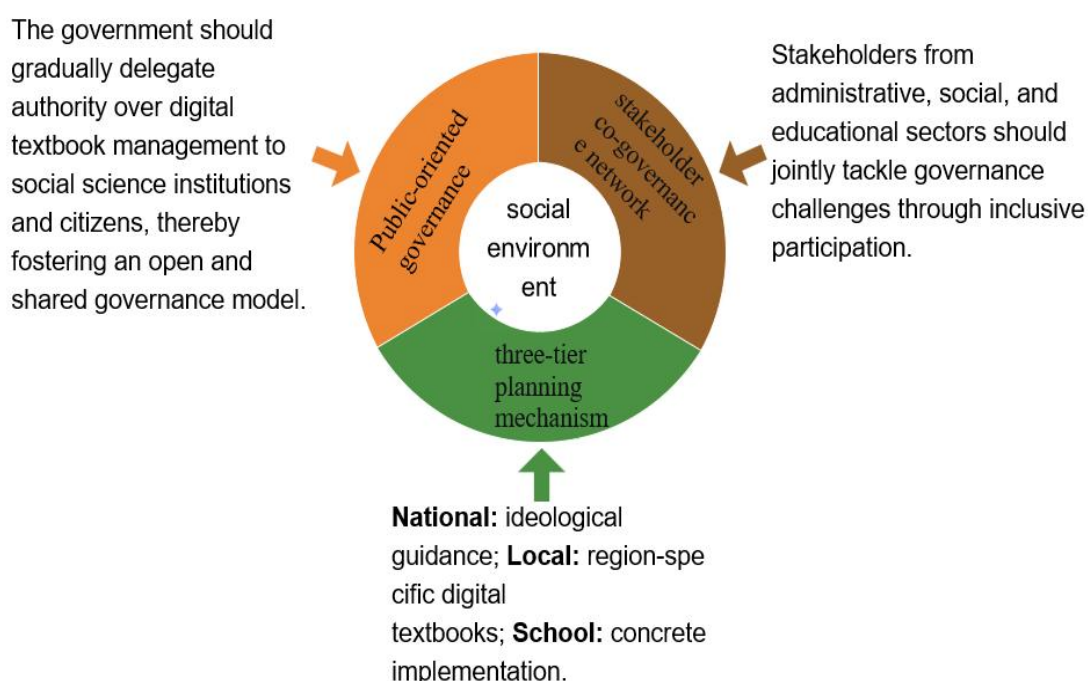


Figure 2. Schematic Diagram of Practical Approaches at the Social Environment Dimension

4.4 Teacher Empowerment: Enhancing Teachers' Digital Competence and Improving Instructional Quality

AI-empowered digital textbooks represent not merely a technological upgrade, but a structural reshaping of the educational ecosystem within schools. To fulfill the fundamental mission of fostering virtue and cultivating talent, and to nurture new-era individuals capable of undertaking the rejuvenation of the Chinese nation, teachers' proficiency in utilizing artificial intelligence technologies has become a critical link in the effective deployment of digital textbooks for instruction.

First, promoting the structural development of teacher training in digital teaching competencies. A full-cycle “pre-service–induction–in-service” teacher education system should be established. Prior to the full-cycle training, teachers' existing digital teaching proficiency should be assessed, and a refined, quantifiable evaluation indicator system should be developed in accordance with the Ministry of Education's industry standard Digital Literacy for Teachers (Liu, Yin, 2024). During the pre-service normal education phase, artificial intelligence technologies should be integrated throughout the entire teacher training process, including “technology internships” during practicum periods—namely, learning relevant AI knowledge to provide a theoretical foundation for subsequent practice. Research has confirmed that teachers who participated in technology internships are more willing and more capable of integrating digital technologies with teaching activities (Alexander, 2014). During the induction phase, teachers can be engaged in practical exercises to enhance their digital competencies through continuous practice, while consulting experienced colleagues or technical specialists to further expand their digital capabilities. For in-service teachers, schools should foster a supportive digital teaching environment, improve the availability and accessibility of digital technologies, and build teachers' confidence in utilizing digital tools for instructional work (Gudmundsdottir, 2018). Teacher training in digital literacy should emphasize the four dimensions of content—targetedness, practicality, effectiveness, and learner centeredness—while reinforcing follow-up support. Leveraging AI, specialized training teams should be assembled to design thematic courses centered on practical subject teaching issues, thereby promoting deep integration of teachers with digital textbooks and comprehensively enhancing their instructional application capabilities.

Second, establishing a resource integration perspective to form a new textbook teaching philosophy of “using correctly, using well, and using flexibly.” Adopting a resource integration perspective, on the one hand, prevents teachers from mechanically relying on

digital textbooks, and on the other hand, promotes the renewal of teachers' teaching philosophies (Zhu, Wang, 2025). By leveraging AI to systematically map the interconnections between textbook knowledge points and curriculum standards, mind maps can be generated to help students develop a holistic view of the subject matter, while simultaneously assisting teachers in comprehending the internal logic of the textbooks and optimizing instructional design—thereby achieving the goal of "using correctly" digital textbooks. Grounded in a vast resource repository and supported by AI-driven semantic analysis, interdisciplinary connections can be established, enabling teachers to accurately understand and utilize textbooks from a cross-disciplinary perspective. This ensures that digital textbooks are "used well", guaranteeing high-quality interdisciplinary instruction (Wang, 2026). Guided by the resource integration perspective, teachers can employ AI to analyze student learning data, precisely aligning with individual students' needs throughout the entire process of textbook use, and providing adaptive instructional scaffolds in real time. This ensures that personalized teaching advances within the Zone of Proximal Development, truly achieving the flexible and effective use of textbooks.

Third, adopting a "dynamic bilateral" teacher-student trust strategy to construct a "teaching, learning, assessment, and practice" instructional service system. First, despite the integration of artificial intelligence, instruction must ultimately be carried out under the supervision and guidance of teachers. Therefore, from the students' perspective, the authoritative position and pedagogical leadership of teachers should be reinforced, enabling students to achieve the dual enhancement of knowledge acquisition and cognitive development under teacher guidance. The reconstruction of teacher authority must transcend instrumental reliance on digital technologies, instead utilizing AI as a catalyst for interpersonal interaction to deepen mutual understanding between teachers and students. This necessitates a fundamental transformation in teacher authority—shifting from institutionally conferred authority to professionally earned recognition—thereby establishing a new type of trust relationship that is compatible with the characteristics of the digital era. Second, a novel instructional model of "teaching learning practice assessment" should be constructed. Through self-developed online courses, AI-powered annotations and contextualized presentations, knowledge graph-assisted learning, extensive multi-type practice questions, and online grading with personalized feedback, teachers can realize a digitally enabled instructional loop that spans from progress tracking to precise review, thereby comprehensively safeguarding students' knowledge mastery and learning experience.

5. Conclusion

Against the backdrop of the 15th Five-Year Plan and the national strategy of building a powerful educational nation, digital textbooks—as a product of the deep integration of artificial intelligence and instruction—bear the significant mission of constructing an autonomous knowledge system, fulfilling the fundamental task of fostering virtue and cultivating talent, and nurturing new era capable individuals. Through the integration of AI, digital textbooks can authentically return teaching to a "student-centered" approach. Leveraging technologies such as large language models and virtual reality, they transform traditional one-way knowledge transmission into profound two-way interaction and immersive learning. Simultaneously, they break the closed nature of traditional textbook content, enabling dynamic knowledge updates, interdisciplinary integration, and flexible modular reorganization, all aimed at cultivating well-rounded talents who possess both a deep sense of national commitment and global vision as well as innovative capabilities. From a national strategic perspective, the essence of AI-empowered digital textbook development lies in reshaping the educational ecosystem through technological means, and in consolidating the foundation of a powerful nation through educational excellence. It represents a practical implementation of the digital education strategy, a critical vehicle for building an autonomous knowledge system, and a timely response by the educational sector to the great rejuvenation of the Chinese nation. Only by proceeding from the overall national strategy and coordinating top-level design with grassroots practice in digital textbook development can this transformation truly become a powerful engine for advancing high-quality educational development and serving the broader cause of national modernization.

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Discourse statement

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