Digital Intelligence Empowerment of Digital Textbooks for Vocational Education: Challenges, Paths, and Strategies (Postprint)

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Abstract

【Purpose】 With the advent of the integrated media era, this study explores the pathways and strategies for empowering the development of digital textbooks in vocational education through high technologies such as artificial intelligence, big data, and cloud computing, thereby further advancing the construction of digital textbooks for vocational education. 【Method】 This paper proposes pathways and strategies for utilizing digitalization to empower vocational education textbook development through a detailed analysis of the challenges and difficulties faced in constructing digital textbooks in the integrated media era. 【Result】 As a crucial component of national development strategy, vocational education faces an urgent need for transformation and upgrading. Against the backdrop of integrated media, digital textbook construction has become a key link in enhancing the quality of vocational education and promoting the integration of industry and education. 【Conclusion】 In the context of integrated media, digital intelligence technologies empowering the development of digital textbooks for vocational education can significantly improve teaching quality and efficiency, thereby advancing the modernization process of vocational education.

Full Text

Research on Challenges, Paths, and Strategies for Empowering Vocational Education Digital Textbooks through Digital Intelligence

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Abstract

Purpose: With the advent of the integrated media era, this study explores the paths and strategies for empowering vocational education digital textbook construction through advanced technologies such as artificial intelligence, big data, and cloud computing, aiming to further advance the development of vocational education digital textbooks.

Method: This paper proposes paths and strategies for digitally empowering vocational education textbook construction through a detailed analysis of the challenges and difficulties faced in digital textbook development within the integrated media context.

Results: As a crucial component of national development strategy, vocational education faces urgent needs for transformation and upgrading. Against the backdrop of integrated media, digital textbook construction has become a key link in enhancing vocational education quality and promoting integration between education and industry.

Conclusion: Under the integrated media context, digital intelligence technology empowering vocational education digital textbook construction can significantly improve teaching quality and efficiency, thereby advancing the modernization of vocational education.

Keywords: Converged Media; Digital Intelligence; Vocational Education; Digital Textbooks; Dynamic Updates

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In recent years, the state and the Ministry of Education have attached great importance to the development of vocational education and the digital transformation of education, issuing a series of policy documents to vigorously promote the construction of vocational education digital textbooks. In 2021, the Ministry of Education issued the *Implementation Plan for the Construction of 14th Five-Year Plan Vocational Education Planning Textbooks*, which explicitly proposed to "promote the construction of supporting resources and digital textbooks for teaching materials, explore the digital transformation of paper textbooks, and form more digital textbooks that are audible, visual, practical, and interactive" [1]. The General Office of the Central Committee of the Communist Party of China and the General Office of the State Council jointly issued the *Implementation Opinions on Promoting the High-Quality Development of Modern Vocational Education* and the *Opinions on Strengthening the Construction of Highly Skilled Talent Teams in the New Era*, which also emphasized the importance of vocational education textbook construction and put forward requirements for the development of digital textbooks, further advancing the process of vocational education digital textbook construction [2].

As an emerging form of teaching resources, vocational education digital textbooks have attracted widespread attention in recent years. On the one hand, dig-

ital textbooks, with their rich media characteristics and interactivity, can enrich teaching content and improve teaching effectiveness. On the other hand, digital textbooks can also promote interaction and communication between teachers and students, meeting the needs of personalized learning [3]. However, existing research also points out that vocational education digital textbooks face challenges in development, including technical thresholds, content quality, and copyright protection [4].

1. Background and Opportunities

1.1 Information Technology Applications Enable Digital Textbook Development

In the information age, students' learning styles and needs have changed significantly. They tend to prefer digital learning resources, hoping to access learning content anytime and anywhere for autonomous and interactive learning. Vocational education digital textbooks can meet these needs, providing students with more convenient and efficient learning methods. The characteristics of vocational education determine that its textbooks need to focus more on practical teaching and skill development. Digital textbooks can provide students with more realistic learning scenarios through simulated training and case analysis, helping them better master professional skills and improve their employment competitiveness.

In the future, vocational education digital textbooks will place greater emphasis on personalized learning and intelligent assessment. Personalized learning will provide customized textbook content and learning paths based on students' interests, abilities, and learning needs, while intelligent assessment will achieve real-time and accurate evaluation of student learning outcomes through data analysis and machine learning technologies, providing teachers with more scientific and effective teaching evidence.

1.2 Artificial Intelligence Accelerates Digital Textbook Implementation

With the rapid development of advanced technologies such as artificial intelligence, big data, and cloud computing, digital technologies have gradually matured, providing strong technical support for vocational education digital textbook construction [5]. These technologies have not only changed the teaching models of vocational education teachers but also expanded the ways and channels through which students receive knowledge [6]. For example, virtual reality and augmented reality technologies can provide students with more vivid and intuitive learning experiences, while big data technology can enable the collection and analysis of student learning data to provide a basis for personalized teaching.

Artificial intelligence can provide intelligent support for vocational education digital textbooks through data analysis, natural language processing, and other

means. For instance, AI can recommend personalized learning paths and textbook resources based on student learning behaviors and achievements. Simultaneously, it can enable intelligent assessment of textbooks, providing teachers with more accurate and comprehensive student learning feedback.

1.3 Converged Media Technology Solves Digital Textbook Presentation Challenges

Converged media technology enables the organic integration of multiple media forms, providing more possibilities for content presentation and dissemination of vocational education digital textbooks. The comprehensive application of various media elements such as text, images, audio, and video can make textbook content richer and more vivid, enhancing student interest and learning effectiveness. Converged media technology has become a key force in promoting vocational education digital textbook construction, greatly improving textbook quality and teaching effectiveness.

Converged media technology can integrate text, images, audio, video, and other media forms organically, providing richer and more vivid content presentation methods for vocational education digital textbooks. In the future, converged media technology will further deepen its application in vocational education digital textbooks, achieving multimedia, interactive, and personalized textbook content, thereby enhancing student learning experiences and outcomes.

The rapid development of converged media technology has brought profound changes to the education sector. With its multimedia, cross-platform, and highly interactive characteristics, converged media provides broad space for the dissemination of educational resources and the innovation of teaching models. Research indicates that converged media technology can break the temporal and spatial limitations of traditional education, achieving sharing and optimal allocation of teaching resources [7]. However, current research on how converged media can specifically empower vocational education digital textbook construction remains insufficient and requires further in-depth exploration.

2.1 Converged Media

Converged media is a new media form that fully utilizes media carriers to comprehensively integrate different media such as broadcast, television, and newspaper—media that share commonalities yet complement each other—in terms of human resources, content, and publicity [8]. It aims to achieve "resource integration, content compatibility, mutual publicity, and shared benefits" through multiple communication channels and platforms to meet the diversified information needs of audiences. Converged media has the following characteristics:

Multimedia: Converged media can comprehensively use text, images, audio, video, and other media forms to present content, enabling audiences to obtain richer and more three-dimensional information experiences. This multimedia

characteristic enhances audience understanding and memory of content, improving communication effectiveness.

Cross-platform: Converged media content is not limited to a single platform but achieves comprehensive coverage through multiple platforms and channels such as websites, WeChat, Weibo, and apps to meet the needs of different audiences.

Interactivity: Converged media has strong interactivity and participation. Audiences can actively participate in content creation and dissemination through interactive methods such as commenting, liking, and sharing, forming closer communication relationships with media.

Immediacy: Converged media has the capability for immediate collection and immediate publication of reports, enabling rapid response to audience needs and providing the freshest and most timely information.

Converged media, through its multimedia, cross-platform, and interactive features, highly aligns with the practical and vocational characteristics of vocational education. On the one hand, converged media can comprehensively use multiple media forms to intuitively display vocational skills and operational processes, improving students' practical abilities and professional literacy. On the other hand, through cross-platform dissemination and interactive feedback mechanisms, converged media enables students to access learning resources anytime and anywhere, achieving personalized and autonomous learning.

2.2 Digital Textbooks

Vocational education digital textbooks refer to new types of textbooks that use digital technology to transform traditional paper textbook content into digital form and incorporate various media elements such as audio, video, animation, and virtual operation platforms [9]. They can not only reconstruct the teaching system but also provide richer and more vivid learning resources and environments.

Rich Media: Vocational education digital textbooks contain rich multimedia resources such as images, audio, video, and animation, combining theoretical cognition with practical training in content. They can intuitively display teaching content and stimulate student interest in learning.

Interactivity: Digital textbooks have appropriate interactive functions, using information technology and intelligent technology to achieve immersive teaching and meet the needs of teaching, assessment, and management. Functions such as online testing, simulated operations, and interactive Q&A can satisfy students' needs for autonomous and inquiry-based learning.

Benchmarking: Textbook content closely aligns with professional standards and job requirements, focusing on cultivating students' professional literacy and practical abilities.

Vocational Orientation: Vocational education digital textbooks highlight vocational education characteristics, using real production projects and typical work tasks as carriers to help students master practical operational techniques and problem-solving abilities.

Process-oriented: Digital textbooks can record students' learning processes and outcomes, providing personalized learning feedback for teachers and students.

2.3 Digital Intelligence

Digital intelligence refers to the full utilization of new technologies such as big data, artificial intelligence, and cloud computing to upgrade and transform traditional businesses, achieving digital and intelligent transformation and development. Technology innovation drives digital intelligence development. The rapid development, updating, and application of new-generation information technologies such as cloud computing, big data, Internet of Things, artificial intelligence, and blockchain require vocational education digital textbook construction to keep pace with the times, stimulate the infinite potential of data elements, and enhance construction capabilities [10]. The full application of new-generation information technologies empowers textbook digitization, optimizing, innovating, and reconstructing vocational textbooks through the organic integration of human wisdom and big data, continuously increasing the quantity and quality of data, enhancing the effectiveness of big data, and forming a new ecosystem.

3. Difficulties and Challenges

As technology continues to advance, how to effectively empower vocational education digital textbook construction has become a research hotspot. Technology empowerment is reflected not only in the development process of digital textbooks but also throughout their application and evaluation. For example, emerging technologies such as artificial intelligence and big data can provide intelligent support for digital textbooks, enabling personalized recommendation of teaching content and precise evaluation of learning effectiveness [11]. However, current research on how technology can specifically empower vocational education digital textbook construction remains insufficient, particularly regarding how to integrate converged media resources and leverage technological advantages under the converged media background. Although domestic and international research on converged media education and vocational education digital textbooks has achieved certain results, several shortcomings remain. First, existing research focuses more on theoretical discussions and technical introductions, lacking in-depth practical case analysis and effect evaluation. Second, research on how converged media can specifically empower vocational education digital textbook construction is still weak and requires further strengthened interdisciplinary and cross-field collaborative research. Deeper research and practice are needed in areas such as the effective integration and utilization of converged

media resources, specific paths and strategies for technology-enabled vocational education digital textbook construction, and evaluation and feedback mechanisms for digital textbook application effects.

3.1 Technical Thresholds and Cost Issues

The construction of converged media digital textbooks requires high technical support, including multimedia production, interactive design, and dynamic updates. This poses a considerable challenge for many vocational education institutions, as they may lack the necessary technical talent and resources. At the same time, the development and maintenance of digital textbooks require certain financial investment, which is a burden for some vocational education institutions with limited funds.

3.2 Content Quality and Copyright Issues

The content quality of digital textbooks directly affects student learning outcomes. However, due to the relatively low production threshold for digital textbooks, the market contains a large number of textbooks with varying quality. Additionally, copyright issues represent an important challenge in digital textbook construction. How to ensure the legality and originality of textbook content and avoid infringement and piracy is a problem that digital textbook developers need to address.

3.3 Teacher and Student Acceptance and Adaptability Issues

Despite the many advantages of digital textbooks, teacher and student acceptance and adaptability remain a challenge. Some teachers may be accustomed to traditional paper textbooks and hold reservations about digital textbooks. Students may lack the necessary digital skills and have not developed good habits for autonomous and active learning, preventing them from effectively utilizing digital textbooks [12].

3.4 Integration of Ideological and Political Elements and Ideological Management Issues

Vocational education not only imparts professional skills but also bears the important task of cultivating students' ideological and political qualities and professional ethics. However, in digital textbook construction, how to effectively integrate ideological and political elements and strengthen ideological management is a problem that needs to be solved. This requires textbook developers to possess not only professional technical knowledge but also profound ideological and political literacy and ideological management capabilities.

4. Paths and Strategies

4.1 Strengthen Policy Guidance and Support

First, the government should issue policy guidance and project funding support. The government should increase investment in vocational education digital textbook construction through quality engineering project approvals, providing necessary funding and policy support. Simultaneously, a comprehensive supervision mechanism should be established to ensure the quality and security of digital textbooks. Additionally, the government should actively guide and encourage enterprises to participate in the construction and operation of vocational education digital textbooks, promoting the development of industry-education integration. Government and education departments should increase technical research and development support for converged media and digital textbook construction, promoting innovation and application of relevant technologies. At the same time, extensive technical application training should be conducted to help vocational education institutions master digital textbook production and management technologies, reducing technical thresholds and costs.

Second, schools should coordinate planning and establish development teams. Schools should actively respond to government calls to accelerate the construction and application of vocational education digital textbooks. Specifically, schools can establish specialized digital textbook development and construction teams responsible for textbook design, production, and updates. Simultaneously, they should strengthen the cultivation of teachers' digital teaching capabilities to enhance their ability to use digital textbooks for classroom instruction. To help teachers better adapt to and use digital textbooks, diversified teacher training should be conducted, including digital skills training, teaching method innovation, and ideological and political literacy enhancement. Through training, teachers' digital teaching capabilities can be improved, enabling them to better utilize digital textbooks for classroom instruction and student learning guidance.

Third, enterprises should actively participate and take initiative. Enterprises should fully leverage their advantages in technology and market aspects to actively participate in the construction and operation of vocational education digital textbooks. Enterprises can cooperate with schools to jointly develop high-quality digital textbooks that meet market demands. Additionally, they can assist schools in achieving digital teaching transformation and upgrading by providing technical support and services.

4.2 Fully Utilize Digital Intelligence Technology Empowerment

Under the converged media background, actively adapting to the new requirements of industrial transformation and upgrading for talent cultivation and efficiently utilizing digital intelligence technology to empower vocational education digital textbook construction has become an important approach to improving vocational education teaching quality and efficiency.

First, content digitization is the foundation of vocational education digital textbook construction. Using computer network technology and digital means to transform traditional paper textbook content into digital form can not only achieve long-term preservation and rapid dissemination of textbooks but also make textbook content more easily retrievable and usable through search engines, databases, and other technical means. During the content digitization process, attention should be paid to the structured processing of textbook content, subdividing and annotating knowledge points to facilitate subsequent multimedia integration and interactive design. Simultaneously, digital copyright protection issues need to be considered to ensure the legal use of textbook content.

Second, multimedia integration is key to enhancing the appeal of digital textbooks. By incorporating multimedia elements such as audio, video, and animation, the presentation forms of textbooks can be enriched, making abstract and complex knowledge intuitive and easy to understand. For example, in mechanical engineering textbooks, 3D animations can be used to display the structure and working principles of mechanical parts; in culinary textbooks, videos can demonstrate the cooking process. Multimedia integration requires close integration of media elements with textbook content, avoiding excessive or inappropriate use of media elements that may distract students. Additionally, the quality and playback smoothness of media elements need to be considered to provide a good user experience.

Third, interactive design is an important means to achieve immediate interaction between students and learning content. By developing interactive textbooks, students can be guided to actively participate in the learning process, improving learning initiative and enthusiasm. For example, interactive Q&A, simulation experiments, and virtual operations can be set up in textbooks to allow students to learn knowledge and master skills through practice. Interactive design requires reasonable setting and effective guidance of interactive links, avoiding overly complex or irrelevant interactive links that may affect student learning effectiveness. Simultaneously, the collection and analysis of interactive data need to be considered to help teachers understand student learning situations and provide targeted teaching guidance.

Fourth, dynamic updating is key to maintaining the timeliness of digital textbooks. Using digital platforms, textbook content can be quickly updated and iterated to reflect the latest industry developments and technological advances in a timely manner. For example, in IT-related textbooks, the latest programming languages and technical frameworks can be updated regularly; in marketing textbooks, the latest market trends and marketing strategy cases can be added. Dynamic updating requires balancing update frequency and quality, avoiding overly frequent updates that may burden students or overly delayed updates that may cause textbook content to become disconnected from reality. Additionally, the review and verification of updated content need to be considered to ensure accuracy and authority.

4.3 Establish Strict Content Review and Copyright Protection Mechanisms

To ensure the content quality and copyright legality of digital textbooks, a strict content review mechanism should be established. This includes reviewing the scientificity, accuracy, and timeliness of textbook content to ensure high quality. Simultaneously, a copyright protection mechanism should be established to register and manage copyrights for digital textbooks and combat infringement and piracy.

4.3.1 Integrate Ideological and Political Elements and Strengthen Ideological Management In digital textbook construction, attention should be paid to integrating ideological and political elements and strengthening ideological management. This can be achieved by adding ideological and political course content and setting up special ideological and political modules in textbooks. Simultaneously, ideological and political review and ideological management of digital textbooks should be strengthened to ensure the correctness and orientation of textbook content. By integrating ideological and political elements and strengthening ideological management, high-quality skilled talents can be cultivated who possess not only proficient professional practical skills and craftsmanship but also good ideological qualities and professional ethics.

4.3.2 Comply with Publishing Standards and Ensure High-Quality and Meticulous Textbooks Textbook publishing should strictly follow national publishing standards, from cover design to table of contents arrangement, to content format and reference citation, all requiring rigor and meticulousness. Simultaneously, attention should be paid to the editing and processing quality of textbooks to ensure fluent language, clear charts, and accurate data, thereby improving overall textbook quality. Additionally, copyright issues should be addressed, respecting others' intellectual property rights and avoiding any infringement.

4.3.3 Strictly Review Content to Ensure Scientific, Systematic, and Applicable Quality During the textbook publishing process, it is essential to thoroughly study and closely align with the spirit and key points of national, provincial, and school-level documents to ensure textbook content meets the new requirements and standards of vocational education in the new era. Attention should be paid to the synergy between theoretical knowledge and technical skills, the practical application of knowledge and technology, and the integration and innovation of theory and skills to comprehensively reflect new achievements in modern science and technology and economic and social development. Digital textbooks for professional courses must closely align with the new demands of industrial transformation and upgrading, future technological development trends, and promptly update new technologies, standards, processes, and specifications adopted in frontline production, clarifying the construction methods and paths for digital textbooks [13]. Currently, when compiling professional textbooks for

vocational colleges, it is necessary to deeply analyze competency requirements, align with professional teaching, professional standards, 1+X vocational skill levels, and national vocational college skills competition requirements, establish a dynamic revision mechanism, and achieve integration of positions, courses, certificates, and competitions.

4.4 Innovate Textbook Formats and Strengthen International Exchange

4.4.1 Conduct In-Depth Market Research to Meet Teacher and Student Needs and Preferences Before textbook publication, extensive and in-depth market research must be conducted to comprehensively understand the actual needs and preferences of vocational college teachers and students for digital textbooks. Based on research findings, textbook content and format should be flexibly adjusted to ensure that textbooks meet both teaching requirements and market demands, thereby improving relevance and competitiveness. Simultaneously, attention should be paid to textbook marketing and promotion to expand their visibility and influence.

4.4.2 Follow Technology Trends and Optimize Textbook Content and Format Textbook publishing should keep pace with information technology development trends and actively introduce new technologies and tools to optimize textbook content and format. For example, explore the application of VR/AR technology in vocational education to provide students with immersive learning experiences. Simultaneously, use big data, artificial intelligence, and other technical means to achieve personalization and intelligence of textbook content. Additionally, attention should be paid to innovation in textbook formats, organically combining paper textbooks, digital courses, QR codes, etc., to form integrated textbooks that meet students' diverse learning needs.

4.4.3 Strengthen International Cooperation and Exchange In promoting the construction of vocational education digital textbooks, attention should also be paid to strengthening international cooperation and exchange. By cooperating with advanced international institutions and enterprises, introducing foreign advanced converged media technology and artificial intelligence technologies can jointly promote the rapid development of vocational education digitalization. Simultaneously, through international exchange and cooperation, sharing experiences and joint research and development can enhance the international competitiveness of China' s vocational education digital textbooks.

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