

International Comparative Study of Digital Textbook Application Policies

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Abstract: To determine the right direction for the future application of digital textbooks, it is essential to gain insights by analyzing the actual situations in countries that have already implemented digital textbooks. Therefore, this paper, building upon a review of the development of digital textbook policies in China, compares the application policies of digital textbooks in the United States, South Korea and Taiwan. The impact of digital textbook policies in these countries is analyzed from three aspects: the promoting body and strategy, the scope of application, the distribution system, and the methods of application. Based on these influences, a proposal for improving China's digital textbook policy is put forward. The improvement plan for digital textbooks presented in this paper is intended to serve as foundational material for shaping future policies and strategies for the development of digital textbooks.

Keywords: digital textbooks, applied politics, international comparative studies

1. Introduction

The development and application of digital textbooks are one of the driving factors for the digitization transformation of education. Digital textbooks are a new type of educational resource that exists in digital form, can be read on digital devices, have dynamically updatable content, and can record interaction traces in real-time. However, digital textbooks are not just typical digital teaching resources. They belong to the textbook series and are directly related to the question of "what kind of people to educate and for whom to educate." Digital textbooks are a new member of the textbook family, possessing both the general attributes of textbooks and the role of being a crucial intermediary between teaching and learning, as well as a significant vehicle for implementing national education policies. At the same time, digital textbooks also possess the general attributes of information technology products, such as multimedia, openness, and interactivity. Therefore, digital textbooks are considered a vital lever for classroom teaching reform and educational transformation, playing a pivotal role in promoting the digital transformation of education in various countries. Based on their specific national context and needs, countries worldwide actively explore the application, promotion, teacher training, application effectiveness, and evaluation criteria of digital textbooks to establish their own systems for the scientific and effective use of digital textbooks. [1]

Therefore, in order to correctly determine the future direction of digital textbook applications and gain insights for improving domestic digital textbook application policies, it is essential to study and analyze the actual situations in other countries where digital textbooks have been used. In this regard, this paper comprehensively analyzes the current status of digital textbooks in other countries and compares it with the domestic application context with the aim of providing guidance for China's digital textbook policies. Particularly, in order to move beyond mere case comparisons, a set of coherent comparative indicators has been developed to systematically compare characteristics among different countries. By investigating the application of digital textbooks in other countries, this data serves as essential information for the effective enhancement of China's digital textbook policies in the future.

2. The Concept of Digital Textbooks

Digital textbooks have a development history of 20 years in China, and they are defined differently by various scholars, with no unified concept at present. Often, people do not strictly differentiate between digital teaching materials and digital textbooks. Generally, digital teaching materials primarily

use information technology as a carrier, are systematically compiled based on specific standards, reflect educational content, and are designed to produce electronic teaching materials for the cultivation of individuals needed by a particular society. These electronically developed teaching materials often do not undergo official educational approval and are not openly permitted for use in classrooms by teachers and students; they rely solely on the market and reader's voluntary usage. Currently, digital teaching materials can be categorized into four levels: digitized print textbooks, multimedia digital teaching materials, interactive digital teaching materials, and aggregated digital teaching materials. 1). Digitized Print Textbooks: This is the most basic level of digitization, represented by static electronic textbooks. The teaching method primarily involves guiding students in reading and practicing. 2). Multimedia Digital Teaching Materials: Multimedia digital teaching materials include audio, video, animations, and more. Teachers not only guide students in reading and practicing but also include listening and observation. 3). Interactive Digital Teaching Materials: Interactive digital teaching materials are data-based materials that allow for interaction. They support interactions between readers and the digital textbook, teacher-student interactions, interactions among students, and interactions between teachers, students, and the authors of digital teaching materials. Encouraging dialogue, communication, and sharing becomes a necessary teaching method. 4). Aggregated Digital Teaching Materials: Aggregated digital teaching materials represent integrated and enhanced digital resources. They are the highest form of digital teaching materials. The teaching method for teachers involves using the learning terminal as the carrier, supported by a learning cloud platform, to achieve efficient multi-subject, multi-dimensional, and multi-level interaction. In contrast, digital textbooks are a narrower category of digital teaching materials and are generally authorized by the education authorities (rather than technical departments). They are allowed to officially enter classrooms and are designated as legal digital teaching materials for use by teachers and students[2]. Digital textbooks are often referred to as "post-modern textbooks" because they mainly utilize information technology and networks to present knowledge in an audible, editable, and remotely deliverable manner. This breaks the limitations of traditional printed textbooks, which can only present knowledge in a text and image format and deliver information linearly[3]. Digital textbooks have clear advantages in terms of design philosophy, curriculum resources, meeting personalized learning needs, and the impact of technology on teaching and learning. Their created interactive and communicative context aligns well with the post-modern spirit of being "multi-dimensional, dynamic, interconnected, and meaningful." [4]

3. Comparative Analysis of Digital Textbook Application Policies in Various Countries

In order to make the comparison of digital textbook application policies in different countries more consistent, coherent, and logical, this paper has selected the following factors as comparative indicators: the leading entities and strategies for promoting digital textbooks, the scope of application, distribution systems, and methods of application. The paper then conducted a comparison of digital textbook policies in the United States, South Korea, and Taiwan as follows.

3.1. Leading Entities and Strategies

United States: The promotion of digital textbooks in the United States involves various entities, including the government, publishers, schools, and teachers. Supported by a fully digitized educational infrastructure, the aim is to provide students with a richer, more flexible, and personalized learning experience[5]. The federal government and state education institutions in the United States actively promote digital education, supporting schools across the country in adopting digital textbooks and online learning platforms to provide students with diverse and rich learning resources. Many American publishers actively drive the development and application of digital textbooks, offering multimedia materials, interactive learning tools, and online courses to enrich students' learning experiences. Schools and teachers throughout the United States actively participate in the development and application of digital education, continuously exploring and innovating digital teaching methods and tools to provide students with more personalized and efficient learning experiences. Educational institutions across the United States continue to strengthen the construction of digital education infrastructure, providing high-speed internet, multimedia classrooms, and online learning platforms to offer students and teachers a convenient and efficient learning and teaching environment.

South Korea: The development of digital textbooks in South Korea is part of the overall planning of the national digital education development strategy, aiming to enhance the country's educational competitiveness through digital education. South Korea's Ministry of Education announced the digital textbook plan on March 8, 2007. South Korea's Ministry of Education adopted a top-down planning

and development approach and followed a "pilot first, then expansion" strategy.[6] The Ministry of Education's initiative for digital textbooks includes three stages: the digital textbook prototype development stage (2007-2011), the integration of digital textbooks into the national curriculum stage (2012-2016), and the use of artificial intelligence and virtual reality technologies in digital textbooks stage (2017-present)[7]. According to the 2021 Education White Paper released by the Korean Education Research Information Institute, the number of elementary and middle schools in South Korea applying digital textbooks increased from 163 in 2014 to 10,755 in 2021[1]. Starting in 2025, South Korean classrooms will introduce "AI digital textbooks" that use artificial intelligence (AI) technology to provide targeted education for students at different levels. Paper textbooks will be used concurrently during the initial three years, with a full transition to digital textbooks expected after 2028.[8]

Taiwan: In recent years, Taiwan has made efforts to build a complete digital textbook industry chain, aiming to integrate digital textbooks deeply into school teaching. They have focused on research in the digital textbook-related fields and have made significant progress. In the process of promoting the application of digital textbooks, Taiwan has established special development plans and design research for digital textbooks to facilitate their application in the field of education. [9]Relevant administrative departments in Taiwan have primarily adopted a "pilot first, then expansion" approach, selecting different schools in Taiwan for pilot programs and inviting experts from universities to guide the specific work of pilot schools, accumulating early experience for comprehensive expansion. During the implementation of these plans, Taiwan's relevant administrative departments have given elementary and middle schools the autonomy to purchase digital information devices and increased funding support for information devices in township schools to meet the needs of township schools for digital facilities, bridging the urban-rural digital gap and creating conditions for digital textbook development in township schools.

3.2. Scope of Application

United States: Digital textbooks are widely used in both K-12 education and higher education in the United States, covering multiple subjects and fields. The application methods of digital textbooks are diverse and include using online platforms, educational software, and applications provided by schools. Many K-12 schools in the United States have already begun using digital textbooks. In K-12 education, digital textbooks are used in subjects such as mathematics, science, language arts, social studies, and more, spanning from kindergarten to 12th grade. The typical mode of application is through school online platforms like Google Classroom or Canvas and other educational software and applications. Digital textbooks are also extensively used in colleges and higher education institutions across the United States. Their application covers fields such as humanities, social sciences, natural sciences, engineering, and more, serving both undergraduate and graduate education. The usual method of application in higher education is through online course management systems like Blackboard, Moodle, and other educational software and applications.

South Korea: Digital textbooks have become an integral part of South Korea's education system and are widely applied. They offer students and teachers a more diverse and richer set of learning resources, helping students better grasp educational content, and allowing teachers to manage and assess students' progress effectively. Digital textbooks are extensively used in South Korean K-12 education, covering all grade levels from elementary to middle school. Subjects include mathematics, science, language arts, social studies, music, physical education, and more. Digital textbooks provide students with multimedia content, aiding their understanding and mastery of learning materials. South Korean higher education institutions, including universities and graduate schools, have also started adopting digital textbooks. Their application in higher education encompasses various fields, including natural sciences, social sciences, engineering, humanities, and more.

Taiwan: Digital textbooks are widely applied in Taiwan, primarily at the elementary and middle school levels, offering more diverse and richer learning resources. They help students better understand and master the study materials and also enhance students' interest, engagement, motivation, and enthusiasm for learning. In Taiwan's elementary schools, digital textbooks cover subjects such as Chinese language, mathematics, natural sciences, social studies, music, physical education, and more. The content of digital textbooks includes text, images, audio, and animations, providing students with a vivid and interactive learning experience. In Taiwanese junior high schools, subjects include Chinese language, mathematics, English, natural sciences, social sciences, and comprehensive activities. In Taiwanese high schools, digital textbooks cover all subjects, offering students a wealth of learning resources and interactive experiences, enhancing their understanding and mastery of study materials.

3.3. Distribution Systems

United States: The distribution system for digital textbooks in the United States is relatively decentralized, with individual states and school districts having their own digital textbook distribution plans and policies. They collaborate with publishers, educational technology companies, or other organizations to develop and provide digital textbooks. Many state governments have formulated distribution plans and policies for digital textbooks, offering students free or discounted access to digital textbooks. For example, California has implemented a statewide digital textbook program and provided a range of digital textbooks to public schools. Many school districts also establish distribution plans for digital textbooks, offering students free or discounted access. School districts typically collaborate with publishers, educational technology companies, or other organizations to develop and provide digital textbooks. Publishers play a significant role in the distribution of digital textbooks. Many publishers have started developing digital textbooks to meet the needs of students and teachers. Publishers often collaborate with educational institutions to develop and provide digital textbooks. Many educational technology companies offer distribution and services for digital textbooks. These companies typically collaborate with educational institutions, publishers, or other organizations to provide digital textbooks to students and teachers.

South Korea: South Korea's digital textbook distribution system varies, with some textbooks overseen by the education authorities and others developed by publishers and then approved by relevant agencies before distribution. The aim is to provide high-quality digital educational resources to students and teachers and promote the development of education in South Korea. For instance, 3rd and 4th-grade social studies and science digital textbooks are developed as nationally designated textbooks and distributed by South Korea's Ministry of Education. However, 7th-grade social studies and science digital textbooks are developed by publishers as authorized and approved textbooks and then applied after review by relevant agencies. In 2013, South Korea's Ministry of Education developed the comprehensive digital textbook service website rang.edunet.net based on technologies such as cloud storage and big data. Another dedicated digital textbook platform website, book.edunet.net, serves demonstration schools, enabling them to search and select E-Book textbooks by adding course content through registered accounts with the Korean Educational Development Institute (KERIS)[10].

Taiwan: Taiwan's digital textbook distribution system is a collaborative effort involving the education authorities, schools, and education resource centers. It includes both free public digital textbooks and paid private digital textbooks, as well as the construction of digital education platforms and teacher training and support programs. The goal is to provide modern educational resources and technological tools to promote education development. Taiwan's digital textbooks are divided into two categories. One is free public digital textbooks provided by the education authorities, primarily covering some subjects in elementary and junior high schools. The other category is paid private digital textbooks produced through collaboration between education resource centers and schools, mainly covering various subjects in high schools and universities. Taiwan's digital textbook distribution system also includes the construction and operation of digital education platforms and teacher training and support programs to ensure that teachers can effectively use digital textbooks for teaching[9].

4. Proposal for the improvement of our country's policy on the application of digital textbooks

4.1. Insights from Application Policies in Various Countries

In 2010, the United States federal government introduced the "Digital Textbook Action Plan" aimed at enhancing student learning outcomes and reducing education costs through the use of digital textbooks. The plan encouraged educational institutions and educational technology companies to collaborate on the development and promotion of digital textbooks, while providing funding and technical support[11]. In 2019, the United States passed the "Affordable College Textbook Act," which mandates that all educational institutions receiving federal education funds must provide free or low-cost digital textbooks to students. This legislation has facilitated the widespread adoption and promotion of digital textbooks[12]. National Instructional Materials Accessibility Standard (NIMAS)[13] and the Individuals with Disabilities Education Act (IDEA)[14] in the United States require that digital textbooks comply with educational standards and guidelines and must be accessible and user-friendly. The U.S. government and educational institutions also assess and monitor the quality and effectiveness of digital textbooks to ensure their quality. Additionally, the U.S. Department of Education and educational institutions offer guidance and training to schools and teachers on the

application of digital textbooks. For example, the National Science Foundation (NSF) provides the "Digital Learning Environments program," which offers training and support to educational institutions and teachers in the development, implementation, and evaluation of digital textbooks[15]. In summary, the United States' digital textbook application policies emphasize practicality and quality, with clear policy objectives, robust measures, and organized promotion. The implementation and promotion of these policies have facilitated the adoption and development of digital textbooks in the United States.

In South Korea, digital textbook policies have been in place since 2007 and have gone through stages of digital textbook development, system improvement, research-focused demonstration application, and effect studies conducted by research schools. From 2019 onward, digital textbooks aligned with the 2015 revised education curriculum have been developed and widely adopted. Results from effect studies of digital textbooks in research schools have shown that digital textbooks, centered on learners, improve teaching and enhance students' future abilities, including self-directed learning, creativity, information utilization, and collaboration. As a result, the number of schools using digital textbooks has steadily increased, and there is a growing recognition and consensus in society regarding the necessity of digital textbooks. Prior to the widespread use of digital textbooks in South Korea, they go through a pilot phase. According to related literature, university researchers first select a small number of students and teachers to use and study the digital textbooks, identify issues during use, and make improvements based on the findings. Subsequently, pilot usage is carried out in a small number of schools before full-scale implementation. However, South Korea has experienced changes in government leadership over the years, which have resulted in frequent changes in the department responsible for implementing and managing digital textbook-related policies. Starting in 2007, the department names have changed several times, including Knowledge Information Policy Division, Network Learning Resources Division (2008-2010), Textbook Planning Group (2011), Educational Information Planning Division (2012), and Textbook Planning Division (2013). This has led to challenges in the consistent execution of policies.[6]

To ensure the effectiveness of digital materials, the Taiwanese region places a strong focus on specific requirements for the design, presentation, and interactivity of digital materials. They emphasize that the design of digital materials should consider teaching content at both vertical and horizontal levels. The choice and application of multimedia elements, such as text, images, dynamic images, and sound, should revolve around teaching goals and content to avoid increasing students' learning burdens. The Taiwanese region strictly controls the digital textbook certification process, which is divided into two stages: initial review and reevaluation. During the initial review, related domain experts are invited to conduct written reviews and scoring of the submitted teaching materials. After a second review by the Quality Assurance Center, grades are awarded to the validated materials, and materials that do not pass certification must be revised and undergo a second review within a specified time. Additionally, to enhance the user experience of digital textbooks, the Taiwanese region places a strong emphasis on research related to digital textbook design. They advocate timely updates to digital textbook design concepts to facilitate the proper integration of textbooks and technology. When digital textbooks are designed to meet both the needs of teachers and students, teachers can engage in innovative teaching, and students can undertake personalized learning. This ensures that both teachers and students can transition from over-reliance on printed materials to the effective use of digital textbooks, thereby significantly increasing the utilization of digital textbooks.[10]

4.2. Improvement Strategies

Based on the analysis of digital textbook application policies in the United States, South Korea, and the Taiwanese region, the following improvement strategies for China's digital textbook policies can be proposed.

Firstly, it is necessary to improve the system, allowing the public to independently choose from a variety of courses in the development of digital textbooks. Currently, digital textbook development in China, especially at the basic education level, is primarily concentrated within digital companies under traditional print textbook publishers. At present, Chinese digital textbooks remain in the phase of digitizing printed textbooks. The content is merely a digital replica of printed textbooks with some additional multimedia resources. However, the interactivity and connectivity are limited. As the government is the institution that promotes macro-level digital transformation in education, it can learn from the United States and encourage more domestic publishers to participate in digital textbook development. The involvement of more organizations will inevitably promote industry growth, giving educational administrators, teachers, students, and parents more choices. While the government retains the right to approve digital textbook distribution, publishers are motivated to develop high-quality

digital textbooks from multiple perspectives to gain market share. This approach will expedite the development of high-quality digital textbooks in China. Restricting digital textbook development to a few digital companies reduces the freedom of choice for government, educational administrators, teachers, and students, and a closed market hinders the creation of high-quality digital textbooks. China should follow the example of the United States, where school districts, publishers, and educational technology companies can all engage in digital textbook development. As long as the developed digital textbooks meet national standards, school administrators and teachers can autonomously choose the digital textbooks suitable for their needs.

Secondly, a strategy of 'trial first, then promotion' should be adopted before fully implementing the use of digital textbooks in schools, similar to what South Korea and Taiwan have done. Currently, digital textbook development in China, especially at the basic education level, is primarily concentrated within digital companies under major print textbook publishers. Many of these companies prioritize technological features in digital textbook development and often overlook educational research, resulting in subpar usability. Moreover, after development, many Chinese digital companies often neglect pilot testing and directly launch products into the market, which can lead to poor user experiences. Unlike this approach, South Korea and Taiwan do not release digital textbooks immediately after development. Instead, the designers of these digital textbooks conduct small-scale usage practice and research among teachers and students. They identify problems encountered during usage and provide feedback to the designers. In response to these issues, designers adjust the digital textbooks, incorporating relevant technology and learning and teaching theories. The adjusted digital textbooks are then pilot-tested in selected schools. Based on the usage experiences of these pilot schools, further issues are identified, and the textbooks are refined before widespread adoption. As digital textbooks are relatively novel compared to printed textbooks, both teachers and students are experimenting with them for the first time. If digital companies focus solely on the technical aspects of development and neglect the user experience, they will face challenges during promotion. Even if educational administrators purchase digital textbooks, if teachers and students have a poor user experience, they may continue to use printed textbooks. This approach not only hinders the development of digital textbooks but also makes it difficult to change the current teaching paradigm and offers no benefits in advancing the digitization of education.

Thirdly, the government should allocate more research and development funds to advance the development of digital textbooks, enabling researchers to create more intelligent and advanced digital learning materials. Currently, China's digital textbook development, promotion, and usage are relatively behind. Digital textbook development relies on digital companies affiliated with publishing houses, but this reliance cannot be absolute. Many employees of Chinese digital companies excel in technology but lack expertise in educational or learning theories. As big data and artificial intelligence continue to evolve, textbooks are gradually transitioning from digital to intelligent. Therefore, whether it's universities, research institutions, publishers, or educational technology companies, they all have a responsibility to participate in the digital textbook development process. Under the guidance of relevant government policies, these organizations can collaborate on joint R&D or independently develop digital textbooks for subsequent promotion and use. Once a significant number of high-quality digital textbooks are available in the country, China can establish free digital textbook platforms or websites like other nations. Teachers, learners, and parents can freely use different versions of digital textbooks for teaching and learning, ensuring the effective utilization of digital teaching resources. However, this will require significant government funding and the implementation of appropriate standardized management policies to effectively manage risks in an Internet context.

5. Conclusion

In order to accurately determine the future direction of digital textbook application in China and to identify the shortcomings of current digital textbook usage and address them, it is essential to establish unified standards, conduct research, and analyze the practical situations in other countries where digital textbooks are already in use. This will help provide necessary insights and recommendations for improving domestic digital textbook application policies. This paper has compared and analyzed digital textbook application policies in the United States, South Korea, and Taiwan, and discussed potential strategies for enhancing China's digital textbook policies.

To achieve this, the paper began by comparing and analyzing the leading entities and strategies for promoting digital textbooks, the scope of their usage, and the distribution systems in each of these countries. It also examined the lessons and insights that can be drawn from the digital textbook policies

of these nations. Building upon the insights from each of these countries, the paper proposed strategies for improving China's digital textbook policies.

Through the improvement strategies presented in this paper, it is hoped that they can serve as valuable foundational information for shaping future policies and development plans related to digital textbooks.

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