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Research on Generative Artificial Intelligence Empowering the Digital Textbook Construction

Liyun Zhu[1,*], Shi Yin[2], Yuying Cheng[1], Yu Deng[1], Bing Lv[1]

[1]College of Economics and Management, Hebei Agricultural University, Baoding, Hebei, 071000, China
[2]College of Humanities and Social Sciences, Hebei Agricultural University, Baoding Hebei, 071000, China
**Corresponding author*

Abstract: *The rapid development of Generative Artificial Intelligence (GAI) technology is driving the digital transformation of higher education courses and teaching, making the construction of digital textbooks increasingly the main focus of higher education's digital upgrading. This study takes the course "Management Forecasting and Decision-Making Technology" as an example and introduces the overview of traditional textbooks. Secondly, in combination with its inherent pain points, it comprehensively elaborates on the necessity of GAI-enabled digital textbook construction for the "Management Forecasting and Decision-Making Technology" course. Finally, from four levels—content generation layer, interaction processing layer, pathway advancement layer, and project-based learning assistance layer—a digital textbook structure framework is constructed to create dynamic and expandable generated content, achieve immersive, inquiry-based, and dialogic learning experiences, provide personalized, precise, and adaptive learning navigation, and enhance overall learning effectiveness.*

Keywords: *Generative Artificial Intelligence; Digital Textbooks; Digital Transformation*

1. Introduction

With the rapid advancements in information technology, the digital transformation of education has become an important strategic theme in the reform and development of education in our country. As a core component of the talent training system, the degree of digitization of teaching materials is directly related to the overall level and quality of educational digitalization. Digital textbooks, as an important direction in the evolution of teaching materials, are an inevitable trend in response to changes in learning methods and educational reforms in the era of generative artificial intelligence. From an international perspective, global education is undergoing a digital revolution, and some developed countries have already placed digital textbooks as a key pillar in their national education strategies. The World Digital Education Conference and the Global Smart Education Conference held successively in 2024 emphasized the need to enrich resource forms, vigorously develop digital textbooks, and make the construction of digital textbooks the main focus of advancing educational digital transformation. In January 2025, the State Council issued the "Outline of the Plan for Building a Strong Education Nation (2024-2035)", which calls for accelerating the digital transformation of teaching materials and promoting AI-assisted educational reform. From the perspective of technological change, generative artificial intelligence technology is reshaping the educational ecosystem, and digital textbooks have become a key medium for integrating new technologies, creating new scenarios, and providing new services. From the perspective of educational development, digital textbooks carry the mission of promoting educational equity and improving educational quality, becoming an indispensable foundation for high-quality educational development.

Existing research mainly focuses on the following aspects. The first aspect is the interpretation and evolution of the concept of digital textbooks. Currently, scholars mainly define digital textbooks from three perspectives: textbooks, technology and publishing. From the perspective of textbook attributes, digital textbooks are defined as a new form of textbook that organically integrates teaching content, tools, resources, and platforms, serving as digital course resources shared by teachers and students [1]. From the perspective of technological attributes, digital textbooks are defined as an innovative integration of traditional textbooks and information technology, being e-books based on curriculum

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planning that are suitable for teaching activities in presenting teaching content vividly through smartphones, tablets, and PCs [2]. From the perspective of publishing, digital textbooks are publications written according to educational curriculum standards, existing in digital form and produced according to legal procedures [3]. The second aspect is the design and development of digital textbooks, including the development of informational content such as graphics, audio and video, 3D animation, and virtual simulations [4]. A few scholars study the intrinsic logic of generative AI technology empowering the development of digital textbooks, risk avoidance strategies [5], structural frameworks, and practical paths [6]. Third is research on the educational innovation applications empowered by digital textbooks. Digital textbooks will break the limitations of traditional teaching, reconstruct the temporal and spatial boundaries of the classroom, promote deep learning among students. Remillard [7] conducted interviews with a total of 39 primary school teachers from Belgium, Finland, Sweden, and the United States to reflect on the impact of using digital teaching resources on teaching. Utterberg [8] observed six mathematics teachers using digital teaching materials for six weeks. REZAT [9] Studied how automatic feedback in digital math textbooks affects the conceptual development of elementary school students. Fourth is research on the construction path of digital textbooks for specific courses. Choppin [10] discussed the trends in the design and use of digital mathematics course resources. Liu [11] constructed digital mathematics experiment textbooks through three approaches: course decomposition, resource development, and system support, explored the construction path of university mathematics digital textbooks from content construction, interactive design, resource integration, and platform development, and analyzed in depth the application scenarios of mathematics digital textbooks in the three core dimensions of classroom teaching.

In summary, existing literature mainly focuses on qualitatively comparing traditional textbooks and digital textbooks from a macro perspective, including the development process of digital textbooks and existing problems. However, there is relatively little research on the development and use of digital textbooks for a specific course. Research on empowering the development of digital textbooks for a specific course using generative artificial intelligence technology to achieve classroom teaching reform is even rarer. This study takes the course "Management Forecasting and Decision-making Techniques" as an example, comprehensively elaborating on the structural construction and practical pathway of a digital textbook empowered by generative artificial intelligence for this course. It uses the AI-empowered digital textbook to conduct ideological and political education in the course, integrate professional and innovative education, and carry out teaching reform and innovation, thereby optimizing the current teaching situation, influencing teachers' teaching methods and concepts, changing students' learning approaches, and making digital textbooks truly an indispensable teaching resource in classroom instruction.

2. Overview of the course 'Management Forecasting and Decision-Making Techniques' and traditional textbooks

'Management Forecasting and Decision-Making Techniques' is a core course of a provincial-level first-class major, with 16 hours of theory and 16 hours of lab work. It is worth 2 credits and is offered in the sixth semester of the third year for the Business Administration major. This course has been developed as a blended online and offline course since 2021, and has successively been recognized as a high-quality course integrating innovation and entrepreneurship at the university level, a demonstration course, a high-quality ideological and political course, and a smart course. Within the curriculum system of the Business Administration major, this course serves as a pivotal link connecting previous and subsequent courses, as well as providing a toolbox of forecasting and decision-making methods. In line with the four major graduation requirements outlined in the talent training program, this course applies forecasting and decision-making methods to scientifically and reasonably solve practical problems in enterprise or industrial development.

The traditional printed textbook used for this course is 'Management Forecasting and Decision Methods' published by Science Press. The content arrangement generally follows the logic of theory—model—method—application. The content scope includes two parts: management forecasting techniques and management decision-making techniques, specifically divided into 10 chapters: Overview of Forecasting, Qualitative Forecasting Methods, Time Series Smoothing Forecasting, Regression Analysis Forecasting, Trend Extrapolation Forecasting, Markov Forecasting, Overview of Decision Making, Deterministic Decision Making, Uncertain Decision Making, and Risk Decision Making. The chapters are distinct, highly logical, and facilitate the construction of a systematic knowledge framework.

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3. The Necessity of GAI Empowering the Development of Digital Textbooks

3.1 Addressing the inherent pain points of traditional textbooks and improving textbook quality

In the context of the era of generative artificial intelligence, with social development, industry innovation, and career changes, new requirements have been put forward for compound application talents with correct values and entrepreneurial thinking. This course is a branch of management science, widely applicable, and closely related to industrial and enterprise development. The post-00s generation belongs to the digital native generation, with strong tool-learning abilities, but they emphasize technology over ethics. Based on the market situation, course context, and student characteristics, there are some pain points in the use of traditional printed textbooks. For instance, the teaching cases cited in each chapter are primarily simplified and static, mostly based on past business events. The data and scenarios cannot be updated in real time; although they have general teaching value, they lack a sense of timeliness. The knowledge presentation method mainly relies on textual descriptions, mathematical formulas, and two-dimensional charts, which is a one-way information transmission mode. Their publication and update cycles are long and lag behind the development of predictive and decision-making technologies such as machine learning and big data analysis. Generative artificial intelligence can assist in generating the latest industry cases based on real-time industry data, thereby closely aligning textbooks with practical needs and maintaining dynamic timeliness.

3.2 Achieving personalized and adaptive learning, promoting student-centered educational transformation

Traditional paper textbooks primarily serve systematic teaching by teachers, but they provide insufficient support for students' independent exploration, immediate feedback, and personalized learning paths. Digital textbooks empowered by generative artificial intelligence possess multidimensional content knowledge and can dynamically generate differentiated learning materials based on students' learning behaviour data, thereby offering personalized learning path recommendations and achieving a 'tailor-made' textbook experience for each student. Textbooks integrated with generative AI can answer students' questions in real time, guide them through predictive modelling, decision analysis, and other tasks step by step, intelligently grade students' responses, accurately identify knowledge gaps, generate learning diagnosis reports, and help students learn precisely.

3.3 Aligning with the national strategy for digital transformation in education and cultivating future management talents

As a core form of new digital resources, digital textbooks' construction and application directly relate to the effectiveness of implementing the national education digitalization strategy. Management forecasting and decision-making abilities are core competencies for managers in the age of digital intelligence. Digital textbooks empowered by generative artificial intelligence support interactive exchanges between teachers and students. Through simulations and 3D animations, abstract algorithms such as decision trees are transformed into interactive, operational dynamic content. This approach not only imparts knowledge but also allows students to personally experience and master intelligent decision-making modes in human-computer collaboration, achieving immersive and inquiry-based learning while cultivating their ability to use AI tools to solve complex management problems.

4. Structural framework for GAI empowering the construction of digital textbooks

4.1 Building a dynamic, real-time, and scalable content generation layer

4.1.1 Generation of explanatory texts and visual charts

For core prediction and decision-making models such as Markov forecasting, regression analysis forecasting, and decision trees, GAI can produce appropriately detailed explanatory texts for students based on their pre-class knowledge mastery and completion rates in the knowledge graph. At the same time, it can automatically transform model formulas and the logical relationships between methods into dynamic visual charts, flowcharts, demonstrating how key parameter changes in the model affect prediction curves and prediction errors, making abstract theories more intuitive.

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4.1.2 Real-time case library and scenario simulation generation

Based on large language models, relevant national policies, financial news, industry development trends, and industrial economic data can be captured in real time, automatically generating timely teaching cases closely related to current enterprise operations and industry economic development. For example, for risk-based decision-making, it can simulate investment decision scenarios in the current hot artificial intelligence industry, synchronizing textbooks with real-world developments. For different teaching contexts, it can generate simulation data with specific statistical characteristics for students to practice unlimited times, solving the problem of difficulty in obtaining real data.

4.1.3 Multi-modal exercise generation and cutting-edge knowledge expansion

Based on the goals of teaching knowledge transfer and difficulty requirements, GAI can assist in creating a vast number of exercises of varying difficulty, including multiple-choice questions, calculation problems, case studies, and comprehensive assessment questions, ensuring customized exercises for each student. It can automatically track the latest research in the fields of prediction and decision-making, such as predicting through machine learning methods like supervised learning, unsupervised learning, and reinforcement learning, and generate concise related reading materials to keep textbook content at the forefront of the discipline. It can simulate real-life scenarios involving multi-party interests, ethical constraints, and significant uncertainty, cultivating students' comprehensive judgment and decision-making abilities.

4.2 Interactive processing layer for achieving immersive, inquiry-based, and dialog-oriented learning experiences

First, utilize AI teaching assistants and the "Smart Learning Companion" agents to assist in answering questions and resolving doubts. Students can ask questions at any time about any concepts, models, formula steps, or case studies in the textbook and receive immediate, accurate, and multi-round guidance. By analyzing the differences in learning participation and learning outcomes across the class, AI teaching assistants can identify common learning obstacles, recognize individualized learning needs, generate teaching analysis reports, and help teachers adjust teaching priorities. Second, assistive interactive execution environment. Generative artificial intelligence can guide students in writing programs for various prediction and decision-making methods. When combined with real-time industry big data to run different prediction and decision-making methods, continuous debugging of the code outputs more accurate prediction results and decision-making proposals. Third, generative artificial intelligence can integrate with real business operations to construct a virtual simulation operational environment, providing students with scenarios for decision-making practice. The AI teaching assistant can simulate stakeholders with differing opinions to provoke discussions, allowing students to apply and master prediction and decision-making techniques in an almost real business environment.

4.3 Providing a personalized, precise, and adaptive learning navigation path recommendation layer

First, for commonly identified learning difficulties, such as challenging problems in the chapter on regression analysis prediction methods, AI teaching assistants are used to conduct real-time online discussions and Q&A sessions, and recommend corresponding learning resources to help most students grasp the principles and operational procedures of these prediction methods. Second, based on students' learning situations and individual needs, generative artificial intelligence technology is used to create personalized learning paths for each student. For example, when learning the fundamental knowledge points of prediction concepts and classification, the knowledge graph links to methods such as the Markov prediction method, trend extrapolation prediction, and time series exponential smoothing prediction. Different students can navigate their learning paths according to their own needs. At the same time, it ensures that each student receives the learning resources most suitable for them, such as recommending related course videos and exercise sets for students who have not firmly grasped the basic knowledge points, and providing corresponding case analyses for students with weaker data processing and method application abilities.

4.4 Project-based learning layer to improve overall learning efficiency

First, every 5-6 students form a group freely, and each group selects a forecasting and decision-making case project based on their major characteristics and real industry development issues. Using generative AI to assist in literature review and other methods, they collect relevant information on the

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forecasting subject, organize related data, and collaboratively write a management forecasting and decision-making case. Second, by using the task engine function of the Learning Pass platform, each lab session is divided into several progressively layered tasks. For example, a lab on time series exponential smoothing forecasting can be designed as four tasks: a review of online knowledge points, AI-assisted forecasting, forecasting in Excel, and submission of the lab report. In the knowledge review phase, each team member is required to review and master knowledge points related to weighted moving average forecasting, single exponential smoothing forecasting, and double exponential smoothing forecasting on the online platform. In the AI-assisted forecasting phase, each group writes certain prompts for the AI assistant based on their project's time series data, instructing the AI assistant to make predictions using weighted moving average and exponential smoothing methods. This cultivates students' ability to ask precise questions, and they summarize the principles and processes of weighted moving average and exponential smoothing forecasting based on the AI assistant's analysis. In the Excel forecasting phase, each group uses the project's historical data to practice the processes of weighted moving average and exponential smoothing forecasting in Excel, and compares the results generated by the AI assistant, enhancing students' ability to assess and synthesize analysis. Project-based learning also integrates innovative entrepreneurial methodology tools such as World Café and the Startup Team Canvas to cultivate students' co-creation ability, empathetic thinking, systems thinking, and critical thinking.

5. Conclusion

This paper takes the course "Management Forecasting and Decision-Making Technology" as an example, systematically explains the limitations of traditional textbooks, and argues for the necessity of GAI-enabled digital textbook construction. By building a four-dimensional structural framework covering the content generation layer, interactive processing layer, path advancement layer, and project-based learning assistance layer, it better supports the immersive, inquiry-based, and dialog-driven learning experiences, achieving the personalized, precise, and adaptive learning navigation. With the further integration of GAI technology and the deep accumulation of educational data, this digital textbook framework is expected to provide a more intelligent and open learning ecosystem for cultivating high-quality management talents with complex decision-making abilities.

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