

# AI-Empowered Personalized Learning Pathway Construction and Teaching Reform in Digital Management Accounting Course

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**Abstract:** Aiming at the issues confronted by the Digital Management Accounting course, including the complexity of its knowledge system, significant stratification in students' learning needs, and the failure of the traditional "uniform" teaching mode to meet individualized cultivation objectives, this study explores a reform pathway that integrates Artificial Intelligence (AI) technology into curriculum teaching. Based on a four-dimensional operational mechanism encompassing "learning status diagnosis—learning profile construction—pathway generation—dynamic feedback," an AI-empowered teaching reform system is constructed, covering stratified teaching resources, an integrated flipped classroom, and a diversified intelligent evaluation system. The findings demonstrate that this pathway can effectively resolve the contradiction between "uniform instruction" and "stratified needs," significantly enhance students' learning autonomy, knowledge transfer, and comprehensive decision-making competence, and provide a reference for the digitalized teaching reform of analogous courses.

**Keywords:** Artificial intelligence; Personalized learning pathway; Digital management accounting; Teaching reform

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## 1. Introduction

With the rapid development of digitalization and intelligent technologies, the traditional educational model is confronted with substantial challenges and opportunities. Artificial Intelligence (AI) technology has been progressively introduced into the educational field to enhance teaching quality and efficiency, and students' learning patterns are transitioning from a paradigmatic mode toward personalization. AI-enabled personalized learning can provide customized learning pathways according to students' learning progress, interests, and study habits, thereby better accommodating individual differences and shifting education from a single "spoon-feeding" approach to one that emphasizes autonomous learning and deep thinking cultivation <sup>[1]</sup>.

Existing studies have demonstrated that AI possesses extensive application prospects in university curriculum teaching and can provide students with personalized and differentiated learning support. Capinding

et al. investigated the impact of AI in higher education on personalized learning, academic performance, and student social interaction <sup>[2]</sup>. Annus examined the use of AI-based educational software and found that students exhibited strong interest in such software, perceiving it as capable of enhancing learning efficiency and improving teacher-student interaction <sup>[3]</sup>. Liu et al. explored the application of AI in deep learning, proposing that AI technology can optimize the teaching process and promote students' knowledge acquisition and capability development <sup>[4]</sup>. Zhang and Hou investigated college teachers' behavioral intention to adopt AI-assisted teaching systems and identified perceived usefulness and perceived ease of use as key influencing factors <sup>[5]</sup>. Forero-Corba and Bennasar conducted a systematic review of AI and machine learning applications in education, pointing out that AI applications can continuously improve teaching quality and educational management <sup>[6]</sup>. Nevertheless, AI-enabled personalized learning still encounters technical and ethical challenges in practical applications and requires sustained exploration <sup>[7]</sup>.

Currently, research on digitalized teaching and intelligent education in universities remains in the exploratory stage, and studies on AI-enabled personalized learning for the Digital Management Accounting course are relatively scarce. This study explores the teaching innovation of an AI-enabled personalized learning pathway based on the Digital Management Accounting course, aiming to provide theoretical support for specialized curriculum reform and practical guidance for educators seeking to leverage AI technology to enhance teaching quality.

## **2. Teaching status and problem analysis of the digital management accounting course**

Digital Management Accounting represents the extension and reconstruction of traditional management accounting in the digital era, with the objective of cultivating interdisciplinary talents equipped with financial expertise, data analytical capabilities, and intelligent decision-making competence. A thorough examination of course characteristics and pedagogical pain points constitutes the prerequisite for exploring AI-empowered teaching reform.

### **2.1. Course characteristics**

#### **2.1.1. Complex knowledge system**

The course exhibits pronounced interdisciplinary integration features. Its knowledge system encompasses not only core management accounting content, including cost management, budgeting management, performance evaluation, and operational decision-making, but also emerging modules such as big data analytics, business intelligence, and digital transformation, thereby presenting a multi-layered, multi-module, and strongly interconnected structure. The course adopts the cultivation main line of "understanding business, mastering management, and making decisions," requiring students to possess comprehensive capabilities in knowledge transfer, data analysis, and strategic decision-making. Significant individual differences among students are also evident.

#### **2.1.2. Pronounced digital orientation**

The course closely aligns with enterprise digital transformation practices, with its essential feature being data-driven management decision-making. Concurrently, the teaching process itself exhibits pronounced data-driven characteristics, as students' online learning behaviors, classroom interactions, and task completion

records can all generate traceable and analyzable data resources, thereby providing a practical foundation for precision teaching and personalized learning.

## **2.2. Problems in traditional teaching**

### **2.2.1. Mismatch between uniform resources and stratified needs**

Although online teaching resources have been developed, courses still mainly adopt standardized materials, including unified textbooks, lecture notes, courseware, and question banks. Resource supply follows a one-way output mode instead of personalized adaptation, which can hardly meet the differentiated needs of students with different foundations and career goals. In addition, the slow update cycle of resources fails to reflect the latest advances in digital management accounting in a timely manner.

### **2.2.2. Conflict between standardized instruction and differentiated teaching**

Current teaching remains teacher-led, with unified content, pace and activities. This causes learning struggles for weaker students and limits development for advanced learners. Teachers assess learning mainly via observation, homework and tests, failing to obtain real-time behavioral data and leading to delayed teaching interventions.

### **2.2.3. Disconnection between single-dimension assessment and competence cultivation**

Course evaluation remains dominated by final examinations and periodic assignments, emphasizing knowledge memorization and formulaic application while lacking dynamic monitoring and feedback on learning investment and capability development trajectories, which makes it difficult to support the whole-process cultivation of students' comprehensive capabilities effectively.

In summary, the traditional teaching mode exhibits pronounced standardized characteristics in terms of resource supply, instructional organization, and evaluation systems, making it inadequate to meet the demands of students' personalized development and digital talent cultivation.

## **3. Practical needs and existing foundations of AI-empowered curriculum reform**

### **3.1. Practical needs**

#### **3.1.1. Accurate identification of learning needs**

Under the traditional teaching mode, instructors' judgments about student learning status rely primarily on classroom performance, homework completion, and examination results, which exhibit significant time lags. AI technology, supported by intelligent teaching tools and learning behavior analytics, can continuously track students' learning processes and generate multi-dimensional learning profiles, thereby providing data support for precision teaching.

#### **3.1.2. Dynamic adjustment of learning content**

In response to diverse learning rhythms and knowledge mastery levels among students, AI can automatically identify learning states based on learning profiles and recommend appropriate learning resources, case tasks, and capability training content for different students, achieving precise matching between learning content and learning needs.

### **3.1.3. Enhancement of learning autonomy**

AI-supported personalized learning pathways can provide students with continuous learning support and immediate feedback. Functions such as intelligent teaching assistants, intelligent Q&A, and learning warnings help reduce frustration during autonomous learning, promoting a transformation in learning styles from “passive reception” to “active construction.”

### **3.1.4. Realization of whole-process evaluation**

AI technology provides technical support for the dynamic tracking and multi-dimensional evaluation of students’ entire learning processes. It enables the construction of a multi-dimensional evaluation system covering knowledge learning, capability development, and learning behaviors, thereby facilitating the transformation of evaluation from outcome judgment to process diagnosis.

## **3.2. Existing foundations**

### **3.2.1. Course resource foundation**

The course team has been continuously advancing curriculum development since 2020. Massive Open Online Courses (MOOCs) and Small Private Online Courses (SPOCs) on Management Accounting have been established, accumulating rich video courses, teaching courseware, case resources, and online test question banks. In 2024, modular upgrading was completed, integrating digital technology, big data analytics, and intelligent decision-making content, alongside relevant knowledge points for the Chartered Global Management Accountant (CGMA) examination. A dual-track teaching mode has been implemented for two student cohorts: the CIMA (Chartered Institute of Management Accountants) orientation class and the digital-intelligent financial management experimental class.

### **3.2.2. Digital technology foundation**

The course has routinely employed smart teaching platforms such as Rain Classroom, achieving data-based management of pre-class previews, classroom interaction, learning tests, and post-class feedback. The curriculum construction platform has been integrated with generative AI tools such as DeepSeek, adding functions including AI course creation, 24-hour intelligent learning companions, intelligent grading, AI teaching companion interaction, and dynamic analysis of teaching data.

### **3.2.3. Teaching-research team foundation**

The course team possesses interdisciplinary backgrounds spanning financial management, management science and engineering, and educational technology. In recent years, the team has undertaken multiple teaching reform projects and accumulated rich research outputs and practical experience in blended teaching, curriculum-based ideological and political education development, and digital teaching resource construction.

## **4. Operational mechanism of the AI-personalized learning pathway**

In response to the complex knowledge system, pronounced stratification of learning needs, and multi-level capability cultivation requirements of the course, this study constructs a four-dimensional operational mechanism encompassing “Learning Status Diagnosis—Learning Profile Construction—Pathway Generation—Dynamic Feedback,” forming a closed-loop personalized learning support system.

#### **4.1. Learning status diagnosis**

AI-driven learning status diagnosis draws upon three dimensions of data: first, knowledge foundation data, assessed through pre-tests of knowledge points and concept comprehension checks to evaluate students' mastery of fundamental management accounting theories; second, learning behavior data, automatically recorded by intelligent teaching tools, including preview completion rates, classroom interaction frequency, assignment submission timeliness, and video viewing duration. Natural Language Processing (NLP) techniques are employed to analyze students' responses to subjective questions such as case analyses; third, development needs data are identified by integrating information regarding students' career development plans and learning interest preferences to recognize their personalized learning objectives<sup>[8]</sup>. AI technology integrates and analyzes these multi-source data to identify students' knowledge weaknesses and potential learning risks.

#### **4.2. Learning profile construction**

According to diagnostic results, a multi-dimensional learning profile system is established, including capability, interest and behavior profiles. The capability profile shows students' knowledge mastery and professional competence, quantifying each module as capability values and generating a visual radar chart. The interest profile identifies learning preferences by analyzing resource access, extended reading, discussion topics and career planning data. The behavior profile records learning features such as resource browsing frequency, online study time and repeated review of knowledge points. All profile data is updated continuously as learning proceeds.

#### **4.3. Learning pathway generation**

Based on learning profiles, a three-tier differentiated learning system is constructed, including Foundation Reinforcement, Progression Enhancement and Advanced Extension. The Foundation Reinforcement pathway is designed for students with weak foundations, focusing on basic lecture videos and practice materials, and will automatically push review resources when knowledge point accuracy is below a set threshold. The Progression Enhancement pathway serves students who meet basic requirements, pushing contextual case studies, comprehensive applications and management decision-making tasks to help them apply theory to practice. The Advanced Extension pathway is for capable learners with further development needs, providing real enterprise management scenarios, professional competition tasks and open inquiry activities to cultivate innovative thinking and complex problem-solving abilities.

#### **4.4. Dynamic feedback optimization**

Through continuous tracking of students' learning process data, learning outcomes are evaluated in real time and pathway plans are adjusted accordingly, forming a closed-loop iterative mechanism of "Learning—Monitoring—Evaluation—Adjustment." First, a learning process database is constructed to assess learning status dynamically. Second, a learning risk early-warning mechanism is established, automatically delivering alert messages and intervention plans to students exhibiting abnormal learning behaviors, lagging progress, or inadequate knowledge mastery. Third, based on the latest learning data, profiles are continuously updated, automatically adjusting learning content and task difficulty to achieve dynamic pathway optimization.

## **5. Teaching reform design based on the AI-personalized learning pathway**

Centered on the demands of personalized learning, a curriculum reform system is constructed encompassing “Precision Resource Provision—Dynamic Instructional Adaptation—Continuous Evaluation Improvement,” facilitating the transition from uniform teaching to individualized cultivation and from experience-driven to data-driven teaching.

### **5.1. Construction of a stratified personalized teaching resource library**

#### **5.1.1. Design of the stratified resource system**

Based on the differentiated learning pathways and learning objectives of students, a stratified resource system is constructed. The Foundation Reinforcement pathway focuses on core content, including fundamental concepts of management accounting, cost management methods, budgeting processes, and performance evaluation indicators, providing foundational resources. The Progression Enhancement pathway incorporates case resources designed around authentic enterprise management scenarios, encompassing budgeting management, operational forecasting, responsibility center evaluation, and digital transformation analysis. The Advanced Extension pathway integrates the requirements of the CGMA competency framework and financial decision-making competitions, introducing authentic enterprise management cases, business analysis projects, and comprehensive decision-making tasks.

#### **5.1.2. Construction of diversified resource carriers**

The course resource library comprises four categories of carriers: micro-lecture videos, AI digital human explanations, intelligent question banks, and an authentic enterprise financial case library. Micro-lecture videos focus on the intensive explanation of core knowledge points, facilitating students’ preview and review during fragmented time. AI digital human explanations are generated based on speech synthesis and virtual avatar technologies, with the capacity to adjust speaking pace and detail emphasis according to student profiles. The intelligent question bank encompasses three tiers—basic, comprehensive, and advanced—supporting automatic test generation and dynamic difficulty adjustment based on profiles. The authentic enterprise financial case library focuses on typical application scenarios of Digital Management Accounting, with case materials sourced from university-enterprise cooperation channels and publicly disclosed data of listed companies. The course team periodically updates the case library in accordance with policy changes and industry dynamics to ensure timeliness.

### **5.2. Construction of an integrated flipped classroom teaching mode**

#### **5.2.1. Pre-class: AI pre-class diagnosis and personalized resource push**

Instructors release preview tasks and diagnostic tests through platforms such as Rain Classroom and MOOC. The system automatically analyzes learning status and generates personalized reports. Based on diagnostic results, adaptive resources are automatically pushed to students. The platform automatically records students’ preview completion and test data, synchronizing this information to the instructor’s terminal, thereby enabling instructors to grasp the overall class distribution and individual anomalies prior to class.

#### **5.2.2. In-class: Human-machine collaborative discussion and stratified case teaching**

Based on pre-class learning analytics, instructors dynamically adjust instructional content, focusing on the knowledge difficulties commonly encountered by students. Stratified case teaching is implemented according

to students' learning profiles: students at the foundation tier engage in analytical training centered on the core knowledge points of cases; those at the progression tier focus on case diagnosis and problem-solving tasks; and students at the extension tier undertake scheme optimization and operational decision-making simulations. Instructors are responsible for organizing discussions, guiding thinking, and shaping values, while AI assistants undertake information retrieval, knowledge assistance, and immediate feedback functions, realizing a collaborative teaching mode of "instructor-led, AI-assisted, student-centered."

### **5.2.3. Post-class: AI intelligent teaching assistants supporting continuous learning**

A 24-hour intelligent teaching assistant system integrated with a domestic AI large language model provides all-day learning support for students. Students can engage in knowledge inquiries, case discussions, and assignment tutoring through natural language interaction. The system automatically generates feedback reports based on learning behaviors and assessment results, performs knowledge-point tracing analysis for incorrect items, and pushes targeted reinforcement training resources. For students with lagging learning progress or elevated learning risk, an early-warning mechanism is automatically triggered, prompting instructors to conduct timely individualized tutoring.

## **5.3. Construction of a diversified intelligent teaching evaluation system**

### **5.3.1. Whole-process learning behavior data collection**

A learning behavior data collection system is established across the three instructional stages of pre-class, in-class, and post-class. During the pre-class stage, data on resource access counts, preview completion rates, and diagnostic test scores are collected. The in-class stage focuses on classroom interaction frequency, case discussion participation, and immediate test results. The post-class stage continuously records assignment completion, frequency of intelligent assistant usage, and changes in knowledge-point mastery.

### **5.3.2. Generation of learner competency maps**

Based on learning behavior data and course assessment results, the system dynamically generates student competency maps covering multiple dimensions, including knowledge mastery, case analysis capability, data processing capability, operational decision-making capability, and innovation practice capability. These maps visually present students' growth trajectories, providing a basis for precise improvement by both instructors and students.

### **5.3.3. Integration of process-based and outcome-based evaluation**

A comprehensive evaluation system integrating "process-based evaluation + outcome-based evaluation" is established. Process-based evaluation focuses on learning investment and capability development, encompassing learning behavior performance, case analysis quality, classroom participation, and project task completion. Outcome-based evaluation measures comprehensive learning effectiveness through course examinations, professional qualification certifications, competition achievements, and practical project outputs. AI automatically generates evaluation reports based on the entire learning process data.

## **6. Conclusion and outlook**

Aiming at the practical challenge that the traditional teaching mode of the Digital Management Accounting

course fails to accommodate students' stratified learning needs, this study constructs an AI-based operational mechanism for personalized learning pathways and designs a teaching reform system encompassing stratified resources, an integrated flipped classroom, and a diversified intelligent evaluation system. Theoretical analysis demonstrates that the AI-driven four-dimensional linkage mechanism of "Learning Status Diagnosis—Learning Profile Construction—Pathway Generation—Dynamic Feedback" can achieve precise identification of learning needs, intelligent matching of learning resources, and continuous optimization of the teaching process, thereby offering a feasible pathway for resolving the contradiction between "uniform instruction" and "stratified needs."

It should be noted that while AI technology empowers teaching reform, it also entails potential risks. It is necessary to establish a quality assurance mechanism combining "instructor review + knowledge base support," adhere to the principle of "AI generation, instructor verification," prevent students from developing AI dependence, and guide them to correctly understand the relationship between technology and human agency, ensuring that technological application serves the essence of education<sup>[9,10]</sup>. Future research will focus on two directions for further development: first, expanding the scope of practical samples and collecting process data through multiple rounds of teaching experiments to empirically validate the reform outcomes; second, exploring the deep integration mechanisms between the AI-personalized learning pathway and other teaching reform elements (such as curriculum-based ideological and political education and industry-academia-research collaboration), thereby further enhancing the systematicness and sustainability of the reform.

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