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**ЖАСАЛМА ИНТЕЛЛЕКТТИН НЕГИЗИНДЕ БАНКТЫН КЫЗМАТКЕРЛЕРИНИН
БИЛИМ БЕРҮҮ СИСТЕМАСЫН ИЗИЛДӨӨ: САН АРАЛЫК ЭГИЗДЕР
ТЕХНОЛОГИЯСЫНЫН НЕГИЗИНДЕ СИМУЛЯЦИЯЛЫК ТАЛДОО**

Аннотация. Жасалма интеллект (АИ) технологиясынын тез өнүгүшү менен банк индустриясы санариптик трансформациянын чек арасы катары өз кызматкерлеринин АИ мүмкүнчүлүктөрүнө жогорку талаптарды койду. Бирок, окутуунун салттуу моделдеринде практикалык, чөмүлүү жана туруктуулук жок, алар татаал жана дайыма өзгөрүп туруучу финансылык бизнес сценарийлеринин талаптарын канааттандыра албайт. Бул изилдөө, банк кызматкерлерине багытталган, санариптик эгиз технологиянын негизинде АИ иштетилген билим берүү системасын изилдеген. Модельдештирүү платформасын куруу менен реалдуу дүйнөдөгү бизнес сценарийлери виртуалдаштырылган жана кызматкерлерге АИ менен байланышкан билимди жана көндүмдөрдү азыраак тобокелдик чөйрөсүндө үйрөнүүгө жана колдонууга жардам берген интерактивдүү тренингдер өткөрүлдү. Изилдөө муктаждыктарды талдоо, системаны долбоорлоо жана симуляциялык эксперименттерди бириктирген ыкманы колдонгон. Натыйжалар көрсөткөндөй, система кызматкерлердин АИ билимин, операциялык эффективдүүлүгүн жана көйгөйлөрдү чечүү көндүмдөрүн кыйла жакшыртып, жумушка ыңгайлашуу жана окуудан канааттануу жагынан мыкты көрсөткүчтөргө ээ болду. Бул изилдөө банк тармагында таланттарды өнүктүрүү үчүн инновациялык жолду гана камсыз кылбастан, ошондой эле каржы секторунда санариптик билим берүү системаларын илгерилетүү жана колдонуу үчүн шилтеме сунуштайт.

Негизги сөздөр: мамлекеттик ооруканалар, аткарууну башкаруу, көрсөткүч системасы, маалыматташтыруу, стимул механизми.

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ИССЛЕДОВАНИЕ СИСТЕМЫ ОБРАЗОВАНИЯ БАНКОВСКИХ СЛУЖАЩИХ НА ОСНОВЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА: ИМИТАЦИОННЫЙ АНАЛИЗ НА ОСНОВЕ ТЕХНОЛОГИИ ЦИФРОВЫХ ДВОЙНИКОВ

Аннотация. В условиях стремительного развития технологий искусственного интеллекта (ИИ) банковская отрасль, являясь передовым звеном цифровой трансформации, предъявляет повышенные требования к возможностям своих сотрудников в области ИИ. Однако традиционным моделям обучения не хватает практичности, погружения в процесс обучения и устойчивости, что делает их неспособными отвечать требованиям сложных и постоянно меняющихся финансовых бизнес-сценариев. Данное исследование, посвященное банковским сотрудникам, изучало систему обучения с применением ИИ, основанную на технологии цифровых двойников. С помощью платформы моделирования были виртуализированы реальные бизнес-сценарии и проведено интерактивное обучение, помогая сотрудникам осваивать и применять знания и навыки, связанные с ИИ, в условиях низкого риска. В исследовании использовался метод, сочетающий анализ потребностей, проектирование системы и имитационные эксперименты. Результаты показали, что система значительно улучшила знания сотрудников в области ИИ, операционную эффективность и навыки решения проблем, продемонстрировав выдающиеся результаты с точки зрения адаптации к работе и удовлетворенности обучением. Данное исследование не только предлагает инновационный подход к развитию талантов в банковской сфере, но и служит примером для продвижения и применения систем цифрового образования в финансовом секторе.

Ключевые слова: государственные больницы, управление эффективностью, система показателей, информатизация, механизм стимулирования.

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RESEARCH ON AI-ENABLED EDUCATION SYSTEM FOR BANK EMPLOYEES: SIMULATION ANALYSIS BASED ON DIGITAL TWIN TECHNOLOGY

Abstract. With the rapid development of artificial intelligence (AI) technology, the banking industry, as a frontier of digital transformation, has placed higher demands on its employees' AI capabilities. However, traditional training models lack practicality, immersion, and sustainability, making them unable to meet the demands of complex and ever-changing financial business scenarios. This study, focusing on bank employees, explored an AI-enabled education system based on digital

twin technology. By constructing a simulation platform, real-world business scenarios were virtualized and interactive training was conducted, helping employees learn and apply AI-related knowledge and skills in a low-risk environment. The study employed a method combining needs analysis, system design, and simulation experiments. Results showed that the system significantly improved employees' AI knowledge, operational efficiency, and problem-solving skills, with outstanding performance in terms of job adaptability and learning satisfaction. This study not only provides an innovative path for talent development in the banking industry but also offers a reference for the promotion and application of digital education systems in the financial sector.

Key words: public hospitals, performance management, indicator system, informatization, incentive mechanism.

INTRODUCTION. In recent years, the application of artificial intelligence (AI) in the banking industry has continued to deepen. From intelligent customer service to risk control, from robo-advisory to compliance oversight, AI is profoundly transforming traditional business models. With the acceleration of digitalization, the banking industry has an urgent need for employees to develop AI capabilities [3, p. 651–663]. However, current bank employee training remains largely limited to traditional classroom lectures and case studies, lacking real-world scenarios and immersive learning experiences [1, p. 688–693]. This results in limited training effectiveness and hinders the rapid transfer and application of employee skills. Against this backdrop, the rise of digital twin technology has brought new opportunities to banking education and training. Digital twins can create highly realistic work scenarios through real-time mapping between virtual and real environments, enabling learners to practice and explore in a virtual environment. This not only avoids the risks associated with actual operations but also enhances learning engagement and effectiveness [4, p. 300–305].

1. AI Capability Demand and Education System Development in the Banking Industry

1.1 Digital Transformation in the Banking Industry and AI Capability Demand

Against the backdrop of global digital transformation, the banking industry has become one of the sectors with the most extensive application of artificial intelligence. In recent years, China's banking industry has seen a continuous increase in its investment in digital transformation. According to the "Banking Industry Development Report (2024)" released by the China Banking Association, over 87% of commercial banks have already implemented AI technologies in risk management, customer service, and robo-advisory [9, p. 1248–1271]. However, despite the continuous improvement in the overall level of AI application in banks, significant gaps remain in the competency structure of employees in specific positions. For example, customer service personnel need to master AI-assisted customer interaction tools, mid- and back-office risk control personnel require data modeling and analysis capabilities, and management places greater emphasis on AI-based strategic decision support [8, p. 250–271]. Currently, most bank training systems still focus on theoretical explanations and case studies, lacking practical simulations and real-time interaction. As a result, employees are often unable to fully utilize the potential of AI tools when facing real-world business situations [2, p. 1–5].

Table 1-1 Bank Job Roles and Required AI Competencies

Job Role	Required AI Competencies	Current Level	Gap
Customer Service	AI-based chatbot operation, sentiment analysis	High	

Job Role	Required AI Competencies	Current Level	Gap
Risk Control Officer	Data mining, predictive modeling, anomaly detection	Medium-High	
Financial Advisor	Intelligent recommendation systems, portfolio simulation	Medium	
IT/Tech Staff	AI model training, algorithm optimization, system integration	Low-Medium	
Managers/Executives	AI-driven decision support, business intelligence	High	

1.2 The Basic Framework of AI-Enabled Education

AI-enabled education is a new model that deeply integrates artificial intelligence technology with education and training. Through intelligent recommendations, personalized learning paths, and simulations, it provides learners with a more efficient and practical learning experience [1, p. 688–693]. Banking employee training has significant industry specificities: on the one hand, complex business scenarios and low risk tolerance require employees to possess both theoretical knowledge and high practical skills [3, p. 651–663]. On the other hand, with the accelerated digitalization of banks and the frequent iteration of new technologies, employees must possess the ability to continuously learn and adapt quickly. Compared to traditional classroom-based training, AI-enabled education enables personalized and dynamic learning through intelligent learning platforms and virtual simulation environments, significantly improving training efficiency and effectiveness [4, p. 300–305].

Table 1-2 Traditional Training vs AI-empowered Training in Banks

Aspect	Traditional Training	AI-empowered Training
Teaching Mode	Lecture-based, case study	Simulation, adaptive learning
Practice Opportunity	Limited	Virtual scenarios, real-time practice
Feedback Mechanism	End-of-course evaluation	Continuous, AI-driven assessment
Learning Flexibility	Fixed schedule and content	Personalized learning path
Effectiveness	Moderate knowledge transfer	Higher knowledge retention & application

1.3 Principles and Objectives of the Education System

To effectively enhance bank employees' AI capabilities, the education system must adhere to four fundamental principles: practicality, flexibility, sustainability, and a combination of technology-driven and humanistic approaches. First, practicality requires that training content be directly aligned with job requirements, such as providing AI customer service simulation training for customer service positions and risk prediction modeling training for risk control personnel. Second, flexibility emphasizes that the system can address the needs of employees at different levels and positions, supporting modular curriculum design and diverse learning paths. Third, sustainability means that the

education system must not be limited to one-time training but must establish mechanisms for continuous learning and dynamic updates to adapt to the rapid iteration of AI technology. Finally, a combination of technology-driven and humanistic approaches requires that while leveraging AI and digital twin technologies, the emotional aspects of employee learning and the interactive experience should be prioritized to ensure that technological application does not diminish humanistic care.

2 Design of a Digital Twin-Based Simulation Education System

2.1 Principles and Educational Applications of Digital Twin Technology

Digital twin technology (DT) is a technology that maps real-world systems to virtual models in real time. Through sensors, data collection, and cloud computing, it enables dynamic interaction between virtual and real environments. In education and training, digital twin technology can virtualize banking business processes and operational scenarios, providing employees with an immersive learning experience [6, p. 239–260]. For example, in customer service scenarios, employees can use digital twin systems to simulate customer interactions and handle complex issues without having to bear actual business risks [9, p. 1248–1271]. In risk management training, employees can perform data analysis and model-based decision-making in a virtual environment, accelerating skill acquisition. Compared to traditional classroom training, digital twin technology not only improves practical application but also optimizes learning paths through real-time feedback, achieving personalized and dynamic learning.

2.2 Digital Twin Design of an AI Education System for the Banking Industry

Targeting the diverse job requirements of bank employees, this study designed an AI education system based on digital twins. This system consists of four core modules: AI fundamentals, intelligent customer service, risk management and decision-making, and data security. The learning path utilizes a "theoretical learning → virtual hands-on training → feedback optimization" model, ensuring that employees can master fundamental knowledge while simultaneously practicing practical operations and continuously adjust their learning strategies through system feedback. Technically, the system integrates AI algorithms, VR/AR immersive training, and a cloud computing platform. This system records learning behavior data in real time and generates analytical reports, helping training managers make informed decisions. This system balances job coverage with operational effectiveness, providing a sustainable path for bank employees to enhance their AI capabilities [4, p. 300–305].

2.3 Learning Evaluation and Assessment Mechanism

To scientifically assess employee learning outcomes within the digital twin education system, this study designed a multi-dimensional evaluation system. First, learning outcomes are evaluated based on knowledge mastery, task completion efficiency, and operational accuracy. Second, behavioral data collection, including interaction logs, operation time, and error rates, documents the employee's learning process, providing data support for personalized learning. Finally, a comprehensive evaluation system combines quantitative indicators with qualitative feedback, considering both employees' actual operational capabilities and their learning attitudes and satisfaction. This evaluation mechanism not only monitors learning progress in real time but also enables continuous optimization of educational content and simulation scenarios through data analysis, enhancing the scientific and targeted nature of training [2, p. 1–5].

3 Simulation Experiment and Empirical Analysis

3.1 Simulation Experiment Design

To verify the effectiveness of the AI education system for bank employees based on digital twin technology, this study designed a systematic simulation experiment. The experimental subjects were bank employees from various positions, including customer service personnel, risk control personnel,

financial advisors, and technical developers. Each group consisted of 20 individuals, for a total sample size of 80. The experimental scenario simulated the bank's core business processes, including customer consultation, credit review, and risk control measures. Interactive training was conducted using a digital twin simulation platform. The experimental process was divided into three phases: the first phase was a pre-test, assessing employees' initial AI capabilities through knowledge tests and practical tasks; the second phase was a training intervention, in which employees completed modular courses and virtual hands-on training on the digital twin platform; and the third phase was a post-test, which further assessed knowledge and practical skills to measure the effectiveness of the training and the level of capability improvement [3, p. 651–663].

Table 3-1 Experimental Groups and Participants

Group	Job Role	Number of Participants
Group A	Customer Service	20
Group B	Risk Control	20
Group C	Financial Advisor	20
Group D	IT / Technical Staff	20

3.2 Experimental Data Collection and Results

The experimental data primarily included pre- and post-test measures of knowledge mastery, task completion time, operational accuracy, and a learning satisfaction survey. The results showed that after completing the digital twin training, employees' AI knowledge scores increased by an average of 28%, task completion time decreased by an average of 15%, and operational error rates decreased by 35%.

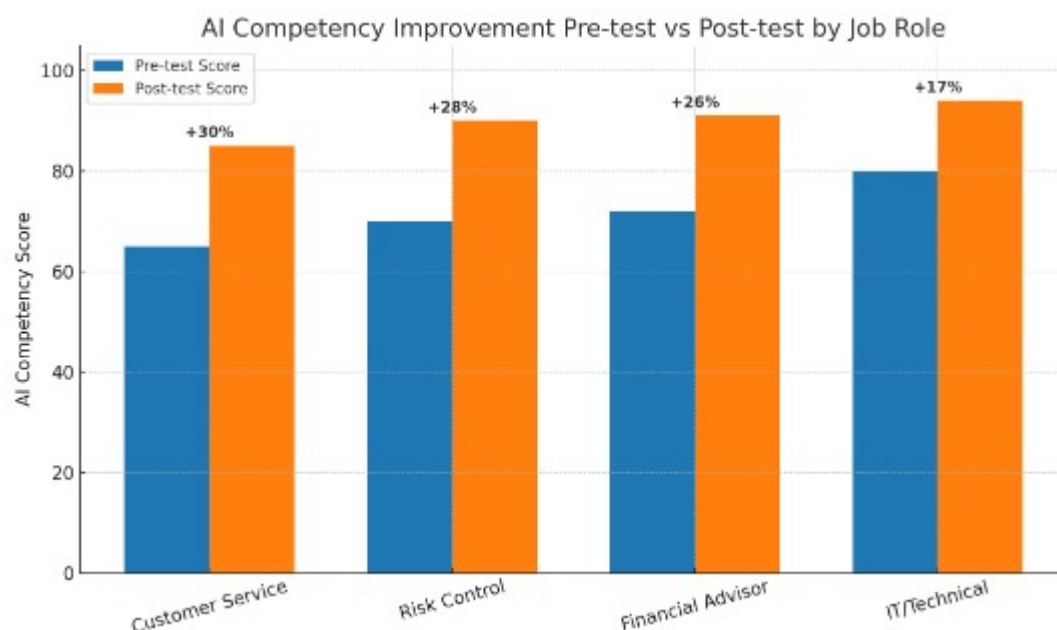


Figure 3-1 AI Competency Improvement Pre-test vs Post-test by Job Role

The extent of improvement varied across employee positions, with customer service and risk management personnel experiencing the most significant improvements. Technical personnel saw relatively smaller improvements, though operational efficiency still improved. The learning satisfaction survey revealed that over 92% of employees expressed positive feedback on the digital twin training, finding it highly practical and interactive. Data analysis demonstrates that the digital twin education system has significant advantages in improving practical operational skills and knowledge application.

Table 3-2 Experimental Data Summary and Analysis

Job Role	Pre-test Score	Post-test Score	Score Improvement (%)	Task Completion Time Reduction (%)	Error Rate Reduction (%)
Customer Service	65	85	30	18	38
Risk Control	70	90	28	16	36
Financial Advisor	72	91	26	12	32
IT / Technical	80	94	17	14	30

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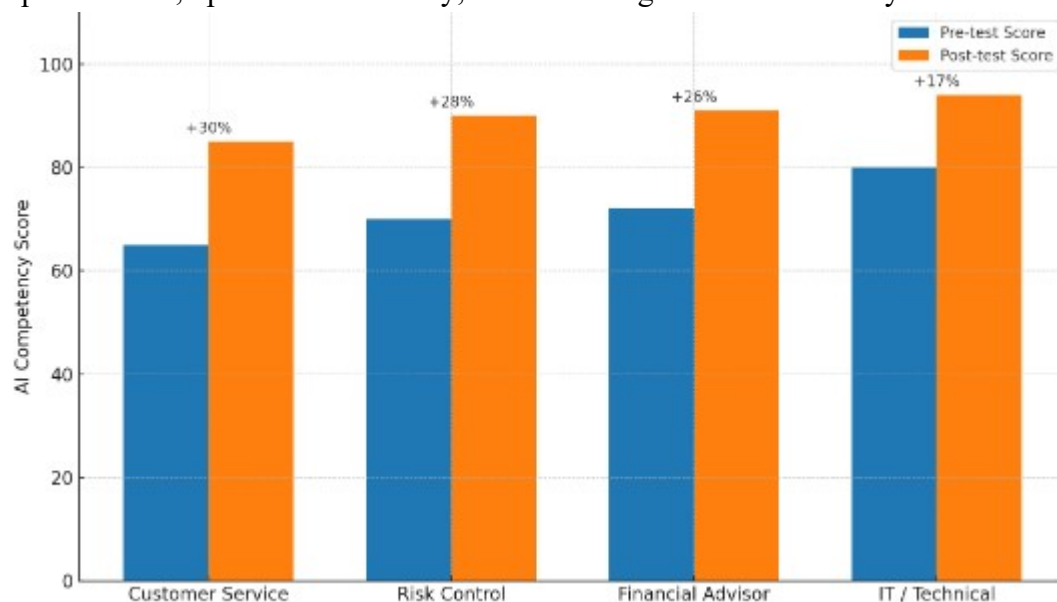


Figure 3-2 AI Competency Improvement Pre-test vs Post-test

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3.3 Discussion and Implications of the Results

The experimental results demonstrate that the AI education system based on digital twins has achieved significant results in improving the skills and operational capabilities of bank employees. The immersive practical environment provided by digital twins enhances employee learning enthusiasm and engagement. Furthermore, real-time feedback optimizes learning paths, enabling personalized education. Furthermore, performance improvement varies across different positions. General employees show significant improvements in basic operational and practical skills, while technical employees experience greater improvement in complex task processing and system integration.

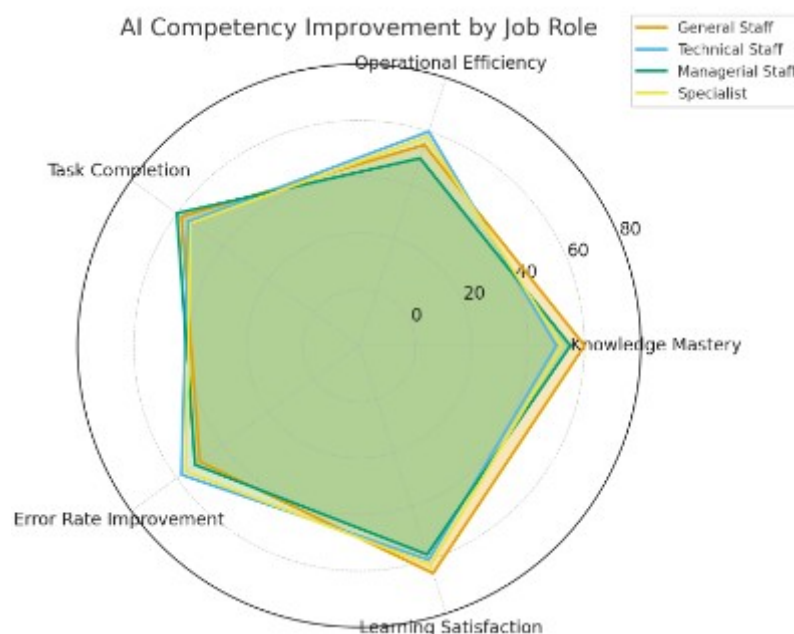


Figure 3-3 AI Competency Improvement by Job Role

Despite the positive results, the study also identified several challenges and limitations: first, the high cost of building and maintaining the digital twin platform; second, employee data privacy and system security require special attention; and third, some employees have limited acceptance of new technologies, which may affect training effectiveness. Based on these findings, banks should prioritize long-term mechanisms, design personalized learning paths, and explore the application of cutting-edge technologies such as the metaverse in education when building AI-enabled education systems, in order to develop sustainable and efficient talent development systems.

CONCLUSION

This study, focused on enhancing the AI capabilities of banking employees, proposed and validated an education system based on digital twin technology. Through an analysis of banking job requirements, the design of an education system, and the implementation of simulation experiments, the research demonstrated that digital twins not only provide employees with an immersive learning experience but also effectively enhance their mastery of AI knowledge and skills. During the

experiments, employees demonstrated higher operational efficiency and adaptability in the business simulation environment, with significantly improved learning satisfaction and job suitability. However, the study also identified challenges with this system regarding technology costs, data privacy, and employee acceptance.

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