Front. Digit. Educ., 2025, 2(1): 3
https://doi.org/10.1007/s44366-025-0042-2

CASE REPORT

Wuhan University Pioneers the "AI +" Professional Knowledge Graph Spanning the Teaching–Learning–Management–Evaluation Chain

Dan Wu[a,b], **Xin Jiang**[b], **Shaobo Liang**[a], **Fei Tang**[b,c], **Chao Qiu**[b], **Chi Yu**[d], **Peihui Yan**[b]

[a] School of Information Management, Wuhan University, Wuhan 430072, China

[b] Undergraduate College of Wuhan University, Wuhan University, Wuhan 430072, China

[c] School of Electrical Engineering and Automation, Wuhan University, Wuhan 430072, China

[d] School of Information, San Jose State University, San Jose, CA 95192, USA

Abstract To address common challenges, such as improving teaching quality, enhancing student engagement, streamlining administrative processes, and developing more effective assessment and evaluation methods, Wuhan University has developed and deployed the "AI +" professional knowledge graph using AI, neural network, and natural language processing, thus creating a benchmark case. The implementation of the "AI +" professional knowledge graph has resulted in more refined teaching designs, more autonomous learning pathways for students, more specialized and digitalized teaching management platforms, and more scientific and standardized full-chain evaluation. The implementation provides a panoramic and dynamic representation of the development of all academic disciplines at the university, making the Luojia Online AI Intelligent Teaching Center more systematic and more intelligent. Moreover, it has accelerated the development of digital intelligence education at the university and created a comprehensive architecture of "six tiers, five dimensions, four profiles, three graphs, two achievements, and one center", pioneering a distinctive Wuhan University model for the cultivation of top-notch innovative talents.

Keywords digital intelligence education, artificial intelligence, professional knowledge graph, Wuhan University

Received January 10, 2025; revised February 10, 2025; accepted February 13, 2025

Dan Wu (✉)
E-mail: woodan@whu.edu.cn

1 AI-Enabled Digital Transformation of Higher Education

The integration of AI in education has been widely discussed as a transformative force, particularly in terms of enabling personalized learning and data-driven decision-making (Siemens, 2013). The advancement of AI technology has triggered a transformation in knowledge production models, reshaping the mechanisms and directions of talent cultivation in higher education. It is imperative to actively and efficiently utilize cutting-edge digital intelligence technologies to drive the digital transformation of traditional higher education. Higher education institutions, with their substantial technological resources and inherent talent advantages, should fully leverage the strengths and potentials of AI and other cutting-edge digital intelligence technologies, such as Big Data analysis and blockchain technology, to innovatively formulate and implement strategies scientifically for the development of AI-enabled higher education. This contributes to the efficient integration of AI into education, thus optimizing the allocation of educational resources, enhancing the quality of talent cultivation, and meeting the evolving needs of societal development.

1.1 | Core Issues of Digital Transformation in Higher Education

Teaching, learning, management, and evaluation are four fundamental components of higher education development, as depicted in Figure 1. These four

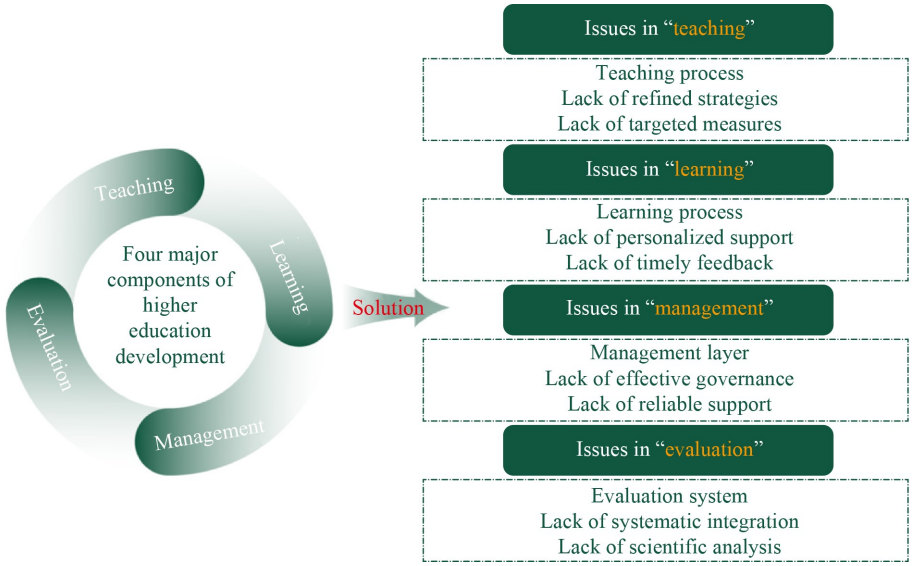

Figure 1 Issues in teaching, learning, management, and evaluation.

components also represent the key domains where AI and other cutting-edge digital intelligence technologies, such as cloud computing and augmented reality (AR) technology, empower the digital transformation of higher education. AI-empowered education is a new research topic in the global higher education community. However, in the context of the transformation of digital intelligence education, institutions have difficulties in utilizing AI technologies effectively to meet the core requirements of those four components.

First, the teaching process should enhance the precision of instruction. Current higher education institutions lack refined strategies and targeted measures on work and time. The teaching process is expected to refine the precision of teaching activities. This includes better coordination of teaching arrangement and monitoring teaching progress, which optimizes teaching contents and improves teaching quality. Therefore, the teaching process should improve the overall quality of talent cultivation in higher education institutions (Fan & Zhang, 2022).

Second, the learning process should provide personalized support and timely feedback. The current higher education systems struggle to effectively support students in meeting their diverse learning needs at different stages to hinder students' well-rounded development. Learners need personalized support and timely feedback throughout the learning process. This involves providing customized learning resources and guidance for students to swiftly identify and overcome learning bottlenecks, improve their learning efficiency, and foster their well-rounded development.

Third, the management process should improve scientific rigor, timeliness, focus, and effectiveness. Current higher education institutions lack scientific and efficient management. Organizational, operational, and coordinative efforts in higher education institutions, include but are not limited to the management of teaching activities, student affairs, faculty teams, and resource distribution. Management should enhance data analysis capabilities and improve platform reliability to ensure a more targeted, scientific, and effective management system. This enables university administrators to access key information quickly and accurately. Important data, such as learning status, faculty allocation, and scientific research project progress from various faculties, are accessed easily, thus leading to more timely and informed decision-making and improving the efficiency of digital resource allocation, utilization, and management.

Fourth, the evaluation process should eliminate data silos and move toward diverse and comprehensive assessment. The current evaluation systems at universities include faculty performance, study demands, teaching facilities, research levels, university–enterprise cooperation, and academic influence. However, these evaluation systems have been plagued by issues, such as data silos and limited data diversity, thus revealing a lack of systematic integration and scientific analysis (Wang, 2024). Therefore, it is crucial to involve diverse evaluation stakeholders and establish a comprehensive higher education quality evaluation framework to address issues (Zhang & Lian, 2024), thereby achieving diversity and comprehensiveness in evaluation. Moreover, data-enabled education evaluation reform is the basic direction of digitisation in education (Zhu & Hu, 2022).

1.2 | Enhancing Smart Education with the "AI +" Professional Knowledge Graph

Based on rich experience in digital intelligence education and to adhere to the principles of "digital technology for good" and "application-driven innovation", Wuhan University focuses on a system of tools, courses, concepts, platforms, and applications that integrate high-quality resources both within and outside the campus. Leveraging the digital intelligence platform called Luojia Online AI Intelligent Teaching Center, Wuhan University has developed a typical case of the "AI +" professional knowledge graph. This case is based on the philosophy of comprehensive coverage of data knowledge and differentiated cultivation of digital intelligence talents, solving the four major issues in teaching, learning, management, and evaluation, and realizing the transformation of the "AI +" teaching model. The "AI +" teaching model provides a structured representation of domain knowledge and provides intelligent tutoring and content recommendations. This showcases the significance of knowledge graphs, which has injected strong momentum into the university's strategy of using intelligence technologies to assist teaching, learning, management, and evaluation. The application of the "AI +" teaching model fosters continuous improvements in education quality, facilitates teaching for faculties and learning for students, enables effective institutional governance, and enhances feedback efficiency.

The case is based on the Luojia Online AI Intelligent Teaching Center accessible via mobile app, mobile mini-program, and desktop platforms. It represents Wuhan University's top-level design for the integration of teaching, learning, management, and evaluation across the entire campus. The implementation of AI-driven systems in higher education aligns with the development of smart learning environments, where adaptive learning models enhance personalized education. The teaching center serves as an essential platform for the digitization and informatization of various disciplines and courses. Luojia Online AI Intelligent Teaching Center, as depicted in Figure 2, integrates AI and ideological and political education concepts into daily teaching activities. It has created an AI teaching assistant and intelligent agent workbench spanning university-wide, discipline-specific, and course-specific levels. It reduces teachers' workload while monitoring students' learning progress intelligently, providing targeted guidance and support. Moreover, the teaching center has introduced a management system for a talent development plan by integrating the traditional educational administration system with a program achievement system. This system integrates graduation requirements, training goals, and course objectives aligned with the talent development plan related to specific course content. The system also enables data collection throughout the entire teaching process, advancing the application of the outcome-based education (OBE) management model. The system provides real-time feedback on the achievement of program and course objectives during teaching and learning activities, thus creating a closed-loop education administration. The establishment and improvement of the teaching center have prepared for the deep integration of AI technology with various aspects of education, such as intelligent tutoring systems for personalized learning, AI-powered assessment tools for automated grading and feedback, data-driven education management systems for optimizing administrative decisions, and AI-assisted research platforms for knowledge discovery.

Similar to other digital transformation initiatives at the university level, this case has been planned and implemented based on the Luojia Online AI Intelligent Teaching Center. It has achieved the upgradation and integration of knowledge graphs, competence graphs, and quality graphs, along with the development of AI-specific intelligent agents. These

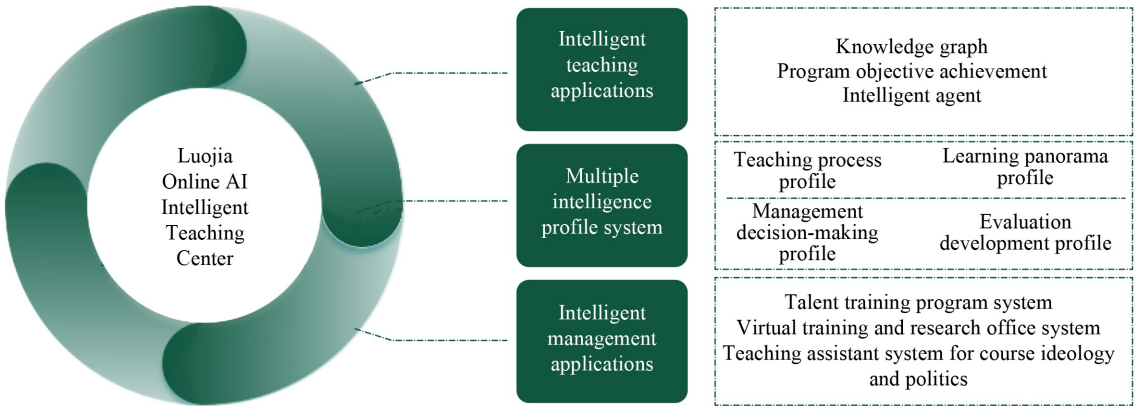

Figure 2 Cover and function display of the Luojia Online AI Intelligent Teaching Center.

efforts have led to the creation of a multidimensional intelligence profile matrix, which encompasses 16 key indices, such as teaching competence, learning challenges, student learning trajectory tracking, and professional growth, culminating in four distinct profiles. As depicted in Figure 3, there are four dimensions, including the teaching process profile, learning panorama profile, management decision-making profile, and evaluation development profile. Each of these knowledge graphs plays a crucial role in fulfilling the core requirements of teaching, learning, management, and evaluation.

The first profile is the teaching process profile. This dimension focuses on the dynamic and ongoing processes of delivering lessons and integrating real-time teaching strategies and methodologies. It helps monitor the alignment of teaching activities with educational objectives, thereby ensuring instructional methods are relevant and effective. By mapping these processes, the knowledge graph aids in the continuous improvement of teaching quality and resource allocation.

The second profile is learning the panorama profile. This dimension provides a holistic view of students' learning experiences, capturing both academic performance and non-cognitive aspects, such as engagement and well-being. It enables instructors and administrators to track individual learning experiences, identify difficulties, and provide personalized learning support, thereby enhancing learning outcomes and fostering a more inclusive learning environment.

The third profile is the management decision-making profile. This dimension integrates data from both teaching and learning activities, thus supporting informed decision-making at the administrative level. By analyzing trends, performance metrics, and feedback loops, this profile aids in optimizing educational strategies, resource distribution, and policy development, thereby achieving the institution's educational goals efficiently and effectively.

The fourth profile is the evaluation development profile. This dimension focuses on the continuous development of evaluation methods and practices in the institution. By analyzing the effectiveness of different assessment tools and learning metrics, this graph supports the improvement of evaluation systems and ensures that they align with both academic and institutional goals.

The aforementioned four profiles enable precise, efficient, and scientifically sound feedback in all aspects of education, bridging teaching, learning, management, and evaluation effectively. Moreover, the design and implementation of this case also aim at deepening and expanding the platform's functionality and efficiency, thereby elevating its intelligence level.

2 AI-Enabled Teaching, Learning, Management, and Evaluation Chain

Wuhan University has implemented comprehensive reforms to address the weaknesses in the digital transformation of higher education. These reforms involve refining teaching design, fostering autonomous learning, specializing and digitalizing teaching management platforms, standardizing full-chain evaluation, and intelligentizing teaching, learning, manage-

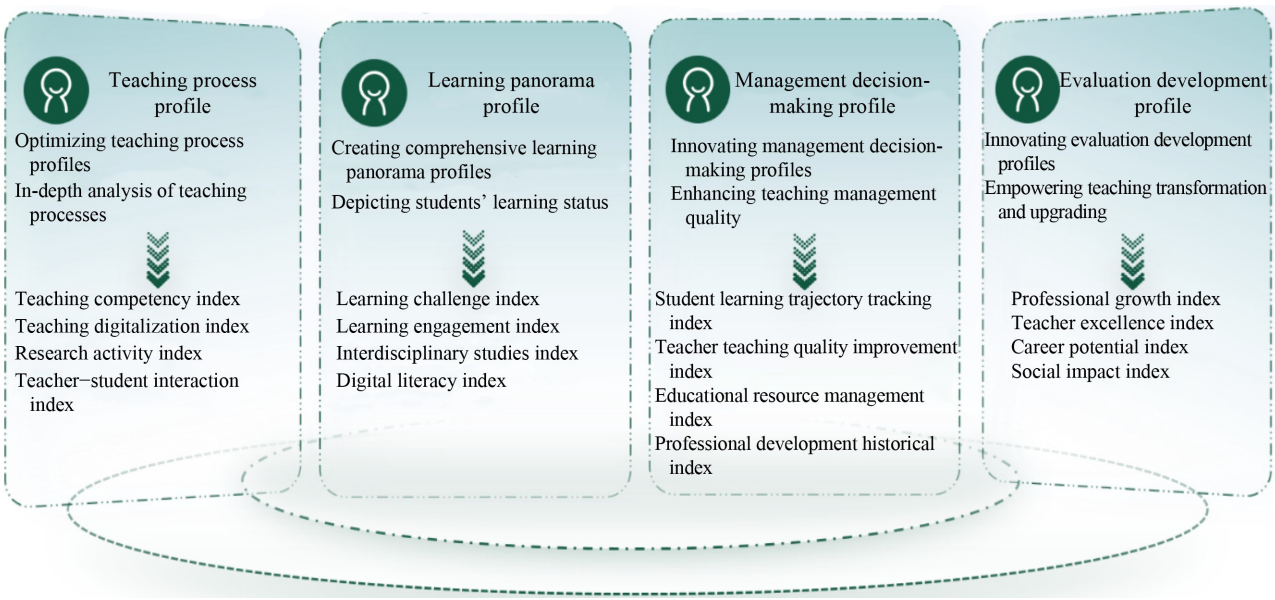

Figure 3 Structure of the teaching, learning, management, and evaluation profiling system.

ment, and evaluation. The university has proposed the construction, as presented in Figure 4 of a six-tier, five-dimension, four-profile, three-graph architecture and data foundation for detailed demand analysis, using the "AI +" professional knowledge graph. The six tiers include training objectives, graduation requirements, graduation indicators, program objectives, course objectives, and course objective achievement. The five dimensions contain programs, thinking, competence, problems, and knowledge. The four profiles refer to the teaching process profile, learning panorama profile, management decision-making profile, and evaluation development profile. The structure in Figure 4 aligns with the principles of OBE, a framework that emphasizes measurable learning outcomes and continuous improvement (Spady, 1994). By integrating AI-based analytics with an OBE-driven approach, institutions can track students' competencies and learning progress in real-time (Biggs & Tang, 2011).

Two achievements, the achievement of program and course objectives (hereafter referred to as two achievements), treated as application goals and the Luojia Online AI Intelligent Teaching Center, serve as the operational platform. These components work synergistically to achieve real-time tracking and improvement of personalized education goals and teaching effectiveness. Based on this, the university has determined four personalized goals for the case's construction and implementation.

2.1 | Building a Comprehensive Management Platform in Six Tiers

This case demonstrates the systematic integration and scientific analysis of the six tiers, including training objectives, graduation requirements, graduation indicators, program objectives, course objectives, and course objective achievement, outlined in the talent development plan. The systematic integration and scientific analysis of the tiers have been based on a sophisticated intelligent management platform, which enables efficient data collection, real-time monitoring, scientific management, and precise program positioning for educational planning.

2.2 | Opening a Pathway for Refined Teaching Transformation in Five Dimensions

This case draws upon a vast amount of process data

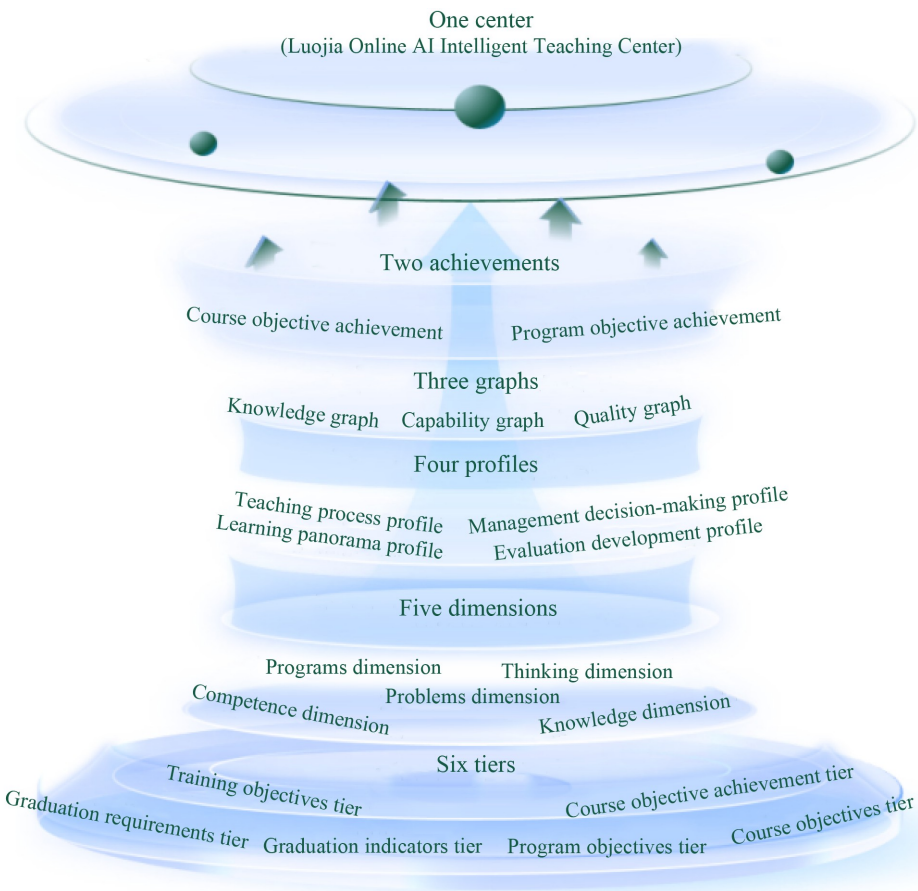

Figure 4 Integrated digital intelligence archetecture.

accumulated over the last decade on the university's teaching platform. Based on semantic paradigms and data mining, it transforms massive data into a chain-based spatial model for teaching improvement. By analyzing and integrating data comprehensively across five core dimensions, including programs, knowledge, competence, problems, and thinking. It constructs an accurate assessment and feedback system, helping teachers adjust their teaching strategies promptly.

2.3 | Exploring Effective Pathways for Exploratory Learning with Four Profiles

This case enhances the knowledge acquisition efficiency and personalized service capabilities of the teaching platform while fostering an environment that encourages students to engage in self-directed exploratory learning. It improves the evaluation profiling system based on student assessment, including the teaching process profile, learning panorama profile, management decision-making profile, and evaluation development profile. These profiles provide reliable support for the evaluation process, thereby contributing to the development of effective pathways for exploratory, self-directed, and innovative learning.

2.4 | Providing Robust Digital Support for Evaluation with Three Graphs and Two Achievements

To address challenges, such as data silos in teaching, educational administration, and evaluation systems, the university has developed a more scientific and intelligent multidisciplinary digital evaluation system. This system includes the creation of knowledge graphs, competence graphs, and quality graphs to enable holistic and comprehensive evaluation, which encompasses assessing students' knowledge mastery and ability levels, teaching quality, and the effectiveness of educational management. Effective assessment in higher education should be competency-based, integrating multiple evaluation metrics to provide meaningful insights. The application of knowledge graphs in assessment enhances the reliability of automated feedback and ensures alignment with institutional learning objectives (Siemens, 2013). Moreover, two evaluation systems and two achievements have been implemented. The case achieves integration and interoperability between these system modules, thereby enhancing the digital intelligence, scientific rigor, and comprehensiveness of the evaluation system.

3 Innovative Applications of AI Technology and Case Building

Wuhan University, through the technology path of its "AI +" professional knowledge graph, has achieved breakthroughs in the dynamic integration of technology by leveraging advanced "AI +" algorithms (Wu, 2024a). This provides personalized recommendations of educational content and precise plans for learners, thereby improving teaching quality and learning efficiency. AI technology has resulted in the development of a method for creating diverse profiles based on professional knowledge graphs, with related patent applications already filed. It is expected to evolve into a universal solution for education, with originality and a competitive edge in innovation.

3.1 | Innovative Applications of AI Technology

The case employs advanced natural language processing (NLP) and knowledge extraction technologies to innovate the "AI +" professional knowledge graph. It addresses challenges effectively, such as the lack of visual representation of professional knowledge, the absence of standardized criteria for course assessments, and the complexity of outcome measurement. By maintaining and analyzing the teaching, learning, management, and evaluation data generated from the "AI +" professional knowledge graph, efficient data extraction and targeted analysis are achieved. This process yields four key profiles ultimately, including the teaching process profile, learning panorama profile, management decision-making profile, and evaluation development profile. These profiles are integrated into the Luojia Online AI Intelligent Teaching Center, which fully supports discipline development, program enhancement, course optimization, personalized teaching, and precise assessment.

The case leverages AI technologies, such as NLP and deep learning to break down knowledge points into granular elements. Each element is further subdivided into multiple nodes, with each node linked to specific post-class learning data. By assigning weight values to knowledge points, the relationships among knowledge points are established. Teachers can then reconstruct knowledge graphs based on the knowledge graph structure preset by AI, thereby leveraging large educational models. Relying on the original "AI +" professional knowledge graph system, multisource data integration and optimization can be achieved. Moreover, a comprehensive evaluation system based on Big Data can be created, enabling holographic feedback

and timely interaction between teaching and learning.

The core of this case is digitization, relying on the Luojia Online AI Intelligent Teaching Center. AI teaching assistants and AI learning partners are used throughout the teaching process, advancing integrated digital intelligence education. Closed-loop data management can be achieved by incorporating features, such as identity authentication, unified platform access, and diverse application services. This scientific and efficient management can achieve innovation across the entire teaching, learning, management, and evaluation process while resolving issues in management and evaluation.

3.2 | Creation of the "AI +" Professional Knowledge Graph

This case centers on the philosophy of comprehensive coverage of data science knowledge and differentiated training of digital intelligence talents (Zhang, 2024), addressing challenges in teaching, learning, management, and evaluation. It aims to achieve a transformative leap from traditional teaching to the "AI +" teaching model, spanning from courses to programs, and from teaching objectives to outcome analyses, as depicted in Figure 5.

The case involves five key components, including the knowledge graph, program platform, advanced AI intelligent agents, multidimensional profile analysis, and intelligent management application. First, the knowledge graph is a comprehensive subject knowledge network built to help students and teachers obtain a clear understanding of the course structure and the relationships among knowledge points. Second, the program platform is based on achievement indicators, optimizing specialized course settings and monitoring teaching quality. Third, to meet both teaching and learning needs, the advanced AI intelligent agents are introduced with functions, including resource recommendations, knowledge point marking, plagiarism detection, voice generation, question creation, lesson plan generation, content review, personalized practice, and statistical analysis. This provides customized learning suggestions for students and teaching support for teachers. Fourth, multidimensional profile analysis is based on the data of teaching, learning, management, and evaluation. Multidimensional profile analysis provides comprehensive information on students' learning habits, skill levels, and interests to create personalized learning pathways. It integrates the entire talent training process and independently develops an "AI +" professional knowledge graph, enables a one-click generation of multidimensional intelligence profile matrices and achievement reports on talent training, and ensures procedural precision and efficient management. Fifth,

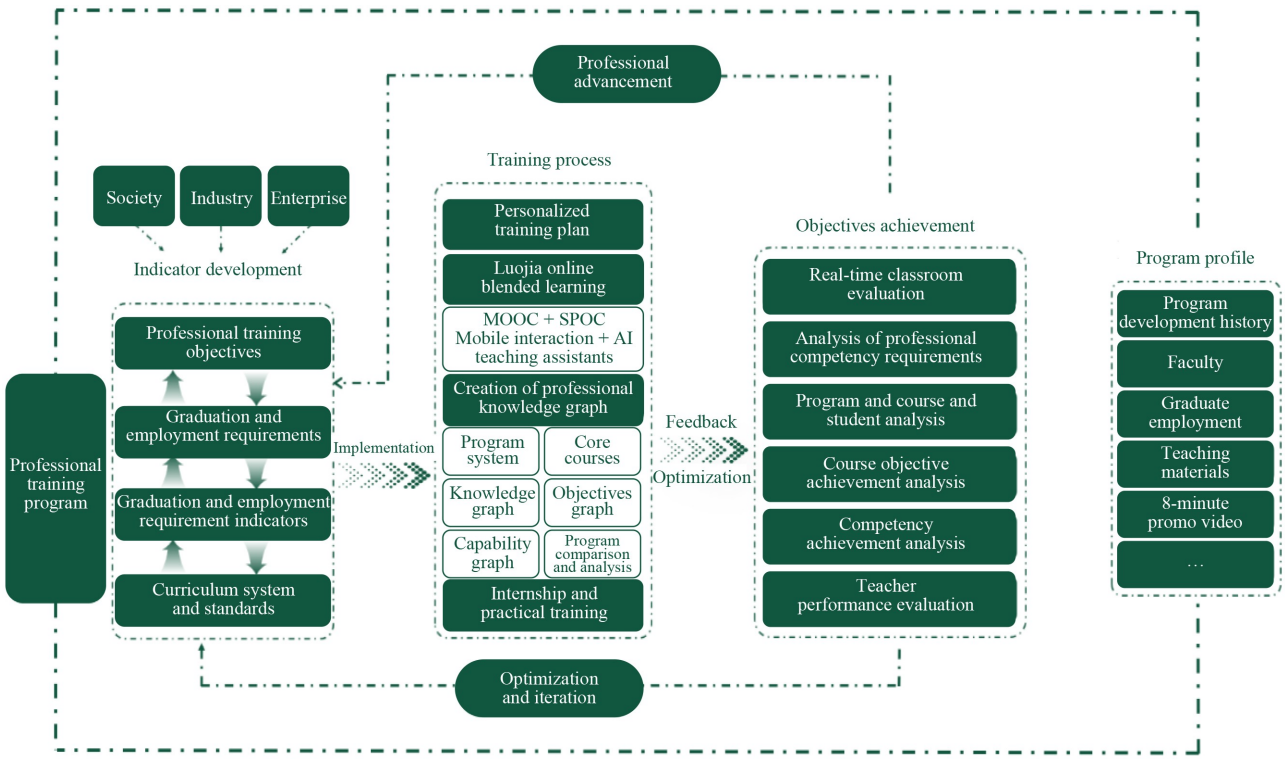

Figure 5 Structure of the "AI +" professional knowledge graph system. MOOC: Massive Open Online Course, SPOC: Small Private Online Course.

the intelligent management application uses Big Data and AI algorithms, optimizes the allocation of educational resources, and enhances the effectiveness of management decision-making.

3.3 | Technological Challenges and Solutions

During the implementation of the "AI +" professional knowledge graph system, several technical challenges have emerged, including data integration, system scalability, AI model optimization, user adoption, and data security (Wu, 2024b). To address these challenges, various solutions have been implemented to ensure system efficiency and reliability. Given diverse data sources with varying formats, a standardized data framework has been established, and AI-driven data-cleaning techniques have been applied to enhance data quality and ensure consistency. As the number of users grows, there exists increasing pressure on system scalability. To mitigate this, a cloud computing architecture has been adopted, enabling dynamic resource allocation and integrating load-balancing mechanisms to maintain stability under high concurrency. In the early stages, the AI models struggled to adapt to different learning needs. Through continuous training and algorithm optimization combined with adaptive learning mechanisms, the system has been refined to dynamically adjust learning pathways based on user feedback, thereby improving the accuracy of personalized recommendations. As for user adoption, it has posed an initial challenge, particularly among faculties and students unfamiliar with AI-driven systems. To facilitate a smooth transition, a comprehensive training program has been introduced offering tutorials and technical support, while ongoing user interface enhancements improved the overall user experience. Given the sensitivity of educational data, robust security measures are also implemented, including encrypted storage, secure access controls, and regular security audits to ensure data compliance and protection. By systematically mitigating these issues, the "AI +" professional knowledge graph system has achieved greater stability, scalability, and long-term sustainability.

3.4 | Long-Term Sustainability of the "AI +" Professional Knowledge Graph System

The long-term sustainability of the "AI +" professional knowledge graph system is a critical aspect that requires continuous attention and careful planning. To ensure the system's viability as it scales, four key factors are addressed. First, system maintenance is essential. Regular maintenance protocols should be established to ensure the system remains operational and up-to-date. This involves routine performance checks, identification of potential issues, and ensuring that all components, such as AI agents and knowledge graphs, are functioning optimally. Second, with evolving AI technologies and educational needs, updates and iterations are crucial. The platform should undergo regular updates, including algorithm improvements, new feature additions, and adjustments based on user feedback. Third, a version control process should be implemented to ensure smooth transitions during updates and minimize disruptions for users. Fourth, scalability should be addressed, considering the anticipated growth in user base and the increasing complexity of educational demands. A cloud-based infrastructure with flexible resource allocation must be used to handle the increased demand without compromising system performance. The use of distributed architectures will ensure that the system remains responsive, even with a growing number of users interacting with the system. To prevent potential bottlenecks, such as server overloads and database performance issues, load-balancing techniques and performance tuning should be regularly assessed and implemented. These measures will ensure the system's effective operations and ability to meet growing demands in the future.

4 Implementation Outcomes and Scalability of the "AI +" Solutions

Following systematic planning and comprehensive development, the "AI +" professional knowledge graph has evolved into an intelligent education and teaching management system spanning all academic disciplines and programs at the university. It has advanced precision in teaching, personalization in learning, digitization in management, and diversification in evaluation effectively, as depicted in Figure 6.

In terms of teaching, the implementation of the case supports the six-tier, five-dimension, and three-graph architecture. The structure innovates in proposing a digital and systematic teaching model. The six tiers form a three-aspect foundation for the professional knowledge graph, including the knowledge graph, capability graph, and quality graph. These three kinds of graphs provide an intuitive course design, thus enabling teaching activities to be more focused on developing students' competence and deepening their knowledge. Moreover, the five dimensions represent the training focuses according to the graduation requirements on programs, thinking, competence, problems, and knowledge.

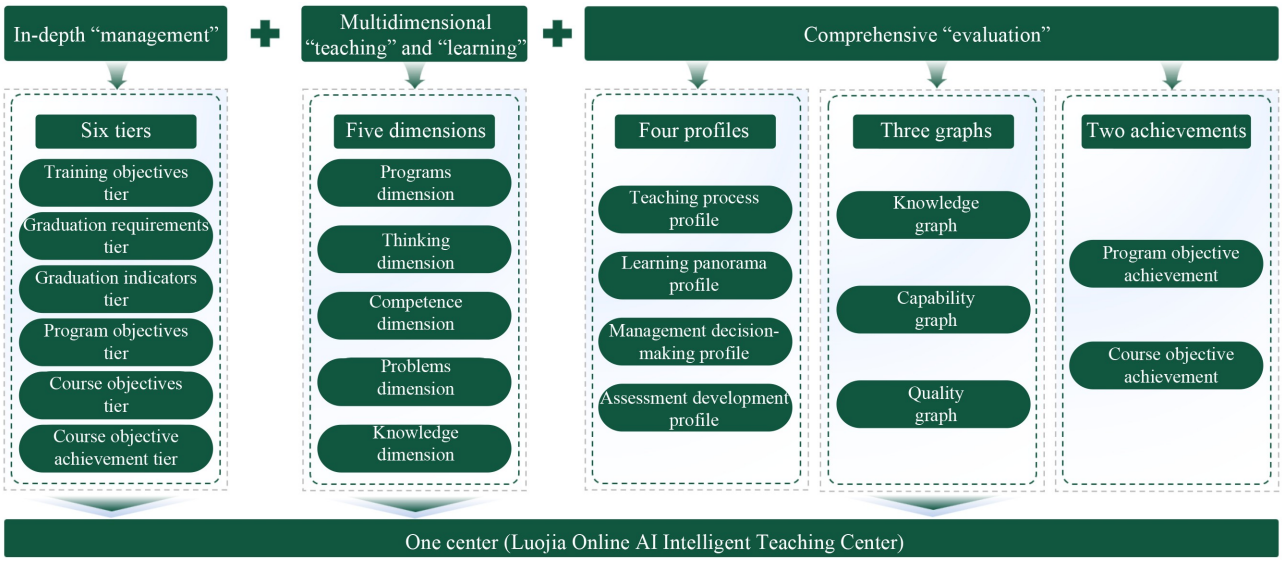

Figure 6 Application effects of teaching, learning, management, and evaluation.

In terms of learning, the three-graph and two-achievement mechanisms provide students with personalized learning paths and feedback. The objective achievement and course objective achievement provide clear curriculum goals and learning paths, thereby enabling students to understand the course system, learning progress, and distance from targets. For example, in the computer science program, the system has reduced course planning time by 40% through automated knowledge graph alignment.

In terms of management, the five-dimension and two-achievement mechanisms enable the digitization and refinement of management processes, providing the support and data sources necessary for generating diverse profiles and offering managers reliable information for judgment and decision-making.

In terms of evaluation, the four profiles, generated by the case in real-time for teachers, students, programs, and courses, achieve scientific and diversified evaluation. These profiles enable evaluation to be conducted from multiple dimensions, ensuring comprehensiveness, fairness, and relevance in education.

In summary, the case effectively addresses the key challenges faced by higher education in advancing digital transformation across teaching, learning, management and evaluation. Its effectiveness demonstrates the substantial potential for popularization as it provides new ideas and methods for the development of higher education. First, the implementation of the case covers all undergraduate programs at Wuhan University, serving approximately 30,000 teachers and students. It establishes a fully digital management system encompassing the entire process from admission to employment. This helps the university to gain insights into the development of its programs and optimize course structures, customize growth paths for students, and improve teaching quality by providing real-time feedback on teaching effectiveness for faculties. Second, by adopting a data-driven and human–machine collaboration management model, the implementation of the case ensures effective operation and continuous evolution, thereby providing a replicable paradigm of smart education for higher education institutions worldwide. Through the innovative application of the case, the accuracy of learning trajectory tracking has improved to 95%, the accuracy of personalized learning path matching has increased to 92%, and teaching effectiveness has increased by 30%, thus significantly improving the overall quality and efficiency of high-quality talent training. The system's wider application is expected to bring forth socio–economic value. Third, the implementation of the case has accelerated the pace of high-quality talent training, optimized the allocation of educational resources, and promoted technological innovation and industrial upgradation. The high-quality operation holds long-term strategic value for enhancing the comprehensive strength of the nation.

As the first smart professional development graph encompassing the four major aspects and the full chain of higher education in China, Wuhan University's "AI +" professional knowledge graph has set a benchmark for the digital transformation of higher education. Its innovative model is expected to lead to a new wave of reform in the global higher education sector.

5 Conclusions

The case in question, Wuhan University's "AI +"

professional knowledge graph, has demonstrated remarkable results in advancing digital transformation. However, it still has limitations. As the system expands its scope for application to other universities, it encounters challenges related to adaptability, long-term sustainability, and upgraded development. Cross-disciplinary data integration and the adaptability of faculties and students pose significant obstacles. Despite the significant potential of the "AI +" system, issues such as data privacy, security, and system adaptability across diverse cultural and technological contexts hinder widespread adoption. For instance, in some traditional teacher-centered contexts, students may resist the AI system's autonomous learning approach. In newly established universities with limited budgets, the system may struggle due to subpar network infrastructure. In addition, the system's maintenance, periodic updates, and adaptability of both faculty and students require more attention, which aims to guarantee its long-term success and scalability worldwide.

Moreover, the research of Wuhan University's "AI +" professional knowledge graph faces limitations, such as insufficient data integrity and accuracy that impact analysis precision. However, the high technical thresholds and resource consumption associated with the construction and maintenance of the knowledge graph make its promotion in institutions with limited resources a challenging task. Moreover, the model's flexibility and adaptability in response to changes in complex teaching scenarios are far from perfect. For instance, sudden shifts between online and offline teaching paradigms, the need to accommodate diverse learning paces among students and the integration of interdisciplinary course contents pose challenges to its seamless adaptation.

Looking ahead, future research and development should focus on integrating emerging technologies to broaden the system's reach beyond Wuhan University. By incorporating advanced AI techniques, such as large-scale deep learning models and NLP, personalized learning experiences, and automated assessment methods can be further optimized. Blockchain technology can enhance the security and transparency of academic record management, while AR and virtual reality can create immersive learning environments. Expansion should also include adapting the system to a wider range of higher education institutions, both domestically and internationally, facilitated by cross-institutional collaboration for data sharing and benchmarking. This will foster a more inclusive and comprehensive AI-powered educational ecosystem worldwide.

Furthermore, it must be noted that multilingual support and cross-cultural adaptability are essential to cater to international students and ensure global applicability. To mitigate these challenges, future research should explore efficient data cleaning and completion algorithms to expand data sources and improve data precision, develop lightweight and easily deployable technologies to reduce the application threshold, and strengthen research on dynamic teaching scenarios to enhance the model's real-time response and adaptation capabilities. Through the exploration of these future research directions, Wuhan University is expected to continue leading the way and contributing to the innovation of educational science and technology, thereby shaping the next phase of digital transformation in higher education worldwide.

Acknowledgment This study was funded by the Hubei Provincial Undergraduate Higher Education Provincial-Level Teaching Reform Research Project (Grant No. 2024001).

Conflict of Interest The authors declare that they have no conflict of interest.

Ethics Statement The authors declare that their Institutional Ethics Committee confirmed that no ethical review was required for this study. Written informed consent for participation was not required because all participants' data was anonymized before the statistical analyses were conducted.

Data Availability Statements The authors confirm that all data generated or analyzed during this study are included in this published article.

References

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university*. 4th ed. Maidenhead: Open University Press.

Fan, J. L., & Zhang, X. P. (2022). Students' sense of acquisition from the perspective of human–computer cooperation: Composition and realization. *Journal of Soochow University (Educational Science Edition)*, (1), 75–85. (in Chinese).

Siemens, G. (2013). Learning analytics: The emergence of a discipline. *American Behavioral Scientist*, *57*(10), 1380–1400.

Spady, W. G. (1994). *Outcome-based education: Critical issues and answers*. Arlington: American Association of School Administrators.

Wang, Y. (2024). *The evaluation guidelines of Wuhan University for digital intelligence education*. Wuhan: Wuhan University Press. (in Chinese).

Wu, D. (2024a). *The assessment guidelines of Wuhan University for AI literacy*. Wuhan: Wuhan University Press. (in Chinese).

Wu, D. (2024b). *The guidelines of building digital intelligence education support system at Wuhan University*. Wuhan: Wuhan University Press. (in Chinese).

Zhang, H. Y., & Lian, Y. D. (2024). On motivation, features and implementation approaches of digital-based education evaluation paradigm. *Heilongjiang Researches on Higher Education*, *42*(1), 23–30. (in Chinese).

Zhang, P. W. (2024). *The white paper on digital intelligence education of Wuhan University*. Wuhan: Wuhan University Press. (in Chinese).

Zhu, Z., & Hu, J. (2022). The logic of practice and opportunities for digital transformation in education. *E-education Research*, *1*, 5–15. (in Chinese).