DI-IDEA Book Series

Digital Intelligence
International Development Education Alliance

White Paper on Digital Intelligence Education Development

Digital Intelligence International Development Education Alliance (DI-IDEA)

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Preface

Humanity is confronted with numerous substantial and intricate issues in the digital intelligence era. International collaboration should be intensified to formulate answers from an interdisciplinary perspective, utilizing both mathematical techniques and digital instruments. Digital intelligence education refers to an interdisciplinary talent development model that primarily utilizes big data and AI technologies to cultivate digital thinking, digital literacy, intelligent computing skills, and the ability to solve problems in the digital intelligence age. This educational approach inherently embodies interdisciplinary traits, as advancements in numerous fields are intimately linked with data and intelligence. In the digital intelligence era, universities play multiple roles: they are not only pioneers and innovators in science and technology bInut also creators and reformers of cultural and intellectual resources. By developing educational systems that are inclusive, equitable, high-quality, and sustainable, universities can generate new knowledge, carry forward cultural heritage, and drive the advancement of human civilization.

In response to the new opportunities and challenges posed by the digital intelligence era to global higher education, the Digital Intelligence International Development Education Alliance (DI-IDEA) was established in 2023 in Beijing, initiated by 30 universities worldwide. Over the past year, DI-IDEA, guided by its vision of "advancing human progress and innovating the future of education," has been actively exploring ways to strengthen collaboration among universities globally, delving into the theories and methods of digital intelligence education, and providing academic support and policy recommendations for the advancement of human society.

White Paper on Digital Intelligence Education Development, published by DI-IDEA, offers a systematic overview of digital intelligence education, covering its concept, the current talent landscape, and the associated educational systems. The document includes exemplary practices from renowned universities around the world and outlines action plans in four areas as follows to promote the common development of digital intelligence education.

First, enhance leadership in digital intelligence education. DI-IDEA is committed to building an inclusive and highly efficient international network for educational development, empowering university leaders with strategic thinking, technological insights, and innovative capabilities in the digital intelligence era. These leaders are expected to drive innovation and transformations within their institutions, ensuring that all students and faculty can fully leverage digital intelligence technologies to achieve personalized and optimized educational experiences.

Second, establish the standards for digital intelligence education. DI-IDEA has proposed standards that aim to provide participating universities and research institutions with a normative guide for developing digital intelligence education programs. These standards offer a comprehensive framework of ethical principles, usage boundaries, and support measures for the responsible and ethical application of digital intelligence technologies, thereby fostering the healthy and sustainable development of digital intelligence education.

Third, develop a digital intelligence education framework. This framework, proposed by DI-IDEA, is designed to provide member universities and research institutions with forward-looking guidance for developing digital intelligence education programs. It offers a solid conceptual foundation, practical strategies, and specific structure and assessment methods for fostering innovation, ethical responsibility, and social engagement in digital education. This framework will continuously evolve and improve through the collaborative efforts of stakeholders from diverse backgrounds and institutional environments.

Fourth, build shared platforms for digital intelligence education. The DI-IDEA platform for digital intelligence education is designed to foster collaborative creation and sharing of digital intelligence education and research outcomes. This platform gathers and shares teaching experiences and exemplary cases of digital intelligence education from university educators worldwide. It guides teachers in leveraging new digital and intelligent technologies, including generative AI, to develop innovative teaching methods. Notably, its member, Camtree, is spearheading the development of the DI-IDEA HUB, a center for academic exchanges and teachers' professional development.

Digital technology and AI are propelling industrial innovation at an unprecedented rate. As the core driver of social progress and economic prosperity, digitization is transforming the global landscape of resource allocation and profoundly restructuring economies while subtly reshaping the international dynamics. Seizing the opportunities of our time and pushing for digital transformation and innovation is a universal challenge that necessitates the extensive involvement and contributions of exceptional digital intelligence talent. During the preparation of this White Paper, we have witnessed significant achievements in the training of digital intelligence talent across the globe. The release of this White Paper is expected to deepen the understanding of, draw attention to, and drum up support for digital intelligence education across various sectors. It aims to attract more international universities, experts, and scholars to the field, ensuring a steady supply of exceptional digital intelligence talent that will contribute to the sustainable development and common prosperity of human society.

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1. Overview of Digital Intelligence Education

1.1 Higher Education in the Digital Intelligence Era

As the new round of technological and industrial revolutions progresses around the world, the value of data as a key factor in production is becoming increasingly prominent. The evolution of the digital economy, typified by the further adoption of digital intelligence across society, is reshaping the nature of employment and the knowledge and skill requirements of the workforce. In this context, digital intelligence can serve as a key driver for the high-quality development of higher education.

1.1.1 Develop digital intelligence education to promote societal transformation and progress

In today's world, digital intelligence technologies are rapidly reshaping socioeconomic development and models of governance. Intelligentization, which refers to the integration of artificial intelligence technologies into various systems, serves not only as a method or means but also as a direction and objective. The advancement of digital intelligence marks a fundamental shift in both the economy and society, ushering in new paradigms for industrial organization, modern infrastructure systems, technological talent development, and social governance.

Enhancing education in digital intelligence will not only boost citizens' digital literacy and skills but also provide ongoing intellectual support for high-quality development of the digital economy and the societal shift towards digital intelligence across various countries. Additionally, it will promote the application of innovative achievements in digital intelligence technologies.

1.1.2 Develop digital intelligence education to promote interdisciplinary integration

The accelerated evolution of digital intelligence technologies profoundly impacts almost every discipline, underscoring the extensive reach of these technological trends. Fostering education in digital intelligence and nurturing talent within this field can spur the integration and emergence of novel interdisciplinary domains. For instance, in the field of "Digital Humanities," digital intelligence technologies offer new tools, subjects, topics, and scenarios that expand the scope of humanities research. Conversely, humanities research helps set ethical benchmarks for digital intelligence technologies and plays a significant role in areas like virtual simulation, emotional algorithms, and computational aesthetics. This synergy creates a rich, diversified digital intelligence ecosystem driven by humanistic values and bolstered by advanced technology.

1.1.3 Develop digital intelligence education to promote the nurturing of innovation

Boosting education in digital intelligence requires building interdisciplinary platforms to facilitate teaching and improving relevant knowledge systems to effectively nurture top talent. As we head into a digitally intelligent era, leading innovators should anchor their work in practical applications. They should integrate digital thinking, digital literacy, and intelligent computing skills within their field of expertise to enhance problem-solving capabilities in real-world scenarios.

1.2. The Concept of Digital Intelligence Education

1.2.1 The concept and characteristics of digital intelligence education

Digital intelligence education refers to an interdisciplinary talent development model that primarily leverages big data and AI technologies to cultivate digital thinking, digital literacy, intelligent computing skills, and the ability to solve problems in the digital intelligence age. The key points of this model are as follows:

First, to foster digital capabilities as an integral part of lifelong learning. In the process of digital intelligence transformation, it is essential that individuals possess not only specialized knowledge and skills but also digital thinking, digital literacy, and the ability to creatively tackle complex problems using intelligent computing skills. Universities must understand the new requirements that digital transformation places on competencies of the workforce and create a talent development philosophy that focuses on digital capabilities.

Second, to place equal emphasis on digital intelligence technologies and technology ethics. The advancement of digital intelligence technologies has introduced complex ethical challenges to society while helping revolutionize the means of production. In the era of digital intelligence, nurturing technological talent involves not only the transmission of skills and ideas but also plays a crucial role in fostering the co-evolution of technology and social norms. Therefore, it is imperative to concurrently bolster training in technological skills and promote education in technology ethics. Universities should focus on raising awareness of ethical issues in technology and enhancing the ability to address these challenges.

Third, to combine digital intelligence education with the tools it empowers. Digital intelligence technologies require the development of interdisciplinary talent through diverse approaches. This involves developing data-intensive research paradigms that serve multiple purposes: a) training researchers who are equipped with the systematic thinking abilities required for adapting to the digital intelligence trend, and who can seamlessly integrate data science skills with their domain expertise; and b) promoting collaboration between universities and companies to nurture professionals who are both theoretically informed and practically experienced. Additionally, digital intelligence technologies such as AI enhance talent training systems with smart, tailored educational content and adaptable teaching approaches.

1.2.2 The essence and elements of digital intelligence education

1.2.2.1 Based on digital literacy

The key to advancing digital intelligence education lies in cultivating digital literacy. Digital literacy is defined as an individual's ability to use digital technologies effectively, safely, and responsibly to access, evaluate, create, and communicate information. Fostering digital literacy better equips students with the skills needed to navigate and excel in the modern world, thereby contributing to the overall sustainability of society.

1.2.2.2 Focused on intelligent computing skills

Intelligent computing skills are based on digital literacy. These skills arise from comprehending, analyzing, and adeptly applying data through AI. In the era of digital intelligence, data is crucial for decision-making, problem-solving, and fostering innovative thinking. Developing intelligent computing skills starts with acquiring fundamental data processing techniques and progresses to mastering statistical and data analysis tools, including machine learning and large language models, to solve real-world problems. This enhances individuals' ability to understand information and enables organizations to make more informed strategies and policies.

1.2.2.3 Supported by data science

Data science is an interdisciplinary field that leverages scientific methods, processes, algorithms, and systems to extract value from data. It integrates foundational theories from multiple fields, including computer science and technology, mathematics, statistics, and information resource management. Data science will become a cornerstone for developing talent in digital intelligence. Individuals in this field need to grasp the theories, methods, and technologies involved in data science. Additionally, they should have the skills to unlock the full value of data through business analysis, data modeling and applications, and the design of intelligent algorithms.

1.2.2.4 Aimed at cultivating interdisciplinary talent with digital thinking and digital literacy

The convergence of various disciplines is a hallmark of modern scientific and technological progress. Education in digital intelligence inherently embodies interdisciplinary traits, as advancements in many fields are closely linked with data and intelligence. To advance digital intelligence education, it is essential to develop an inclusive, equitable, high-quality, and sustainable lifelong education system that is attuned to the needs of the digital intelligence era and to nurture talent that can develop and apply digital thinking, digital literacy, and intelligent computing skills.

1.3 The Purposes of Training Digital Intelligence Talent

1.3.1 Empower technological innovation

Innovation drives development, and science and technology shape the future. In the era of the digital economy, the innovation of digital technologies presents significant opportunities and new challenges for future education. The defining feature of future education will be the integration of human and machine in digital intelligence education. Therefore, universities need to hasten the development of a new educational paradigm led by human-machine collaboration with a view to promoting universal and lifelong learning across society while bolstering digital competitiveness.

1.3.2 Foster digital industries

Research shows that between 2013 and 2021, the digital intelligence talent index—based on the number of universities and programs training talent in both traditional and emerging (i.e. digital intelligence) fields—grew by 5.44 times. Despite this growth, the supply of such talent remains significantly below the demands of the digital economy. It is predicted that by 2025, the value-added output of core industries in the digital economy will account for 10% of GDP. As digital industrialization and industrial digitization accelerate, the shortfall in digital intelligence talent will continue to grow.

1.3.3 Promote societal transformation

In the era of digital intelligence, data, information, and knowledge are characterized by their mobility, contextuality, and social relevance. The advancement of the Internet and instant messaging technologies is set to further promote the creation of new social spaces that blend virtual and real elements, alongside a more sophisticated social division of labor. Digital intelligence technologies will infiltrate all sectors, including the "smart cities," smart mining, smart road networks, automated ports, and logistics robots.

1.3.4 Engage in digital governance

Global digital governance encompasses both theoretical research and policy implementation aimed at addressing transnational issues related to digital technologies. It seeks to create systems and mechanisms for managing international public risks and unlocking global public value. In other words, digital governance means not only governance using digital tools but also the governance of these tools. As issues with global digital governance become increasingly prominent, universities should leverage their academic strengths to actively engage in addressing these challenges and contribute to the construction of an equitable and efficient global digital governance framework. This effort is crucial for fostering development and ensuring security on a global scale in the era of digital intelligence.

2. Digital Intelligence Education System

The expert group that authored this White Paper conducted a comprehensive online survey on talent development at 60 renowned universities worldwide. Their analysis focused on educational objectives, program structures, and curriculum systems, such as computer science and technology, mathematics, statistics, and information resource management.

2.1 Disciplinary System

2.1.1 Educational objectives

2.1.1.1 Master fundamental knowledge

General courses that promote digital thinking and provide foundational data science education to enhance digital literacy. Some universities offer general courses like "Introduction to Data Science" to develop students' digital thinking abilities across different disciplines

2.1.1.2 Foster interdisciplinary expertise

Courses that prioritize the application of data science methods and technologies across various disciplines to offer targeted training based on the specific characteristics of each field.

2.1.1.3 Develop problem-solving skills

Undergraduate students are required to acquire fundamental knowledge and skills in their fields, while postgraduates focus on in-depth research and innovation within specific areas. Some universities also offer practical courses or project-based training. For instance, the Massachusetts Institute of Technology (MIT) organizes small-group seminars that encourage hands-on involvement. These courses integrate lab projects that require knowledge-intensive exchanges, such as econometrics and data science.

2.1.2 Current status of academic program development

Among the 60 universities surveyed, 54 have introduced data science programs, including 25 that offer these programs at both undergraduate and postgraduate levels. Another 25 universities, representing 40% of those with data science programs, deliver these programs through collaborations across multiple schools and departments or via interdisciplinary research institutes. The interdisciplinary nature of data science is leading universities to shift from single-discipline programs to more collaborative, interdisciplinary approaches to develop innovative and interdisciplinary talent.

2.2 Curriculum System

Universities design their training courses according to different levels of education, typically using a modular curriculum system that offers specialized courses for students from various disciplines. Additionally, students are supported in selecting course modules based on their degree programs, minors, and training needs.

2.2.1 Undergraduate curriculum system

In the field of data science education, core undergraduate curricula prioritize foundational courses in relevant subjects. These curricula concentrate on equipping students with practical skills such as data analytics, mining, and visualization. Typically, the curriculum is structured around a core set of courses that include general education in data science fundamentals and essential data processing methods and technologies. In such cases, students are required to take general courses, such as “Introduction to Data Science,” alongside key courses like “Linear Algebra,” “Fundamentals of Computer Programming,” and “Machine Learning.” These courses are designed to provide a robust theoretical base and practical skills.

Additionally, compulsory course systems incorporate foundational courses in mathematics, statistics, and information resource management. In terms of elective major courses, universities offer a range of advanced technical courses, including "Introduction to Scientific Computing," "Introduction to Statistical Learning," "Data Management Systems," "Advanced Big Data Analytics," "Big Data Storage and Management," and "Applications of Data Structures and Algorithms." Students are encouraged to tailor their education to align with their personal interests and career goals.

It is noteworthy that practical courses, such as "Comprehensive Data Management Practices," "Data Analysis Experiments," and "Big Data Practices," play a significant role in these curricula. These courses not only help students integrate theoretical knowledge with practical experience but also enhance their ability to tackle complex data problems. For instance, MIT's Capstone Experience and individual research projects aim to enhance students' skills in empirical analysis and problem-solving by engaging them with real-world case studies and experiments.

2.2.2 Postgraduate curriculum system

In the field of postgraduate data science education, curricula are typically divided into compulsory and elective major courses at both Master's and doctoral levels. For Master's students, compulsory courses may cover three core modules: Data Science, Mathematics and Statistics, and Computational Science. These modules include courses such as "Big Data Analytics and Processing," "Data Mining," "Probabilities and Statistics for Data Science," and "Foundations of Computational Data Science," designed to build a solid foundation in these areas. Elective courses at the Master's level are divided into two modules: advanced data science methods and interdisciplinary fields. The former includes cutting-edge topics such as "Dynamic Programming and Reinforcement Learning;" while the latter includes courses like "Corporate Data Mining," "Biomedical Statistics," and "Geographic Information Technology," aimed at broadening students' knowledge. Compulsory courses in doctoral programs delve into advanced theories with compulsory courses such as "Stochastic Processes," "Advanced Probability," and "Statistical Inference," to deepen students' understanding of these theories. Elective courses for doctoral students, including "Algorithm Analysis" and "Advanced

Machine Learning," are tailored to students' specific research interests, supporting their in-depth exploration in particular fields.

Furthermore, postgraduate curricula include research projects, internships, and other practical activities designed to develop students' ability to solve complex problems. For example, MIT requires a minimum four-week internship, while the University of Oxford mandates participation in lectures, capstone experience projects, and seminars or workshops. Both Imperial College London and the University College London highlight the importance of engaging in data science research projects or seminars. These practical courses not only enhance students' professional knowledge in the field of data analytics but also guide them in exploring the latest advancements and applications in data science. By engaging systematically in these courses, postgraduates gain the essential experience and skills necessary for future academic research or career development.

2.2.3 Research progress

In the field of digital intelligence education, universities not only dedicate themselves to exploring fundamental theories and developing new algorithms, but also emphasize the application of research outcomes to solve real-world problems. When it comes to machine learning and deep learning, universities have enhanced their academic reputation by publishing numerous papers on the application of new algorithms and models, spanning various areas such as image recognition, speech recognition, and natural language processing. In the realm of big data analytics and data management, universities have introduced innovative methods for processing and analyzing big data, addressing real-world challenges in health care, finance, and e-commerce. These achievements are often manifested through scholarly articles and patent filings. In terms of AI and intelligent decision-making, the development of intelligent decision support systems has achieved success in areas like health care management, financial risk assessment, and intelligent traffic management, thus driving the automation of relevant industries. Breakthroughs in computational statistics and data visualization have improved both the efficiency of data analysis and the clarity of its visual representation, benefiting both scientific research and engineering practices. Interdisciplinary collaboration has also facilitated the resolution of complex problems and promoted the widespread application of data science methods across multiple disciplines. These educational and research achievements not only propel academic progress but also provide critical support for industry innovation and societal development.

2.3 Textbook System

In terms of cultivating digital intelligence talent, the selection and use of relevant textbooks vary depending on universities and their curriculums. Generally, universities prioritize authoritative and classic resources. Commonly selected English textbooks include *Introduction to Statistical Learning, Pattern Recognition and Machine Learning, Deep Learning, The Elements of Statistical Learning, and Bayesian Data Analysis*. The relevant Chinese textbooks are mainly adapted from international sources, covering foundational theories and methods while integrating real-life cases and applications. This approach aims to develop students' theoretical knowledge and practical skills to address the increasingly complex and diverse needs in the digital intelligence field. Textbooks on basic theories and methods include *Machine Learning, Data Mining and Analytics,* and *Fundamentals of Artificial Intelligence*. Those on cutting-edge technologies and research areas include *Deep Learning* and *Big Data Technologies and Applications*. Textbooks focused on practical cases and projects include *Introduction to Data Science* and *Machine Learning in Practice*. Textbooks that foster interdisciplinary integration and international perspectives include *Computer Vision and Image Processing and Natural Language Processing*.

2.4 Support System

2.4.1 Experiment platforms

Globally, universities specializing in digital intelligence are leading innovation and breakthroughs in fields like data science, AI, and machine learning. They are establishing cutting-edge laboratories and research centers that bring together top scholars and research teams, showcasing a trend towards diverse and state-of-the-art experiment platforms for nurturing talent in digital intelligence. These platforms are equipped with high-performance computing facilities, sophisticated sensors, and advanced machine learning algorithms. Additionally, they maintain strong partnerships with technology companies, providing academic research with extensive application scenarios and resources, and facilitating the commercialization of technologies and research achievements.

For instance, the University of Oxford has several prominent laboratories in the fields of computer science and AI. Specifically, the Oxford Robotics Institute is dedicated to robotics and autonomous systems, covering all aspects from perception and planning to control and operation. The Oxford-Man Institute of Quantitative Finance integrates mathematical modeling with computer science to perform quantitative analysis and forecasting of financial markets. At Tsinghua University, the State Key Laboratory of Intelligent Technology and Systems assembles leading scholars and researchers in computer science, AI, and machine learning. The laboratory is furnished with advanced facilities including supercomputers, distributed storage systems, and high-performance servers, to support large-scale data processing and complex algorithm computations. It not only undertakes numerous national and industrial collaborative research projects but also achieves deep integration of academic research and engineering applications in the design of intelligent systems and big data analytics, thus providing a substantial supply of high-caliber researchers and industrial technologists for society. Peking University's Computer Vision and Digital Art Lab, within the School of Electronics Engineering and Computer Science, is renowned for its research in image recognition, pattern recognition, and AI applications. The lab offers students a world-class research environment and technological support, promoting talent development and innovation in the field.

2.4.2 Faculty strength

To address the complex challenges in digital intelligence education, universities are not only gathering top faculty but also fostering interdisciplinary research and application skills among them. Professors and their research teams have undertaken numerous influential research projects within their respective fields, providing students with extensive academic resources and practical opportunities. These teams span not only foundational disciplines like computer science and mathematics but also related fields such as statistics, engineering, and biology. By integrating specialized knowledge from different fields, interdisciplinary teams are better positioned to advance cutting-edge research and innovative applications.

For example, the University of Oxford is home to several world-renowned professors and researchers in machine learning, computer vision, and data science, such as Michael Osborne and Phil Blunsom, whose contributions in both academia and industry have significantly advanced the quality of research and education. Similarly, Harvard University has a number of leading professors and researchers in data science, computer science, and AI, including Yoshua Bengio, who have made substantial contributions to advancing research in deep learning and natural language processing.

2.5 Evaluation System

Universities are focusing on cultivating talent in digital intelligence by implementing multidimensional student evaluation systems. These systems assess not only students' mastery of theoretical knowledge but also their application skills and problem-solving abilities through real-world projects. This comprehensive evaluation covers students' academic strengths, practical skills, and career potential, aiming to continuously improve educational quality and curriculum design, while ensuring alignment with market demands.

Personal development plans (PDPs) and feedback mechanisms: Some universities implement PDPs and feedback mechanisms to help students set personalized learning goals and regularly evaluate their progress and achievements.

Internships and project assessments: The evaluation criteria include the quality of project outcomes, problem-solving abilities, teamwork, and communication skills. These assessments not only examine students' programming or mathematical modeling skills but also reflect their teamwork capabilities and potential for innovation.

Academic competitions and certification exams: As a means of assessing students' abilities, these competitions and exams help students build confidence and expand academic horizons.

Mentors' evaluations and recommendations: Through these evaluations and recommendations, mentors provide personalized guidance, helping students make better academic and career choices.

Industry collaborations and employer feedback: Universities often collaborate with industries to gather feedback on the skills employers expect from graduates.

3. Case Studies for Digital Intelligence Education

As the digitization of global education accelerates, digital intelligence education has emerged as a key driver for innovation and transformation in higher education. Universities worldwide are responding to this trend by exploring new models and pathways for digital intelligence education through multidimensional strategies, including the creation of smart virtual classrooms, curriculum optimization, development of teaching experimental platforms, innovation in teaching assessment and faculty development, and the integration of AI in higher education. This report provides a detailed analysis of how universities are leveraging digital intelligence education to enhance teaching quality, foster educational equity, and nurture innovative talent. It sheds light on the core values and future trends of digital intelligence education, contributing insight and guidance to the high-quality development of global higher education.

3.1 Course Case Studies

3.1.1 Curriculum development

Case Study I: Zhejiang University's General AI Curriculum

In March 2024, Zhejiang University established the AI Education Research Center, aiming to develop a multi-level, high-quality general AI curriculum for both undergraduate and postgraduate students, and to advance AI textbooks, practical teaching methods, and faculty development. The curriculum comprises two main components:

1. AI+X Interdisciplinary Courses: This group includes at least 100 courses that deeply integrate AI with various disciplines. It allows students to explore new AI theories, technologies, and methods from an interdisciplinary perspective, broadening their academic horizons and enhancing their ability to innovate across fields.

2. General AI course: Designed for students from both STEM and Liberal Arts backgrounds, this group features various versions of the course "Introduction to Artificial Intelligence," catering to different academic needs of students. Specifically, "Introduction to Artificial Intelligence (A)" focuses on STEM fields, emphasizing the integration of theory and practice to develop the students' abilities to apply AI in solving specialized problems. "Introduction to Artificial Intelligence (B)" course is designed for liberal arts students with some programming background. This course covers fundamental AI principles and their applications in liberal arts fields. "Introduction to Artificial Intelligence (C)" targets liberal arts students without a programming background, focusing on basic AI knowledge, fostering interest in the subject, and instilling awareness of AI ethics and social responsibility.

At Zhejiang University, the "Introduction to Artificial Intelligence" course has established a systematic AI knowledge graph, consisting of 10 modules and 63 knowledge points. This comprehensive curriculum covers a broad range of content, from foundational theories to practical case studies. It is supported by extensive teaching resources, including over 2,000 minutes of instructional videos, nearly 1,000 pages of PowerPoint slides, and hundreds of practical exercises. These resources offer students a high-quality, immersive, and interactive learning experience.

Case Study II: Sun Yat-sen University's AI Curriculum

In 2021, Sun Yat-sen University and Huawei Technologies Co., Ltd. jointly launched the "Smart Base" industry-education integration and collaborative talent development program, aiming to develop a digital intelligence education system aligned with industry needs and accommodating students from diverse academic backgrounds. This program adheres to the principles of "general education + specialization," "theory + practice," and "interdisciplinary integration

+ innovation" in designing a multi-tiered, multidimensional curriculum. The curriculum is structured into five categories: general courses, foundational courses, core courses, experimental and practical courses, and applied courses. This structure spans the entire spectrum from theory to practice, including basic AI knowledge, specific technological applications, and hands-on experience. General courses such as "Introduction to Artificial Intelligence" and "Data Security and Privacy Protection" are open to all students, aiming to disseminate basic concepts and ethical principles in the digital intelligence era. Foundational courses delve into specialized areas like machine learning and data mining, providing students with a solid theoretical foundation. Core courses focus on cutting-edge technologies such as deep learning and pattern recognition. Experimental and practical courses, like programming and AI practices, allow students to apply theoretical knowledge in real-world scenarios. Applied courses, such as "Robot Operating System (ROS) and Applications" and "IoT Technology and Applications," guide students in fostering innovative thinking and using their knowledge to solve complex real-world problems. This program has successfully developed 85 courses that incorporate Huawei's cutting-edge technologies including Kunpeng, Ascend, and Huawei Cloud, allowing students to engage with the latest industry advancements. Over 3,200 students have participated in the program, with more than 100 earning relevant technical certifications. Additionally, over 50 outstanding students have received scholarships and been recognized with the title of "Star of the Future."

Case Study III: Fudan University's AI Curriculum

In 2024, Fudan University unveiled the development of an AI curriculum and educational reform, known as the "AI Curriculum." This initiative aims to accelerate the establishment of an AI innovation ecosystem and pioneer new approaches to cultivating interdisciplinary AI+ talents. Based on the characteristics of AI development and the university's AI and AI+ talent cultivation framework, categorized into "general," "core," and "advanced" tiers, Fudan University has developed a high-quality integrated AI-BEST progressive curriculum for both undergraduate and graduate students. This curriculum includes four types of courses: AI general foundation courses, specialized core courses, advanced discipline-specific courses, and applied courses in vertical domains.

During the 2024-2025 academic year, the curriculum plans to offer no fewer than 100 AI-related courses, achieving three 100% penetration goals: full AI course coverage for all undergraduate and postgraduate students, AI+ education coverage for all primary disciplines, and AI literacy requirements for all majors. This comprehensive, multi-tiered curriculum addresses not only the diverse learning needs of students at different stages but also enhances their interdisciplinary skills and fosters innovation in practical applications.

Furthermore, Fudan University is actively exploring new models for AI+ talent development, striving to empower a wide range of industries with AI. The "AI Curriculum" initiative, grounded in the AI-BEST curriculum, will organize course clusters into three flexible AI+ educational pathways: dual bachelor's degrees in "X + AI," joint master's and PhD degrees in "X + AI," and micro-majors in "AI and AI+." These options offer students from different backgrounds diverse and flexible learning paths. This series of innovative measures not only broadens students' academic horizons but also provides opportunities for interdisciplinary learning, enabling them to gain in-depth knowledge of AI technologies and their applications in specific fields while mastering their own disciplinary expertise.

Case Study IV: Peking University's Undergraduate Digital Intelligence Curriculum

Peking University has launched the Implementation Plan for Undergraduate Digital Intelligence Education, aiming to build a multi-tiered and multi-pathway educational system. This plan is designed to foster foundational skills in mathematics and computer science among students, equip them with theoretical methods in AI and data science, and enhance their digital intelligence literacy and innovative practice skills. The plan employs an educational model that integrates foundational, general, and specialized courses to nurture innovative talent equipped for future challenges. Key tasks include establishing specialties in digital intelligence, developing a multi-pathway undergraduate curriculum in this field, enhancing AI education, and monitoring the quality of digital intelligence courses.

Students from various backgrounds can access a comprehensive digital intelligence course cluster thanks to the curriculum's progressive series of courses, which begins with general foundational courses and progresses to specialized core courses in AI or data science. Emphasis is placed on integrating AI content into foundational courses such as computer science to enhance students' digital thinking and AI literacy.

Peking University will further enhance basic education in mathematics and computer science by updating the undergraduate computer science curriculum. This will include AI and other next-generation IT topics in compulsory courses such as "Introduction to Computing B/C" and "Data Structures and Algorithms," thereby improving students' digital intelligence literacy and application skills. Additionally, the course "Problem Solving and Programming" will be transformed into the "AI and Computational Thinking" series. This new series will adopt a problem-oriented approach and connect each course with specific scientific and philosophical issues, enhancing students' ability to use AI in solving discipline-related problems.

Moreover, Peking University is actively developing general courses on AI and data science to foster interdisciplinary thinking and digital intelligence application skills. The "Boya AI Lectures" will invite experts and scholars to share academic insights and the latest advancements in AI, further broadening students' horizons.

Case Study V: The University of Cambridge's Curriculum for MSt in AI Ethics and Society

The University of Cambridge has launched the curriculum for MSt in AI Ethics and Society, aiming to train leaders who can profoundly understand and address the ethical and societal challenges posed by AI. This curriculum covers critical issues such as privacy, surveillance, fairness, equity, algorithmic bias, misinformation, big data, and responsible innovation. Collaboratively developed by the Leverhulme Centre for the Future of Intelligence and the Institute of Continuing Education at the university, the curriculum pools expertise from multiple disciplines, including philosophy, machine learning, computer science, policy, and law. It received the 2022 CogX Award for "Best Course in AI." Key features of the curriculum include its interdisciplinary methodology and its emphasis on ethical considerations, specialized skills, and real-world applications. The courses span technology, philosophy, law, and social sciences, providing students with an extensive and thorough understanding of the subject matter. This equips them to effectively recognize, analyze, and tackle the ethical and societal challenges associated with the rapid progression of AI today. The curriculum encourages students to integrate theoretical knowledge with hands-on experience. Through a combination of face-to-face instruction, case studies, seminars, thesis workshops, and practical exercises, students will gain a deeper understanding of the ethical and societal challenges associated with AI and learn to apply interdisciplinary theories and methods to address these challenges. This educational model aims not only to sharpen their critical thinking but also cultivate their innovation abilities and leadership skills.

Case Study VI: Nanjing University's Curriculum for "1+X+Y" Core General AI Courses

In 2024, Nanjing University introduced the three-tiered "1+X+Y" curriculum to train future leaders with data, computational, and intelligent thinking. This curriculum equips every student at the university to navigate the challenges of the AI era and succeed in their specific domains. The "1" in "1+X+Y" refers to a core general AI course, led by eminent AI scholars such as Prof. Tan Tieniu, a Chinese Academy of Sciences fellow, and Prof. Zhou Zhihua, a European Academy of Sciences fellow. This course adopts a teaching model that integrates collective lectures, small group seminars, internships, and AI teaching assistants, aiming to spark students' interest in AI, impart fundamental concepts, and foster a proper understanding of the AI era. Tailored to diverse majors, the course engages students in discussions on intriguing questions like "How does AI perceive the world?" and "In what ways could AI surpass human capabilities?," thereby prompting them to demystify AI. The "X" represents over 100 interdisciplinary AI literacy courses designed for broader learning. The primary goal is to help lower-year students expand their understanding and perspectives on AI. These courses cover fields such as natural sciences, digital humanities, digital economics, and social sciences. Notable examples include "Learning and Research within an AI Context" at the School of Business, "Programming Driven by AI" at the Software Institute, and "Human Languages and LLMs" at the School of Foreign Studies. The courses aim to meet the advanced requirements of students from various majors and enhance their comprehension of AI's role in their specific areas of interest. Furthermore, the School of Artificial Intelligence offers seven systematic courses focusing on AI application skills, which are accessible to all students at Nanjing University. The "Y" represents advanced courses that integrate AI deeply across various disciplines, primarily targeting upper-year students. These courses follow a "lecture + project" model, allowing students to engage in hands-on activities and deep interaction. Students also have the opportunity to participate in cutting-edge research projects at key laboratories and leading enterprises. The courses aim to enhance students' ability to address complex challenges across disciplines in the forthcoming AI era, while also cultivating their leadership and entrepreneurial spirit.

Case Study VII: Lanzhou University's Micro-Major in Digital Technologies

Lanzhou University's talent development plan for 2023 emphasizes information literacy and data analysis skills. To develop these core competencies in specialized fields, the university has not only incorporated programming, big data, AI, and machine learning courses into the majority of its majors but also introduced a series of micro-majors in digital technologies, such as "Cognitive Science and AI," "Digital Government and Smart City Governance," "Evidence-Based Medicine," "Digital Media Design," "Smart Education Technology," and "Big Data Applications—Digital and Smart Earth." These micro-majors aim to enrich the curriculum and cultivate interdisciplinary talents with innovative abilities. For instance, "Cognitive Science and AI" focuses on the frontiers of cognition and AI to explore new cognitive horizons for students, while "Digital Government and Smart City Governance" develops specialized administrative talent skilled in applying administrative theories and mathematical statistics to meet the needs of modern society. Lanzhou University also prioritizes the practicality and forward-thinking nature of its courses. For example, "Evidence-Based Medicine" provides students with robust skills in finding and assessing medical evidence, as well as comprehensive knowledge of this subject. "Digital Media Design" gives students a holistic platform to master the art of digital media through interdisciplinary instruction and hands-on experience, fostering innovative new-media talent with practical abilities. "Smart Education Technology" integrates industry insights and market analysis with the job requirements of leading AI education firms, allowing students to make good use of smart educational technologies and boost their proficiency in the field. "Big Data Applications—Digital and Smart Earth" focuses on practical skills and innovative thinking, enabling students to proficiently process and analyze big data, comprehend AI applications in Earth sciences, and gain an interdisciplinary understanding of the Earth's complex systems and their interactions with human society.

Case Study VIII: Lingnan University's Curriculum for Bachelor of Arts (Honours) in Cultural Studies (BACS)

The BACS curriculum at Lingnan University in Hong Kong aims to cultivate students' digital skills and critical digital literacy, preparing them to drive innovation in media, culture, and community development. This curriculum has three main characteristics: First, it nurtures socially responsible change makers by blending theory with practice. Students are expected to develop a deep understanding of the intricate dynamics between society and the individual, and address real-world problems through media production, studio learning, and capstone projects. Second, it is skills-focused and flexibly structured around media, culture, and community development. The curriculum features two majors: "Digital Culture and Media Practices" and "Cultural Sharing, Societal Innovation, and Creativity," each designed to meet the evolving needs of diverse industries. Third, it promotes a critical, non-deterministic approach to digital technologies, encouraging students to embrace new technologies while cultivating critical thinking skills to navigate the rapidly changing tech environment. To achieve these objectives, the BACS curriculum includes a series of compulsory courses such as "Culture and the Modern World," "Methods for Cultural Studies," and "Perspectives on Cultural Studies," laying the theoretical and methodological foundation for students. Students may choose one of the two majors, each of which addresses three topics: theory, practice, and policy and management. Specifically, "Digital Culture and Media Practices" focuses on trends in the digital media industry, while "Cultural Sharing, Societal Innovation, and Creativity" focuses on exploring new economic and social relations in the age of digital intelligence. Additionally, courses such as "The Future of Platforms and Open Cooperativism" and "Digital Technologies and Knowledge Sharing" introduce cutting-edge theories and practices related to innovations in the digital society and to cultural industries and culture sharing. Courses like "Reflections on Societal Innovation" and "Social Value and Impact Assessment: A Critical Introduction" help students critically analyze the processes and effects of societal innovation. Courses such as "Food, Technology, and Environment" and "Urban Culture" meld theory with practice, focusing on key topics of culture sharing and innovative societal practices, including urban environments and sustainable development.

3.1.2 Textbook development

Case Study I: Zhejiang University's High-level AI Textbook Series

Zhejiang University has developed a textbook series encompassing popular science, general education, discipline courses, and interdisciplinary studies. This series has now included 25 textbooks on technological theories and 11 on practical applications. It covers a wide range of topics such as foundational theories, algorithmic models, technological systems, hardware chips and ethical standards, and interdisciplinary "AI+" fields and practices, offering students comprehensive and in-depth learning resources. In 2023, a team led by Academician Pan Yunhe took charge of textbook development in the field of next-generation IT (AI). The team has led the creation of 20 textbooks, including *Introduction to Artificial Intelligence*, *Pattern Recognition*, *Machine Learning*, and *Deep Learning*. A range of digital teaching resources, such as instructional videos, case studies, and practical manuals, complement these textbooks, offering diverse learning tools to both faculty and students. The design of these teaching materials incorporates various application scenarios, such as syllabus creation and preview/review assistance. With these intelligent auxiliary services, the focus of education shifts from traditional knowledge-based approaches to competency-based ones, injecting new vitality into educational modernization.

Case Study II: Sun Yat-sen University's Practice-Oriented and

Interdisciplinary AI Textbooks

Sun Yat-sen University actively promotes the "AI+" textbook development. It has established approximately 30 AI-related textbooks spanning engineering, humanities, and medical fields, achieving deep interdisciplinary integration. *AI Principles and Practices*, for example, is a fully digitized textbook that not only provides a systematic exposition of theoretical knowledge but also integrates research practices. Through experimental demonstrations, practical training, and interdisciplinary case studies, these textbooks foster students' innovative thinking and problem-solving skills, embodying an educational philosophy that values both theory and practice while enhancing interdisciplinary integration. To deepen the digital transformation of textbooks in response to the demands of the information age, Sun Yat-sen University encourages faculty members to continue developing intelligent, multidimensional, and visualized digital learning resources. Tools like AI assistants and online interactive platforms will facilitate personalized teaching and improve the efficiency and quality of learning.

Case Study III: Wuhan University's Textbook System for Digital Intelligence Talent Development

Wuhan University has structured its digital intelligence talent development courses into four categories: general education, empowerment, application, and discipline. These categories correspond to four academic levels: senior high, Bachelor's, professional Master's, and PhD programs. The university employs a systematic training approach that includes "classified + graded" module selection, "interdisciplinary + innovative" course setting, and "foundational + scenario-based" teaching methods. To meet the talent development needs of different categories and levels, the digital intelligence courses are divided into three progressively challenging modules— "Data Fundamentals," "Data Intelligence," and "Data Innovation"— providing targeted educational pathways.

Regarding course setting, an "interdisciplinary + innovative" approach is adopted for curricular reform. First, by merging existing courses and upgrading the teaching methods, Wuhan University efficiently optimizes its digital intelligence curriculum. Second, new courses such as "Data Collection," "Data Management," and “Data Visualization” are introduced based on the principles of data science. These courses, previously either unavailable or offered only in a rudimentary form, represent a bold restructuring of the knowledge system.

In terms of teaching, Wuhan University employs a “foundational + scenario-based” approach that combines uniform foundational knowledge instruction with scenario-specific practical training. The university marshals its educational resources to create a comprehensive digital intelligence curriculum that includes 18 courses. Among them, nine are undergraduate courses—three general courses and six interdisciplinary foundational courses—seven courses tailored for professional Master’s programs, and two designed for doctoral studies. By systematically developing its comprehensive talent development system, Wuhan University cultivates digital intelligence expertise across different fields and academic levels.

3.2 Exemplary Platforms

3.2.1 Virtual classroom platforms

Case Study I: Shanghai Jiao Tong University’s CNMOOC Platform

Since its establishment in 2014, the CNMOOC platform of Shanghai Jiao Tong University has amassed 2.05 million registered users and 623 participating institutions, facilitating approximately 740,000 instances of credit recognition, with its influence growing daily. The platform utilizes a teaching model that combines MOOCs (Massive Open Online Courses), SPOCs (Small Private Online Courses), and in-house instructors, supported by a mutual credit recognition system for online courses. It has frequently organized “MOOCs Go West Synchronous Classroom” events, which feature live broadcasts of top-tier courses from the university to the western regions, thus providing valuable educational resources and helping to reduce educational disparities. The adoption of digital human technology in experimental and practical courses enriches instructional methods and enhances students’ hands-on skills and innovation abilities by integrating online theoretical learning with offline practice. This technology not only provides round-the-clock teaching services but also enhances learning outcomes through interactive methods.

Case Study II: Lanzhou University's SPOC Online Teaching Platform

Lanzhou University has developed a campus-wide SPOC online teaching platform using Chaoxing Group's "1 + 3" technology framework. This platform is integrated with the unified "Online Lanzhou University" system, facilitating campus-wide information exchanges and resource sharing. The SPOC platform delivers a teaching and learning environment tailored to each faculty member and student, effectively supporting educational activities before, during, and after class. Emphasizing the creation and sharing of online course resources, Lanzhou University encourages faculty to blend creatively the strengths of traditional and online teaching for various undergraduate courses and beyond. The SPOC platform currently serves over 36,000 students, 2,700 teachers, and 500 administrative staff, supporting activities such as general education, blended learning, course resource development, interactive teaching, and specialized training. It houses an extensive collection of 700,000 teaching resources and a question bank with 1.4 million entries. Additional features include student performance analysis, comprehensive competency assessments, online teacher training, and training certification management, all of which significantly enhance the educational quality and develop students' overall capabilities.

Case Study III: University of Science and Technology of China's Hanhai Teaching Platform

The Hanhai Teaching Platform, developed by the University of Science and Technology of China, is an integrated portal for teaching, recording and broadcasting, and resource sharing, providing comprehensive support for undergraduate education. This platform offers features like courseware creation, material upload, interactions, as well as management of assignments and exams. The recording and broadcasting function allows for automatic live and recorded sessions based on course schedules, while also supporting video editing and voice-to-text transcription.

The resource platform hosts a variety of educational materials, enabling hierarchical categorization and tag-based searching. The Hanhai Teaching Platform integrates classroom lectures and recorded sessions with O2O (Offline to Online) education, interfacing with academic systems, teaching assistant systems, and ClassIn teaching tools. By leveraging AI, big data, and other technologies, the platform ensures a seamless integration of various teaching modes.

To leverage the university's strengths and academic characteristics, the platform has established an online resource system tailored to educational goals and needs while incorporating distinctive teaching elements. By aggregating electronic resources and fostering collaboration among multiple university units, the platform has emerged as an important vehicle for the development and sharing of educational resources.

Case Study IV: The Chinese University of Hong Kong's Self-learning Platform for Blended Learning (BLISS)

BLISS is a collaborative effort between the Chinese University of Hong Kong, Hong Kong Baptist University, and FlippEducatorsHK. It aims to deepen the practical exploration and innovative application of blended learning models. With its exceptional teaching efficiency and flexibility, BLISS has successfully fostered students' self-learning abilities and sparked their interest in exploration.

BLISS provides comprehensive and extensive professional development support for teachers, including diverse training opportunities such as certificate programs and workshops, as well as professional consulting services from educational advisors. By creating a resource-rich platform with self-learning materials across a wide range of disciplines, BLISS not only enriches students' learning options but also provides strong community support for professional exchange among teachers.

Furthermore, BLISS has developed a blended teaching skills development model through systematic literature reviews and qualitative meta-analyses. This model is structured into three tiers: principles, preparations, and strategies. It aims to assist regions, schools, and educator training institutions in planning and designing relevant professional development programs to enhance teachers' blended teaching capabilities.

Highlighting the importance of professional development, BLISS encourages educators to transition from traditional roles as knowledge providers to designers and facilitators of learning activities, aiming to build a learning community among teachers and students. The blended teaching model encompasses pre-class, in-class, and post-class stages, integrating online and offline teaching to facilitate real-time interactions between teachers and students.

Additionally, BLISS stands out for its precise monitoring and feedback on learning progress. Through an electronic badge system, students' learning activities are effectively tracked and incentivized. BLISS also includes note-taking and self-assessment tools that enable students to record key points and self-test throughout the learning process, thereby reinforcing their knowledge more effectively. Additionally, the adjustable video playback speed accommodates different learning paces, showcasing the platform's user-friendly design.

3.2.2 Digital intelligence practice and innovation platforms

Case Study I: Xi'an Jiaotong University's Digital Twin-Based Virtual Teaching Platform for Intelligent Manufacturing

Xi'an Jiaotong University's Mechanical Engineering program has developed a comprehensive intelligent manufacturing practice platform utilizing digital twin technology. This platform integrates a big data analysis system and a CNC cloud system, enabling digital twin planning that mirrors mechanical behavior characteristics. The seamless integration of the physical and digital realms provides robust support for digital intelligence practice-based teaching.

Centered around this core platform, Xi'an Jiaotong University has explored a teaching model that blends real and virtual environments. It has established a collaborative teaching lab based on digital twin technology, a physical platform for intelligent production featuring advanced manufacturing equipment and complex processes, and a virtual workshop that mirrors a real one, achieving data synchronization between the two environments. This innovative model significantly enriches the content and format of practical teaching, allowing students to simulate and refine the behavior of physical entities in a virtual environment, thereby deepening their understanding of complex engineering issues and enhancing their problem-solving abilities.

Furthermore, Xi'an Jiaotong University, with a focus on students' skill development and aligned with industry needs, has designed a range of practical teaching activities based on digital twin technology. Leveraging its digital twin-based experimental platform for intelligent manufacturing, the university has developed a practice-based teaching system that spans the entire product development lifecycle, covering various knowledge areas including intelligent design, manufacturing, measurement, control, operations, and maintenance. The university has created a talent development chain by transforming research achievements into teaching programs, driven by the demands for technological development and engineering verification Additionally, it has implemented a multidimensional teaching model that combines online remote teaching, online virtual simulation, and offline project practice, providing students with a more flexible and comprehensive learning experience that effectively enhances their ability to tackle real-world engineering problems.

Case Study II: Zhejiang University's Next-generation AI-powered Education Platform

In July 2020, the Zhejiang University Institute of Artificial Intelligence launched Zhihai, a next-generation platform for AI-powered educational innovation. One of the platform's core features is its interactive teaching tool, Mo-Tutor, which creatively integrates multimedia resources including text, images, videos, code, and demonstration documents. These resources are further enhanced by functionalities such as video playback, voice explanations, graphic annotations, and code execution, creating an immersive teaching experience. Through QR code links, the multimedia resources are closely connected with the knowledge points of physical teaching materials, achieving a digital upgrade of traditional textbooks and pioneering a new form of digital publishing.

Additionally, Mo-Tutor bridges theory and practice by lowering the barriers to AI development and offering an integrated online training environment. This facilitates the shift from knowledge dissemination to skill cultivation., The Zhihai platform, in collaboration with Higher Education Press, Alibaba, and UniDT, has co-developed the educational LLM, Zhihai-Sanle educational model to address the paradigm shift brought about by generative AI. Zhihai-Sanle provides personalized learning services, such as instant Q&A, exercise generation, and case expansion, leading the way in AI-powered education through the Higher Education Press cloud service platform. Zhihai is committed to the philosophy of "AI-powered education first" and provides a full range of services, from platform building and resource sharing to intelligent model enhancement and hands-on project development. Its provision of educational services is tailored to the diverse educational requirements of learners at all levels, from K-12 to higher education.

Case Study III: Wuhan University's "Six One's" Innovative Experiment-based Teaching Platform

Wuhan University, adhering to the philosophy of "joint construction, shared benefits, interconnectivity, interdisciplinary integration, and open operations," has established the "Six One's" Innovative Experiment-based Teaching Platform to cultivate digital intelligence talent. This platform includes a "standards system" and a "one-stop portal" while consolidating three key resources—data, tools, and computing power—to support talent development, research, innovation, entrepreneurship, and social services. The first component of the "Six One's" is a data set. To meet the data resources needs of digital intelligence talent in eight key fields for internships and practical training, Wuhan University is building a repository of experimental teaching data resources. This repository is characterized by authentic large-scale data tailored to specific disciplines, alongside a metadata catalog for the data set. It provides sustainable cloud services for big data storage, processing, development, and sharing.

The second component is a toolset. Wuhan University is developing a full range of tools and software that covers the entire data lifecycle, from data collection and processing to data management, analysis, and application. The university also leverages global open-source algorithmic resources to build an open, shared collection of algorithms, models, tools, and software, enabling students to engage in hands-on programming training, covering everything from software and tool usage to the development of intelligent computing algorithms and models.

The third component is a computing power pool. Following the principles of "openness, sharing, and scalability," Wuhan University has adopted a parallel heterogeneous computing framework to dynamically scale and flexibly aggregate computing resources to meet the experimental needs of different fields. The university is also developing a dynamic management platform for the allocation of experimental computing resources, enabling task-based and time-scheduled distribution and scheduling of resources, providing flexible computing power support for big data experiments in various fields of digital intelligence.

The fourth component is a set of standards. In line with the principles of "adopting existing standards where applicable, selecting the best where multiple standards exist, and creating new ones where none are available," Wuhan University is establishing a comprehensive standards system that encompasses data collection, storage, processing, quality, governance, control, and services.

The fifth component is a one-stop portal. The portal allows Wuhan University's faculty and students to easily access a wide range of digital intelligence resources, including software tools, computing power storage, data samples, algorithmic models, and application cases. It facilitates various levels of digital intelligence experimental teaching and practical training ranging from undergraduate to doctoral studies and encourages the exchange and sharing of digital intelligence learning resources via an online open community.

The sixth component is a digital intelligence community. Following the "cognition–practice–innovation–entrepreneurship" chain, Wuhan University has adopted the "digital intelligence +" model, anchored by the university's Center of Innovative & Entrepreneurial Practice for Students. Drawing on the disciplinary strengths of various schools, the university promotes interdisciplinary innovation and collaboration with industry. It also supports the establishment of multiple "digital intelligence +" innovation and entrepreneurship sub-centers, providing comprehensive support for faculty and students in innovation, creation, and entrepreneurial practice activities, while fostering a conducive environment for "digital intelligence+" talent development.

Case Study IV: The Chinese University of Hong Kong's uReply SRS

Launched by the Chinese University of Hong Kong, uReply is an online student response system (SRS) specifically designed for mobile devices. This system enhances the interaction between teaching and learning through mobile technology, fostering students' proactive engagement. The highly interactive and participatory learning environment that the system offers promotes the modernization of educational paradigms. uReply has gained widespread recognition across universities in Hong Kong and has evolved into a versatile educational platform through continuous development and expansion. It not only supports self-directed learning but also incorporates gamification and location-based interaction, significantly expanding educational opportunities.

The basic features of uReply include single and multiple question sessions, activities, and assessments, which together create a comprehensive and immersive interactive learning environment. Notably, uReply GO introduces a geolocation-based learning trajectory, linking action points with questions on an online map to enhance the practical and experiential aspects of learning. Meanwhile, uShare facilitates multimedia communication between teachers and students, significantly enriching the forms of interaction and greatly improving the efficiency and clarity of information exchange, making the learning process more engaging and intuitive.

The design of uReply adheres to pedagogical principles, allowing teachers to customize educational activities to fit their teaching goals and to meet the specific needs of their students. Its asynchronous learning feature provides students with a personalized educational experience, while gamified elements like speed challenges and peer reviews not only make learning more engaging but also increase student motivation and participation.

3.2.3 Intelligent educational practice platforms

Case Study I: Sun Yat-sen University's EasyHPC, An AI-Powered Online Supercomputing Practice-Based Education Platform

Sun Yat-sen University, in collaboration with the National Supercomputer Center in Guangzhou and other institutions, has developed a practice-based education platform called EasyHPC. This initiative aims to address the challenges of supercomputing talent development by reconciling mass education with individualized instruction, compensating for the shortage of qualified instructors, and enhancing the intelligence level of practical teaching.

EasyHPC offers three main features. First, it utilizes an AI-driven model for cultivating students' practical skills through a learner-centered big data platform for practice-based education. This platform provides diverse programming environments and model support, along with personalized intelligent guidance to customize training programs using AI technology. Second, EasyHPC utilizes AI to conduct in-depth analyses of students' learning performance and autonomously generate high-performance computing learning content tailored to their skill levels. This feature significantly enhances personalized and self-directed learning by employing content generation technologies based on precise assessments. Third, EasyHPC leverages knowledge graph-driven technologies for educational causal analysis and knowledge reasoning to develop algorithms that enable intelligent decision-making and resource allocation. By integrating these technologies, EasyHPC enhances its ability to analyze educational data, mine associative rules, and make intelligent decisions aligned with the intrinsic properties of educational data and the universal principles of educational resource distribution. Widely used across China's 31 provinces and municipalities, as well as in Hong Kong, Macao, Taiwan, and BRI countries, EasyHPC has served over 20,000 users and amassed more than 37 million visits. With its extensive application and influence, EasyHPC has not only enhanced the practical instruction of over 100 high-performance computing courses but also fostered cross-regional and cross-cultural sharing of educational resources.

Case Study II: Fudan University's "Meta-Innovation Center - An Interdisciplinary Innovation Practice Platform"

The Meta-Innovation Center enhances the information and intelligence capabilities, big data visualization, and electro-optical-mechanical integration of Fudan University's laboratory buildings. Focusing on in-depth integration of fields like machine vision, digital arts, and psychological and behavioral sciences, it provides students with a cutting-edge hands-on environment. The Center features several thematic labs, each dedicated to specific areas including AI, VR/AR applications, digital arts, LIDAR, machine vision, and biomimetic design. Supported by public services such as CNC machining and 3D printing, these labs have created a comprehensive, multi-tiered ecosystem for innovative practice, promoting the blending of disciplines and diversifying skill sets.

The Fudanverse is Fudan University's teaching metaverse that incorporates advanced AI technology within a multiplayer immersive virtual simulation platform. This self-developed 3D virtual space offers high-fidelity, real-time simulations of various devices and the underlying physics algorithms for experiments, successfully addressing safety challenges like accidental radiation exposure and equipment damage. Utilizing WAN multi-client synchronization technology, the Fudanverse supports simultaneous online interaction for over 100 participants. It is also compatible with various devices, greatly enhancing accessibility to immersive learning. In its virtual labs, students enjoy extensive experimental freedom under the remote guidance of teachers and can even simulate the consequences of operational errors. This boundaryless educational model significantly broadens the temporal and spatial limits of education, opening new avenues for exploring the correlation between teaching outcomes and methodologies.

Case Study III: Peking University's "Huaxiaobei" AI-powered Learning Platform

"Huaxiaobei" is an AI-powered chemical experiment learning platform co-developed by the College of Chemistry and Molecular Engineering, the Center for Excellent Teaching and Learning, and the School of Electronics Engineering and Computer Science at Peking University. Centered on chemistry as a foundational science, the platform features three core functions: knowledge Q&A, feedback reporting, and proposal assessment. These features create a 24/7 intelligent learning environment for students. The platform not only expands the scope of experimental teaching but also provides personalized learning support, offering tailored learning experiences, intelligent services, and precise management.

Built on an advanced large language model (LLM) and trained on high-quality, domain-specific data in the field of chemistry, the platform significantly boosts model accuracy and practicality. It employs a heuristic questioning mechanism that instantly responds to students' questions on a wide range of topics, including experimental principles, operational procedures, and chemical safety. The platform also generates and assesses students' assignments based on the breadth and depth of their inquiries, fostering proactive learning and critical thinking.

Moreover, the platform offers intelligent evaluation of academic papers and experimental proposals, providing specialized feedback and optimization suggestions, thereby enriching teaching strategies and improving overall teaching quality. By leveraging knowledge graph and experimental skills graph technologies, it integrates dispersed knowledge and skills into a systematic, intelligent educational support system.

Through the analysis of students' behavior data, the platform generates personalized learning profiles and learning analytics reports, helping instructors accurately identify each student's educational needs and potential shortcomings. This data-driven foundation facilitates the implementation of tailored instructional designs. Additionally, the platform dynamically adapts experimental content and teaching difficulty based on students' progress and proficiency levels, ensuring that each student develops at their own pace, thus enabling individualized instruction.

Case Study IV: The University of Hong Kong's E-learning Platform

The University of Hong Kong has launched a cutting-edge digital platform called e-learning, which has significantly enhanced the efficiency of educational resource utilization and the quality of learning process management. Furthermore, this platform has made breakthroughs in fostering autonomous learning and critical thinking abilities. A highlight of the e-learning platform is the integration of chatbots. This intelligent tool provides round-the-clock, real-time text support to effectively answer student inquiries regarding course content. Chatbots have notably increased the speed at which students receive feedback, with their 24/7 availability earning widespread recognition. The introduction of chatbots exemplifies the application of educational technology in personalized learning support. Additionally, e-learning incorporates advanced language models like ChatGPT to enhance the process of teaching, learning, and assessment. However, these tools present their own challenges. For example, educators may find it difficult to identify AI-generated content. Tools like GPTZero, OpenAI Text Classifier, and Writer AI Content Detector enhance authorship verification by assessing textual complexity and stylistic shifts. Meanwhile, computational linguistics tools such as Coh-Metrix enable educators to compare the writing styles across student submissions, ensuring fairness in assessments.

To address the potential impacts of AI tools, the University of Hong Kong encourages faculty members to design assignments that promote students' deep thinking and creative writing. This includes requiring students to submit drafts or writing plans for comparison with final submissions, recording the writing process via screen sharing, and reflecting on the process to assess students' metacognitive abilities. Teachers can also create assessment questions that examine skills such as inductive and multi-step reasoning, which AI tools often struggle to replicate accurately. In situations where students are permitted to use tools like ChatGPT, teachers may ask them to engage in reflective writing, explore the differences between human and AI-assisted learning, share personal experiences with accelerated learning through AI, and offer advice on enhancing AI-supported educational processes. Such activities not only deepen students' comprehension of AI tools but also reinforce their awareness of academic integrity and ethical use.

Case Study V: American University of Sharjah's AI Hub - An Intelligent Education Platform

The Center for Innovation in Teaching and Learning at American University of Sharjah introduced the AI Hub in April 2024. This platform operates with three main goals: First, to enhance education excellence by incorporating AI-driven methods and tools that personalize and improve the quality of learning experiences. Second, to foster a spirit of innovation by serving as a catalyst for collaboration among educators, students, and researchers, thereby broadening the possibilities of teaching and learning. Third, to build a community centered around the AI Hub, which comprises a network of forward-looking individuals passionate about exploring AI's potential. This community encourages learning and growth through discussion forums, workshops, and collaborative projects.

AI Week, an integral part of the AI Hub, focuses on the transformative power of AI in education through keynote speeches, panel discussions, and workshops. Panel members explore the challenges of generative AI in higher education and strategies for effectively integrating AI into academic settings. Workshops offer participants opportunities to explore AI applications, ranging from generative AI tools for researchers to interactive sessions with AI professors, equipping them with practical skills and deep insights into AI's transformative potential in education.

A highlight of AI Week is the AI Exhibition, showcasing cutting-edge technologies and solutions from leading organizations such as Casio, Urbi, Al Hathboor Bikal.ai, +twe, Saal.ai, Klickdata, and almalearning.ai. These exhibits not only represent the latest advancements in AI technology but also facilitate interactions with industry experts, deepening participants' understanding of AI applications in the educational sector. Through the AI Hub, the American University of Sharjah is pioneering a new educational paradigm that adapts to the rapidly changing technological landscape while stimulating and cultivating students' innovation capabilities and critical thinking skills.

Case Study VI: University of Michigan's MAIZEY - An AI Teaching Assistant

The University of Michigan has launched an AI teaching assistant called MAIZEY. Leveraging advanced large language model (LLM) technology, MAIZEY converts complex course materials into well-structured knowledge frameworks, greatly enhancing students' independent learning abilities. Developed from a deep understanding of course syllabi, MAIZEY integrates seamlessly with learning management systems like Canvas and utilizes a full range of digital course components, including lecture slides and audio recordings. Using a custom Langchain model , MAIZEY efficiently transcribes and catalogs these resources, ensuring pertinent and prompt responses to student queries.

Additionally, MAIZEY offers rapid, personalized feedback, functioning like a teaching assistant with impeccable memory. It skillfully navigates course archives to present the most relevant materials in a clear, easily understandable language. MAIZEY has attracted daily engagement from over 40% of students and has significantly improved their academic performance, with an average increase of 5% in student grades since its adoption.

The success of MAIZEY can be attributed to its highly customizable features, which empower educators to guide AI-assisted teaching in diverse contexts, along with its cost-effective scalability that expands access to a broader student base. Providing 24/7 timely feedback, MAIZEY greatly enhances student engagement and interaction. Its advanced indexing and personalized settings ensure a tailored learning experience. Furthermore, MAIZEY's ability to handle multiple file formats enhances its versatility, making it an invaluable asset for students and an effective tool for educators. To sum up, MAIZEY enhances both the quality and the efficiency of educational processes.

Case Study VII: Wuhan University's Luojia Online AI Intelligent Teaching Center

Adhering to the overall policy of "top-level design, comprehensive planning, categorized training, and steady advancement," Wuhan University focuses on profoundly integrating AI technology to promote educational paradigm shifts and nurture future-oriented talent. It aims to establish a new ecosystem of digital intelligence education that seamlessly merges teaching applications, educational data, and campus services. To achieve this, the university has launched the "Luojia Online AI Intelligent Teaching Center," a distinctive brand that encompasses the entire student training life cycle and acts as a key driver for the transformation and upgrading of academic programs.

The Center features an integrated management system that fully leverages existing research outcomes in AI teaching and educational management. Building on advanced technologies such as IoT, big data, cloud computing, and microservices, the Center aims to deliver multi-dimensional services across classroom, mobile, and administrative platforms, blending both physical and virtual realms. The Center actively promotes intelligent-assisted learning, teaching, and administration, constructing a comprehensive intelligent ecosystem.

Wuhan University, with the support of the Center, has developed a specialized knowledge graph system, created AI teaching agents, and built a big data middle office for education. Unlike conventional systems of its kind, the specialized knowledge graph system integrates the knowledge structure with problem-based learning (PBL) and outcome-based education (OBE). This approach moves beyond traditional knowledge delivery, focusing instead on achieving teaching and capability objectives. Such a transition, supported by a comprehensive, multi-dimensional evaluation system that develops diverse profiles, helps complete the university's digital transformation loop.

AI teaching agents cover various aspects, including "computational intelligence + education," "perceptual intelligence + education," and "cognitive intelligence + education." The applications of AI teaching agents for online classes, personalized learning pathway design, intelligent tutoring, and adaptive learning systems allow Wuhan University to smartly manage a broad spectrum of educational resources. Through intelligent content generation and personalized recommendations, the university is able to provide teachers and students with richer, more targeted educational resources.

The big data middle office integrates teaching data across the university, enabling unified data management, analysis, and application. This integration also improves resource allocation, boosts teaching quality, fosters educational innovation, and promotes scientific decision-making. In short, the Center enhances the efficiency of both teaching and educational management and fully exploits the value of data. It provides more personalized and efficient educational support for teachers and students, ultimately fostering ongoing innovations in teaching models.

Case Study VIII: Lingnan University's IDEAL-Gen.AI - An AI Platform for Teaching Design and Proactive Learning

The IICA-TDLE Project, funded by the University Grants Committee of Hong Kong SAR, is an inter-university collaboration led by Lingnan University, in partnership with several UGC-funded institutions, including the Hong Kong University of Science and Technology, the Chinese University of Hong Kong, and the Hong Kong Polytechnic University. The project aims to promote the widespread adoption of virtual and blended teaching and learning by developing the IDEAL-Gen.AI teaching design platform, which integrates AI technology to provide educators with a robust toolkit. By leveraging generative AI and large language models (LLMs), IDEAL-Gen.AI enables instructional designers to effortlessly create highly customized educational materials, thereby enhancing teaching efficiency and enriching the learning experience. The launch of IDEAL-Gen.AI marks a breakthrough in instructional design and content creation. Its core advantage lies in its unique automated instructional design feature, which can rapidly generate personalized learning activities, lesson plans, and assessment tasks based on the specific needs of educators. Compared to traditional manual instructional design methods, IDEAL-Gen.AI significantly reduces the time and effort required for content creation, enabling educators to focus more on improving teaching quality. The platform also features an automatic prompt generator that users can customize by applying filters for subject, learning domain, and academic level. IDEAL-Gen.AI is freely accessible to educators worldwide, reducing barriers to access and reflecting the project team's dedication to making advanced educational technologies widely available. The platform is set to expand its functionalities and services to meet the diverse needs of educators. Plans are underway to introduce more templates and filters for AI-driven grading rubrics, exam questions, and assessment criteria, further streamlining the evaluation process. Additionally, the platform is dedicated to building a community of educators to encourage collaboration and the shared use of AI in instructional design.

3.3 Case Studies for Teaching Assistants

3.3.1 AI-empowered instruction in specialized courses

Case Study I: Southeast University's AI-powered Exploration of Instruction in the "University Physics" Course

The School of Physics at Southeast University has developed an AI-powered teaching assistant system for the "University Physics" course. This system significantly enhances instructional quality and efficiency by processing vast amounts of data to automatically refine course materials and provide personalized learning recommendations. It also helps teachers accurately identify students' learning challenges through real-time assessments and feedback, offering robust support for individualized guidance. Moreover, this intelligent teaching tool fosters students' independent learning skills and equips teachers with data-driven insights to adjust their instructional strategies, enabling the visualized management of the educational process.

Case Study II: Peking University's AI-powered BB Enhancing the Development Mathematics Program

Peking University's AI teaching assistant "Brainiac Buddy" (BB) has been successfully applied to multiple courses at the School of Mathematical Sciences, including "Mathematical Methods in Image Processing," since the fall semester of 2023. Leveraging generative language models and the retrieval-augmented generation technology framework, BB not only accurately addresses student inquiries by providing extensive course materials and references, but also constructs personalized knowledge bases to assist students in in-depth preparation and review. BB's heuristic Q&A feature fosters independent thinking by using counterquestions to stimulate inquiry and creativity, effectively promoting active learning. For teachers, BB is also a powerful tool, aiding in the development of lesson plans and the design of test banks.

3.3.2 Innovative interdisciplinary applications of AI

Case Study I: Zhejiang University's "Zhihai Series" LLMs for AI-powered Courses in Vertical Domains

Zhejiang University established a research consortium in August 2023, focusing on foundation models for "AI+X" disciplines in vertical domains. The university has since officially released the "Zhihai series" of large language models (LLMs), including "Sanle" for AI education, "Luwen" for judicial affairs, "Jinpan" for finance, and "Dayu" for intelligent accounting. Additionally, studies have commenced on LLMs such as "Dunhuang" for Dunhuang studies, "Kaiwu" for intelligent design, "Zhixing" for LLM collaboration, "Zhiguang" for spatiotemporal data, "Wuhua" for drug synthesis, "Fuxi-Wanxiang" for geographical science, and "Zhuzhao" for film and TV production. These models offer a range of services, including intelligent Q&A, test generation, learning navigation, and teaching assessment, creating a digital and intelligent platform for a more personalized and smarter learning experience. So far, the Zhihai-Sanle model has served over 530 students across 14 universities, including Zhejiang University, Tongji University, Harbin Institute of Technology, Wuhan University, Jilin University, Liaoning University, Dalian University of Technology, Huazhong University of Science and

Technology, and Beijing Normal University. It has delivered tens of thousands of high-quality responses, concept analyses, and personalized recommendations, significantly enhancing learning efficiency.

Case Study II: University of Michigan's "AI in Medicine"

The University of Michigan Medical School integrates AI technology into medical education. It has established an interdisciplinary team of experts from various fields, including scholars in clinical practice, IT, and educational assessment. Their goal is to embed AI into teaching, learning, and evaluation processes by jointly planning and implementing a series of innovative pilot projects, thus clarifying AI's multiple roles in medical education and assessment. Committed to Diversity, Equity, Inclusion, and Justice (DEIJ), the initiative ensures ethical and equitable AI usage in education. A key objective is to pinpoint gaps in AI knowledge and skills among medical students and teachers. A comprehensive evaluation of the existing educational framework is essential to identify areas where AI skills development can be enhanced. Following this evaluation, the initiative seeks to establish a regulatory body that will guide and oversee the incorporation and use of AI in medical education.

In addition, the initiative has created a robust suite of resources and a versatile platform for sharing AI usage guidelines, best practices, and teaching materials, thereby ensuring effective and ethical AI applications in academic settings. It has also developed a series of educational programs that incorporate AI to improve teaching and learning models. For example, smart flashcards utilize AI algorithms to tailor learning materials and review schedules to individual students, enhancing their learning efficiency and retention. Meanwhile, generative modules allow students to interact with AI to explore different solutions, thereby extending the breadth and depth of learning. As the interdisciplinary team keeps refining their theoretical and practical approaches, the initiative is able to keep pace with the fast-evolving AI landscape. Through the strategic implementation of AI, the University of Michigan Medical School has not only established itself as a leader in innovative medical education but also prepared future healthcare professionals to thrive in a digitized and data-centric world.

Case Study III: University of Cambridge's AI-powered Accelerate Programme for Scientific Discovery

The Department of Computer Science and Technology at the University of Cambridge has launched the Accelerate Programme for Scientific Discovery, which deeply integrates AI with traditional research through a series of interdisciplinary initiatives, including the intelligent analysis of complex systems, the creation of the Human Developmental Cell Atlas, the use of data science to understand mental health, the study of complex geometry in string theory, the establishment of digital twin models for personalized treatment recommendations, and the exploration of LLM applications in interdisciplinary research. These initiatives not only push the boundaries of science but also equip a generation of researchers with AI-centric thinking. More importantly, the program highlights digital intelligence education as an effective tool for future-focused collaboration in specialized development. Through study groups, online modules, and workshops, the program promotes knowledge sharing, skills enhancement, and the establishment of a global research collaboration network.

The success of the program heralds the following trends in digital intelligence education. First, interdisciplinary knowledge integration and innovation: AI will bridge disciplines and spawn new research fields. Second, enhancement of practical application skills: AI will empower young researchers to lead scientific and societal advancement. Third, expansion of collaboration opportunities: The increased international academic cooperation and exchanges will foster a global research ecosystem.

3.4 Case Studies for Evaluation

3.4.1 Monitoring and evaluation of teaching quality

Case Study I: Xi'an Jiaotong University's Digital Intelligence Platform for Real-time Monitoring of Teaching Quality

Xi'an Jiaotong University has established a digital intelligence platform for real-time monitoring of teaching quality. This platform introduces a new management mechanism based on the "Four-Precision Model," focusing on precise data collection, accurate classroom evaluations, rigorous instructor supervision, and tailored student support, infusing digital dynamics into faculty development and teaching enhancement.

First, by integrating IoT and cloud computing, the platform aggregates real-time data from multiple sources, covering in-class activities, extracurricular events, and student life. This effectively addresses the challenges of precise data collection.

Second, leveraging expert knowledge and data-driven insights, the platform has developed a "Teaching Evaluation Assistant," which provides categorized and multi-dimensional evaluations based on different course types and evaluators, significantly improving the accuracy and efficiency of assessments.

Third, to further strengthen the faculty, Xi'an Jiaotong University has created a problem-driven mechanism for rigorous instructor supervision. This system operates at three levels—university, school, and department—utilizing strategies such as collaborative supervision, warning interviews, progressive training, and expert consultations to guide teachers effectively and address the precision of supervision.

Fourth, since 2011, the "Teaching Evaluation Assistant" system has been providing students with personalized academic tutoring, psychological counseling, financial aid, and career guidance.

Overall, these series of innovative measures have achieved precise data collection, accurate classroom evaluations, rigorous instructor supervision, and personalized student support, continuously enhancing educational quality. This has led to the formation of a new educational management mechanism based on the Four Precision Model, fostering a culture of mutual respect in the classroom and improving the teaching quality and efficiency.

Case Study II: Shanghai Jiao Tong University's Platforms for Online Teaching Supervision and Educational Data Analysis and Visualization

Shanghai Jiao Tong University has developed a university-school collaborative platform for online teaching supervision and a "dynamic, comprehensive, and intelligent" platform for educational data analysis and visualization. In 2021, the university launched a new model of online teaching supervision, aiming to enhance the efficiency and fairness of educational evaluations. Central to this model are the supervision committees at both the university and school levels, which replace the traditional "drop-in observation classroom" approach with an online approach that covers over 500 classrooms across the campus. The platform's intuitive map interface allows supervisors to quickly locate the target classrooms and conduct real-time online observations, along with the ability to replay classes afterward. It provides multiple perspectives—including the teacher's presentation, the students' environment, and displays of instructional content—enabling supervisors to submit detailed, and objective feedback online. In 2023, the platform was enhanced with a mobile observation feature, significantly broadening the scope and the flexibility of supervisory activities. Since its official launch in September, the platform has overseen thousands of classes, accumulating valuable insights and becoming a key driving force behind educational reform. Additionally, Shanghai Jiao Tong University has developed a platform for educational data analysis and visualization, aiming at driving instructional innovation through data and enhancing teaching quality. This platform focuses on three dimensions: teachers, students, and educational management. It utilizes advanced data mining technologies to provide precise data support for all stakeholders. For educators, the platform offers detailed teaching reports that cover a range of aspects such as student assignments, classroom discussions, quizzes, and attendance, helping them understand students' progress in real time and adjust teaching strategies accordingly. For students, the platform presents personalized learning reports, including students' progress tracking, rankings, and teachers' comments. It also sends timely reminders about assignment deadlines through the Jiaowoban App, promoting independent learning and self-management. For educational managers, the platform's decision-making analysis reports encompass key indicators of university-wide teaching activities, such as platform traffic, resource utilization, and attendance rates, aiding in the enhancement of teaching strategies and management effectiveness.

Case Study III: University of Science and Technology of China's Smart Education Analysis System

The University of Science and Technology of China has developed a smart education analysis system capable of quantifying various aspects of classroom behavior and extracting comprehensive data on teaching and learning. Built on this system, the university has established a smart evaluation framework that provides robust support for ongoing improvements in teaching quality and educational management. The system efficiently captures classroom video signals and extracts information on classroom behavior by connecting with both the teaching data center and classroom video equipment. It employs technologies such as multi-view skeleton action recognition, multi-camera sensing, and intelligent data anonymization to convert behavioral observations into measurable data. The system then applies learning models and filtering adjustments to create specific metrics for intelligent analysis of classroom dynamics. Additionally, it can issue alerts regarding anomalies in educational processes, such as attendance issues, varying levels of engagement, and teacher-related concerns including tardiness, absences, and early departures. Timely detection and handling of such concerns promote refined educational management and scientific decision-making. Ultimately, the system presents educational data on a dashboard and generates analytical reports for individual schools and the entire university, providing visual data support for educational administrators to enhance educational strategies and improve the overall teaching quality.

Case Study IV: Wuhan University's "AI+" Major Framework

Guided by the concept of digital intelligence education, Wuhan University has developed and launched an "AI+" Major Framework. By establishing a framework featuring "six levels, five core focuses, four profiles, three maps, two achievements, and one center," the university effectively integrates teaching, learning, management, and evaluation to objectively, scientifically, and intelligently assess the development of digital intelligence talent. The "AI+" Major Framework uses advanced technologies for natural language processing and knowledge extraction to addresses issues such as the lack of visualization for specialized knowledge, insufficient standardization in course assessments, and cumbersome achievement calculations.

The creation of a "six-level" system fosters a dynamic management ecosystem for digital intelligence majors, enhancing precision and responsiveness in their monitoring and development. Through the effective integration of extensive data from the “five core focuses,” the university has established a system that delivers accurate and timely evaluations and feedback, facilitating prompt adjustments in teaching strategies and the innovation of learning models. By employing AI technology, the university has explored personalized, adaptive, and exploratory learning pathways, with the “four profiles” serving as the foundation for course design and evaluation. Comprehensive evaluations are achieved through the development of knowledge, competency, and quality maps, alongside the introduction of an evaluation system for courses and major achievements, thereby enhancing the scientific and intelligent nature of the evaluation process. Furthermore, an overarching strategic framework has been established to synchronize efforts across the university, culminating in the launch of the Luojia Online AI Intelligent Teaching Center. This center integrates apps, mini-programs, and PC interfaces to deliver an end-to-end, one-stop solution.

Case Study V: Sun Yat-sen University’s AI-powered Classroom Teaching Evaluation Reform System

Sun Yat-sen University has established an AI-powered classroom teaching evaluation platform to comprehensively enhance the digital literacy of educators. Supported by technologies like image recognition, speech analysis, and text recognition, this platform aggregates real-time data from multimedia lesson plans, recorded teacher-student interactions, and blackboard writings. It employs digital tools to provide immediate feedback on educational dynamics to educators and administrators, enabling them to promptly identify shortcomings in teaching and enhance oversight of classroom activities. The platform is characterized by its innovative approach to evaluating the overall educational process. Moving away from traditional random classroom inspections, it utilizes a data-driven evaluation model that focuses on classroom indicators and tracks anomalies in overall AI scores against established benchmarks. By incorporating this tracking process into supervisory tasks, the platform has significantly boosted the accuracy, diversity, and objectivity of assessments.

Furthermore, the platform archives extensive records of classroom activities, analyzing multimodal (e.g. affective, behavioral, and cognitive) data collected during educational interactions to monitor aspects like student attentiveness, engagement, and teaching style. This analysis provides educators with detailed feedback, fostering a deeper understanding of learning and teaching conditions and empowering them to adjust their strategies and enhance their skills. Consequently, the platform has established a data-driven positive feedback mechanism that encompasses comprehensive evaluation, rigorous supervision, diversified support, and collaborative improvement.

3.4.2 Teachers' professional development in the context of digital intelligence education

Case Study I: Peking University's International Program on the Teaching and Learning Training for Fostering Digital Intelligence Literacy

Peking University has organized a series of salons and seminars themed around "Educational Transformation and Strategies in the Context of Generative AI." These events not only bring together front-line teachers from various disciplines across the university but also invite industry experts and academic leaders to explore the latest AI applications in teaching, along with the challenges and opportunities they present. By staying updated with global trends, building consensus among educators, and engaging in innovative practices, these seminars have deepened teachers' understanding of how to incorporate emerging technologies into their classrooms and enhanced their practical application skills.

Furthermore, Peking University regularly collaborates with leading global universities such as the University of Cambridge and the University of Michigan to host the annual "Digital Intelligence Literacy" international symposium. These conferences focus on exploring the deep integration of AI in teaching practices, promoting the digital intelligence transformation of research paradigms, advancing digital intelligence education models, and fostering an international community for academic exchange. Particularly since 2020, Peking University has engaged in a four-year intensive collaboration with the University of Michigan, hosting annual training sessions themed "Innovation and Evidence-Based Teaching," "The

New Era and Engineering Education," "AI and the Professional Development of University Teachers," and "Generative Artificial Intelligence." Through these collaborations and AI-focused training, Peking University consistently equips its faculty members with global perspectives and insights into the latest technological trends.

Case Study II: Digital Transformation of Fudan University's Higher Education Quality Assurance System

Fudan University is actively exploring new pathways for the digital transformation of its quality assurance system, establishing a data-driven, holistic, and multi-dimensional framework for higher education quality assurance, thereby facilitating a transition to data-centric management of undergraduate programs. This system integrates various data sources, including student evaluations of teachers, feedback from teaching supervisors, classroom observations, student-led technological innovations, and teaching operational data, to create precise profiles for undergraduate education. It focuses on five core objectives: enhancing teacher performance, strengthening teacher training, improving course quality, boosting student success, and refining educational management. By conducting in-depth analyses of educational quality across various schools and departments, the system identifies strengths and weaknesses, enabling targeted strategies to enhance the overall quality of undergraduate education.

Furthermore, Fudan University prioritizes the development of personalized teaching profiles. Leveraging AI technology, it analyzes student feedback on teaching to uncover their learning needs and provide educators with tailored recommendations to enhance teaching methods and effectiveness. Building on this, the university has implemented a closed-loop "teaching-evaluation-support" system that customizes professional development plans for educators based on collected data and assigns mentors for personalized guidance, fostering their professional growth.

Additionally, Fudan University's smart teaching resource platform integrates live-streaming, online education, and teaching evaluations into a single, user-friendly portal. This platform meets students' demands for open and accessible learning while accelerating the distribution and utilization of high-quality teaching resources.

Case Study III: The Chinese University of Hong Kong's Online Course on the "Integration and Application of Technologies in Higher Education"

The Chinese University of Hong Kong's course on the "Integration and Application of Technologies in Higher Education" provides new teachers, including teaching assistants and Ph.D students, with a platform for gaining an in-depth understanding of online teaching. Offered through the KEEPMoodle platform to global educators, the course consists of nine modules that systematically introduce the theoretical foundations and practical applications of e-learning. Covering synchronous online instruction, multimedia content creation, strategies to stimulate student engagement, catering to special educational needs, and the utilization of online assessments, the course comprehensively deepens teachers' understanding of online education and enhances their ability to implement technology-enhanced strategies. As an exemplar of digital teaching, the course offers advanced insights into the design of online programs and equips teachers with essential skills for technology integration. This enables them to incorporate gamified learning, learning analytics, AI, machine learning, and other cutting-edge technologies to enhance classroom interaction and improve learning outcomes.

Case Study IV: Harvard University's Seminar on Teaching with Generative AI

Harvard University is actively transforming its teaching methods by incorporating a range of emerging technologies, including generative AI, virtual presentation platforms, online collaboration tools, and micro-scale machine learning. These technologies not only enhance teaching efficiency but also provide a variety of personalized learning experiences. For instance, generative AI enables educators to focus on curriculum design, while virtual presentation platforms improve students' public speaking skills. Online teaching platforms allow students worldwide to participate flexibly. Technological tools in STEM education, such as data visualization and online experimental platforms, enhance students' understanding of complex concepts and their practical skills. Additionally, user-friendly design initiatives leverage technology to tackle global challenges, flipped classrooms promote proactive learning among students, and innovations in acoustical engineering boost their understanding in the field.

Overall, these technologies not only boost engagement and broaden academic outreach but also enrich learning outcomes at Harvard. The Derek Bok Center for Teaching and Learning has held a seminar titled "Teaching with Generative AI," indicating the ongoing integration of generative AI into Harvard's educational system. Technologies like AI-powered education tools could not only transform teaching methods by helping create instructional content and personalized materials, but also grant students easy access to learning resources and support. Dr. Stephanie Gil, an assistant professor of Computer Science, offers a course on "Planning and Learning Methods in AI," which reshapes students' understanding of AI through new technologies. Generative AI enables teachers to devote more time to instructional design and interaction, while students gain personalized learning experiences through AI-generated tools. The course educates students in applying modern AI technologies to develop and implement solutions to complex problems, thus enhancing their expertise and practical skills in the field of AI. An article featured by the Derek Bok Center, titled "Behind the Visuals of Harvard Horizons," discusses the utilization of virtual presentation technology to turn the dissertation research of Ph.D students into five-minute presentations for a public audience. This technology utilizes digital tools to bolster students' speaking and visual presentation skills, making intricate academic content more accessible to a general audience. It not only enhances students' ability to present their research effectively in real-world contexts but also promotes interdisciplinary communication and academic outreach. The Derek Bok Center is providing office hours and tutoring services online for faculty, students, and educational researchers, demonstrating the application of online collaboration tools at Harvard. These tools flexibly accommodate various time zones and remote work scenarios, allowing students and teachers to participate in learning and discussions from any location at any time. Thanks to the online collaboration technology, Harvard has maintained its leadership in a globalized educational environment.

The Derek Bok Center has also held a seminar titled "Foundations of Teaching in STEM," exploring innovative educational tools in science, technology, engineering, and mathematics. These tools may include online experimental platforms, data visualization tools, and automated assessment systems. Introducing new technologies in STEM not only enhances the efficacy of teaching but also helps students better understand complex concepts and develop hands-on abilities. The Derek Bok Center highlights the importance of engaging audiences in "professional stories" during academic presentations, which potentially involves adopting technological approaches such as online surveys, real-time feedback, and multimedia to increase classroom interaction. These approaches invigorate the classroom experience, increasing student engagement while improving learning outcomes.

3.5 Case Studies of Collaborations

3.5.1 Mechanisms for inter-university collaboration and resource sharing

Case Study I: Zhejiang University's "AI+X" Micro-majors - A Collaboration with Other Five Top Universities in East China

In January 2021, Zhejiang University, in collaboration with Fudan University, the University of Science and Technology of China, Shanghai Jiao Tong University, Nanjing University, and Tongji University, jointly launched the "AI+X" micro-major program, an innovative initiative for cultivating interdisciplinary AI talent (hereinafter referred to as the "AI+X" micro-major program). This program, the first of its kind in China, established a pioneering micro-major educational model that facilitates inter-university course co-development and selection, mutual recognition of credits, and jointly signed certificates with mutual recognition. By breaking down barriers between universities, schools, departments, and disciplines, and integrating the efforts of government, academia, and industry, the program brings together top scholars and industry experts to deliver courses that foster innovative teaching and management across institutions, colleges, disciplines, and majors, allowing students from various interdisciplinary fields to learn more flexibly and efficiently, understand the foundational knowledge of AI, master core AI theories, and enhance their practical AI application skills. Under the coordination of the Teaching Collaboration Center for the Five Universities in East China, the "AI+X" micro-major program is open to students from the aforementioned universities. It aims to expand further, eventually opening to additional universities, industries, and the wider public. The implementation of the "AI+X" micro-major program has innovatively built a new model of integrating scientific research and education with industry collaboration, fostering talent cultivation, interdisciplinary studies, and the development of an AI ecosystem. It strengthens the connection between the education, talent, industry, and innovation chains, promoting high-quality, high-level micro-major courses and facilitating deeper collaboration in higher education across the Yangtze River Delta region.

Case Study II: Sun Yat-sen University's Initiative of Advancing AI-powered Teaching and Research in Western China Through Multi-University Collaboration

Sun Yat-sen University has established an online-to-offline (O2O) collaboration and exchange platform through its Virtual Teaching and Research Office for Medical Statistics, enhancing the joint development and sharing of educational resources across regions and universities. In collaboration with Kashi University and Guilin Medical University, Sun Yat-sen University is jointly exploring a new teaching model for the "Medical Statistics" course that integrates both online and offline synchronous classroom environments. Leveraging Sun Yat-sen University's Synchronous Classroom Platform, the three universities have successfully conducted 16 cross-regional synchronous classes, fostering a community that promotes mutual learning and resource sharing among educators.

Focusing on individualized teaching and intelligent learning, Sun Yat-sen University has introduced AI technology via Smart Education of China to perform in-depth analyses of data related to classroom norms, faculty engagement, and student-teacher interactions. Based on these analyses, intelligent post-class reports are generated to provide feedback that helps refine teaching strategies. The creation of learning behavior profiles enables teachers to accurately assess learning outcomes and tailor educational experiences to meet the needs of diverse students and academic environments.

Furthermore, the intelligent knowledge graphs not only facilitate personalized learning paths but also provide educators with insights for reflection and continuous improvement in their teaching strategies.

3.5.2 Mechanisms for international collaboration in course development

Case Study I: Shanghai Jiao Tong University's Jiao · Tong Global Virtual Classroom

In 2021, Shanghai Jiao Tong University launched the Jiao · Tong Global Virtual Classroom initiative, aiming to establish an online platform that transcends geographical boundaries through the co-development and sharing of course resources with high-level strategic partner universities worldwide. To ensure an immersive learning experience, the initiative was designed at the technical level, where video conferencing software systems were employed to achieve a seamless integration of online and offline environments. This setup allows teachers and remote students to interact as if they were in the same classroom. On-site participants can clearly see remote inquirers displayed on the screen, fostering a cohesive presence that greatly enhances intellectual and cultural exchanges across borders. By the spring semester of 2024, the "course co-development" segment of the initiative had launched over 160 all-English featured courses at undergraduate, master's, and doctoral levels in collaboration with more than 50 prestigious universities from 18 countries, including members of the Association of Pacific Rim Universities as well as institutions in Japan, Singapore, the UK, France, Germany, Russia, the US, and Australia.

Case Study II: The 1st Global Digital Intelligence Education Innovation Competition

The Digital Intelligence International Development Education Alliance (DI-IDEA) held the the 1st Global Digital Intelligence Education Innovation Competition in 2024. This event aimed to enhance exchanges and cooperation among member institutions and universities worldwide, advance teaching and learning through competition, and explore new paradigms of talent development in the digital intelligence era. The competition featured three primary tracks: the Innovation Track, the Sustainable Development and Cultural Preservation Track, and the AI4Science Track. These tracks were designed to inspire innovative thinking and stimulate problem-solving skills from various perspectives. Specifically, the Innovation Track focused on employing AI to address real-world challenges in fields such as life sciences, materials sciences, and aerospace information; the Sustainable Development and Cultural Preservation Track encouraged the application of technology to tackle relevant issues; and the AI4Science Track explored the potential applications of AI in research. The competition was open to students currently enrolled at universities worldwide and to those who graduated within the last three years, promoting interdisciplinary and inter-university collaboration. Spanning several months, the event provided participants with a platform to fully showcase their creativity and talents. Substantial prizes were awarded to encourage the pursuit of excellence, recognize innovative spirit, and acknowledge practical achievements. The 1st Global Digital Intelligence Education Innovation Competition was not only a prominent academic contest but also a platform for promoting international exchanges, exploring educational innovations, and nurturing talent for the new era.

4. Development of Digital Intelligence Education

Amidst the global wave of digital transformation, digital intelligence education has emerged as a key focus for educational reform, showcasing its immense potential and value. Advancing this field requires enhanced collaboration among universities worldwide. By promoting cross-border academic discussions and technology sharing, these institutions can collectively explore new models and pathways for digital intelligence education, thereby creating a more efficient, equitable, and sustainable system in this domain.

Since its establishment in Beijing in November 2023, DI-IDEA has been committed to the vision of "advancing human progress and innovating the future of education." It has continuously enhanced global exchanges on higher education and collaborated to tackle the major challenges of the digital intelligence era. To promote the joint development of digital intelligence education, DI-IDEA has put forward the following four action plans:

4.1 Enhance Leadership in Digital Intelligence Education

DI-IDEA aims to enhance the high-quality development of education at universities and research institutions in the digital intelligence era. By promoting the deep integration of digital intelligence and education through multi-dimensional efforts, it seeks to strengthen leadership in digital intelligence education and support education institutions in adapting to and leading educational reforms.

4.1.1 Goals and vision

4.1.1.1 Purpose and overall vision

DI-IDEA is committed to building an inclusive and highly efficient international network for educational development, empowering university leaders with strategic thinking, technological insights, and innovative capabilities in the era of digital intelligence. These leaders are expected to drive innovation and transformations within their institutions, ensuring that all students and faculty can fully leverage digital intelligence technologies to achieve personalized and optimized educational experiences. We warmly welcome more international universities to join us in fostering educational leaders equipped with a global perspective, capable of adapting to and leading educational transformations in this digital intelligence era.

4.1.1.2 Global context and significance

In the context of globalization, enhancing educational leadership is not only key to improving education quality but also to fostering international educational collaboration and innovation. DI-IDEA advocates that through international cooperation, member universities can collectively explore how to cultivate educational leaders with a global perspective, prepared to guide educational transformations in the digital intelligence era. This type of collaboration not only fosters the development of disciplines but also enables member universities to contribute to the enhancement of education and student experiences within their own institutions, thereby addressing the ever-evolving needs and priorities of contemporary education.

4.1.2 Fostering leadership in digital intelligence education

4.1.2.1 Foundation

The foundation for fostering leadership in digital intelligence education lies in enhancing the comprehensive competencies of educational leaders. This entails not only strategic thinking, technological insights, innovation capabilities, and a deep understanding of educational trends, but also the creation of a supportive environment for digital intelligence learning. DI-IDEA encourages educational leaders to adopt a forward-thinking perspective, identifying future educational trends, actively exploring and embracing new models and technologies, and developing strategies to enhance educational quality and efficiency.

To achieve this goal, we believe the following key elements are crucial:

Safety: to create a safe and open environment where every participant feels free to express themselves candidly and openly.

Confidentiality: to place strong emphasis on participants' privacy, ensuring that their opinions and ideas are fully considered within a confidential setting.

Co-creation: to encourage collaborative efforts to build a learning community that addresses both individual and institutional needs in educational leadership development.

Projects: to empower educational leaders to turn theoretical knowledge into practical actions through participation in real-world projects, further deepening and consolidating their learning.

Action: to promote continuous improvement through reflection and action, facilitating leaders to make ongoing progress in their careers and achieve personal growth.

Through these approaches, DI-IDEA aims to provide educational leaders with a comprehensive, interactive, and practice-oriented platform to adapt to and lead educational transformation in the age of digital intelligence.

4.1.2.2 Framework

To systematically foster leadership in digital intelligence education, DI-IDEA is committed to building a multi-dimensional framework that includes the following key components:

Strategic planning and execution: Educational leaders need to develop and implement strategic plans to optimize the academic and teaching environment in higher education institutions.

International perspective and collaboration: Build an international academic network through educational leadership programs to promote exchange and cooperation among global educational leaders.

Technological application and innovation: Encourage educational leaders to explore the application of AI in education through case studies and practical projects.

Educational quality and assessment: Utilize AI tools and systems for data analysis to support educational decision-making; continually improve teaching quality based on AI-driven assessments.

Leadership development platform: Provide educational leaders with a comprehensive development platform that facilitates immersive learning and in-depth exchanges through online discussions, on-site workshops, in-person seminars, and other channels.

Through this framework, DI-IDEA aims to offer a comprehensive and systematic roadmap for educational leaders to adapt to and guide educational innovations in the age of digital intelligence.

4.1.3 International education leadership programs

In November 2023, King's College London—a member of DI-IDEA—collaborated with the London School of Economics and Political Science, Monash University, and the University of Warwick to initiate the International Education Leadership Program (IELP), which also includes Peking University as a participant. The IELP aims to explore how to nurture educational leaders with a global perspective and advance the high-quality development of universities in the digital intelligence era.

The IELP provides educational leaders with a platform for immersive learning and in-depth exchanges through online discussions, on-site workshops, in-person seminars, and other meticulously designed channels. A significant component of this program is the three-day in-person seminar, held at the University of Cambridge's Madingley Hall in early July 2024. At this seminar, educational researchers from five of the world's top universities engaged in lively discussions on the revolutionary impact of generative AI on higher education. In addition to these discussions, the organizers conducted an AI awareness survey and performed a personality analysis for the scholars in attendance, ensuring that the event was both relaxed and engaging. Through diverse interactions, the IELP enhances the strategic planning and execution skills of educational leaders, improving the academic and teaching environment of universities and bolstering the leaders' abilities to tackle challenges in the education sector.

In the digital intelligence era, enhancing educational leadership has become a key factor in whether universities can adapt to and lead change. Educational leaders should possess strategic thinking skills, insight into future educational trends, and the ability to design reform strategies for their institutions. Through the IELP, DI-IDEA enables these leaders to actively explore and adopt new educational models and technologies, thus extensively and intensively fostering leadership in digital intelligence education.

4.2 Establish Standards for Digital Intelligence Education

DI-IDEA has proposed standards for digital intelligence education, aiming to provide participating universities and research institutions with a normative guide for developing digital intelligence education programs. These standards offer a comprehensive framework of ethical principles, usage boundaries, and support measures for the responsible and ethical application of digital intelligence technologies, thereby fostering the healthy and sustainable development of digital intelligence education. As digital intelligence technology rapidly advances and finds innovative applications for education, these standards will be continuously updated and refined.

4.2.1 Goals and vision

4.2.1.1 Purpose and overall vision

The DI-IDEA standards foster the healthy development of digital intelligence education from the perspectives of ethical norms and usage boundaries. Addressing the ethical concerns associated with digital intelligence technologies, these standards draw from academic guidelines for AI-generated content (AIGC) provided international organizations and prestigious universities. They outline a framework of fundamental principles for the ethical application of these technologies in education and promote consensus among universities and research institutions regarding their application. This ensures that students and educators engage with digital intelligence technology with the appropriate attitudes and values.

4.2.1.2 Global context and significance

As the world undergoes a digital intelligence transformation, the DI-IDEA standards aim to position member universities as leaders in the responsible use of digital intelligence technologies. These standards incorporate ethical principles and norms that ensure that faculty and students apply these technologies ethically in both education and research. To maintain their leadership, the DI-IDEA standards are aligned with international frameworks, such as the UNESCO Guidance for Generative AI in Education and Research. The establishment of the DI-IDEA standards enables member universities to continue leading the development of digital intelligence education while fully considering the social impact and ethical responsibilities associated with the application of digital intelligence technologies.

4.4.2 The framework of digital intelligence education standards

The DI-IDEA framework of digital intelligence education standards consists of three parts: cognitive attitudes, ethical principles, and supervisory mechanisms. This framework enables university administrators, students, and faculty members to fully develop digital intelligence literacy, understand the impact of digital intelligence technologies on education, and learn how to use them appropriately. The framework draws on the academic standards of top universities like MIT, Cambridge, and Harvard, providing a scientific and systemic guide for digital intelligence education stakeholders in the application of these technologies.

Cognitive attitudes: the university's acceptance of digital intelligence technologies and willingness to adopt them. This includes openness to emerging technologies, adaptability to changes brought by such technologies, and expectations regarding technological development.

Ethical principles: the moral guidelines and codes of conduct for university stakeholders using digital intelligence technologies. This includes awareness of ethical issues arising from the application of these technologies, strategies for addressing these issues, and a sense of social responsibility in their use.

Supervisory mechanisms: risk monitoring and evaluation of the processes, outcomes, and stakeholders in digital intelligence education. The aim is to ensure the legality, rationality, and effectiveness of digital intelligence education activities.

4.2.2.1 Cognitive attitudes

Universities should adopt an open, inclusive, and proactive stance towards digital intelligence technologies, such as Artificial Intelligence Generated Content (AIGC). A majority of the Top 100 universities in the QS2023 rankings support the use of AIGC to enhance teaching quality, improve research efficiency, and boost technological awareness. By actively introducing and promoting digital intelligence technologies, universities can focus on achieving higher-level educational goals, foster interdisciplinary integration, drive academic innovation, and maintain their leadership in teaching and research.

4.2.2.2 Ethical principles

Digital intelligence technologies have created opportunities for educational development by reshaping teaching, research, talent cultivation, and institutional management. However, these advancements also present significant ethical challenges. Issues such as data privacy and security, algorithmic bias, and the digital divide highlight limitations of technology. The adoption of digital intelligence technologies in universities may lead to risks concerning research integrity, declines in students' cognitive abilities, and a trend towards formalized education. In response to these challenges, universities should adhere to fundamental ethical principles, including fairness and inclusiveness, privacy and security, integrity and transparency, and a people-first approach.

Fairness and inclusiveness: Universities need to optimize their public infrastructure for digital intelligence and strengthen the development of digital intelligence education platforms and smart campuses. This will ensure sufficient computing power and data storage capabilities to meet the ever-growing demands for digital intelligence education and research, allowing every student equitable access to high-quality educational resources.

Privacy and security: Universities should implement comprehensive and rigorous technological and managerial measures, including strengthening data encryption, enforcing strict access control mechanisms, conducting regular security audits and risk assessments, enhancing information security awareness among faculty and students, and establishing robust data breach response protocols. These measures will safeguard the data security and privacy of both teachers and students, prevent data misuse, and maintain a clean educational environment.

Integrity and transparency: In terms of teaching, educators should establish clear academic standards for the use of digital intelligence technologies based on course characteristics. This includes outlining permissible and prohibited scenarios for technologies such as AIGC, as well as disclosure requirements and content review mechanisms. Students should responsibly disclose and clearly indicate the extent of their use of technologies such as AIGC and take responsibility for the accuracy and reliability of the generated content. When it comes to research, both educators and students should uphold integrity when using AIGC and other digital intelligence technologies, avoiding academic misconduct such as plagiarism, disseminating false findings, generating papers with no substantive contribution, and infringing upon others' intellectual property.

People first: First, the development and application of digital intelligence technologies at universities cannot succeed without a humanistic spirit, which fosters a more caring and inclusive ecosystem for digital intelligence education. Second, the framework for digital intelligence education should prioritize liberation over restriction, consistently respecting, promoting, and protecting the autonomy of both students and educators. (1) Cultivate a student-centered approach: Educators should explore efficient educational models that underscore human-machine collaboration while guiding students to critically engage with these technologies. This approach prioritizes the development of independent thinking, logical reasoning, and innovation skills. (2) Reinforce the role of teachers: The transition to digital intelligence redefines teachers as learning partners, shifting the focus of university instruction from factual knowledge to scientific perspectives, reasoning, and methodologies. In this context, the essence of education lies in the collaboration and interaction between students and teachers, positioning teachers as guides rather than replacements.

4.2.2.3 Supervisory mechanisms

To ensure that the application of digital intelligence technology in education is balanced against ethical risks, it is imperative to actively explore mechanisms for monitoring, evaluating, and addressing these risks to maximize the benefits of this technology.

Digital intelligence education poses significant challenges to educational assessment. Key questions include: How should the effectiveness of human-machine co-teaching be evaluated? Furthermore, how should students' learning abilities and outcomes be assessed—specifically, what essential knowledge and skills should students master, and what methods should be used for effective evaluation?

To address these questions, universities need to consider how digital intelligence technology has reshaped teaching content, methods, and models, as well as its long-term effects on students' physical and mental well-being, learning efficiency, creativity, and critical thinking skills. In line with the trends in digital intelligence education, universities should establish appropriate regulations for monitoring and assessing both teaching effectiveness and learning outcomes.

4.2.3 Support measures from universities

4.2.3.1 Curriculum construction

Guided by the trends in digital intelligence education, universities should design curricula that include modules on foundational theories, core technologies, application scenarios, and ethics and social impacts.

4.2.3.2 Faculty training

Universities should regularly organize faculty training in digital intelligence technology, educational technology, and ethical standards to enhance teaching quality and professional competence.

4.2.3.3 Ethics education

Universities should offer compulsory or elective courses on digital intelligence technology ethics. These courses should systematically cover ethical theories, case studies, relevant laws and regulations, and ethical standards to deepen students' understanding of how the application of digital intelligence technology shapes ethics, values, and societal engagement. Additionally, universities should establish resource repositories for education in digital intelligence technology ethics, collecting relevant literature, case studies, research reports, and other materials from both domestic and international sources for faculty and student reference. To further enhance ethical awareness and responsibility in digital intelligence, universities should organize various activities—including lectures, seminars, and debates—to engage both faculty and students.

4.3 Develop a Digital Intelligence Education Framework

DI-IDEA has proposed a framework for digital intelligence education, aiming to provide member universities and research institutions with forward-looking guidance for developing digital intelligence education programs. This framework offers a solid conceptual foundation and practical strategies for fostering innovation, ethical responsibility, and social engagement in digital education. While the framework outlines its structure and assessment methods, it remains a proposal that awaits future implementation and refinement. It will continuously evolve and improve through the collaborative efforts of individuals from diverse backgrounds and institutional environments.

4.3.1 Goals and vision

4.3.1.1 Purpose and overall vision

The DI-IDEA framework bases digital intelligence education on a "social practice" model of education emphasizing that teaching, learning, and technological innovation are inseparable from their social and institutional contexts. This framework views the interaction of students and educators with AI, big data, and digital tools as part of their ongoing communication and reflection within their professional, disciplinary, and social circles. Students and educators are expected to not only acquire technological proficiency but also to deeply understand the societal implications of their technological engagements.

Drawing on the theoretical foundations established by Gherardi (2000) and Nicolini et al. (1998) and enriched by practical experiences from universities like Harvard and Stanford, the framework strives to ensure that students develop exceptional technological skills while also becoming reflective and ethically aware practitioners. It underscores the profound societal implications of students' technological engagements, enabling them to balance innovative practices with social responsibility and thus address the challenges and needs of specific environments.

4.3.1.2 Global context and significance

Amidst the global wave of digital transformation, the DI-IDEA framework positions member universities as leaders in advancing cutting-edge innovation, social relevance, and ethical responsibility. By adopting a social practice approach, the framework integrates faculty teaching and student learning with the practical application of digital technologies in broader social and institutional contexts. Moreover, these practices and learning experiences are progressively shaped by collaborative engagement within specialized communities, alongside the material and ethical impacts brought about by emerging technologies.

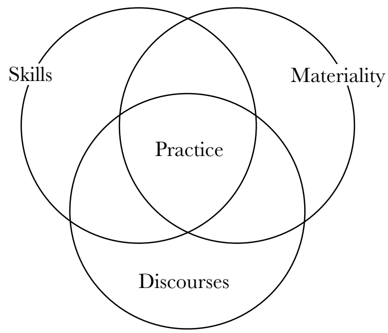

Figure 1: The theory of social practice, adapted from Shove et al. (2012), places practice at the intersection of skills, the materiality of technologies and their contexts, and public, disciplinary, and educational discourses

To sustain its leadership, DI-IDEA has aligned the framework with international standards (e.g. OECD Future of Education and Skills 2030) and established partnerships with global institutions. These efforts will help member universities remain at the forefront of digital education while fostering a deeper understanding of the social and cultural impacts of technological innovation.

4.3.1.3 Core values and technology ethics

The DI-IDEA framework regards ethics as an indispensable component of digital intelligence practices. This framework not only aligns with the theory of social practice but also draws on practical applications from institutions like Stanford

University, such as “algorithmic ethics audits” and “digital citizenship portfolios.” The framework emphasizes that ethical responsibility stems from the materiality of technology, the formation of relevant discourses, and embedded specialized practices. In this way, students are encouraged not only to develop technological skills but also to understand how these skills are informed by social, material, and discursive practices within their fields.

4.3.2 Structure

The DI-IDEA framework is structured into three levels—foundational, intermediate, and advanced—each grounded in the core principles of the social practice theory. In this way, students are encouraged not only to develop technological skills but also to understand how these skills are shaped by social, material, and discursive practices within their specialized communities. Drawing on practical experience from institutions such as Harvard and Stanford, the framework provides a strong foundation for students to navigate complex digital environments.

Foundational level: Focus on developing digital literacy and critical thinking, helping students effectively use digital tools within broader ethical and social contexts.

Intermediate level: Strengthen algorithmic thinking and interdisciplinary applications, encouraging students to reflect on the ethical and societal impacts of their technological solutions.

Advanced level: Cultivate AI innovation and digital entrepreneurship, emphasizing the integration of ethical considerations throughout business models and technological development.

The framework not only draws on social practice theories but also encourages students to view digital intelligence education as a socially embedded practice, ensuring that they remain keenly aware of social and ethical issues while addressing technological challenges.

4.3.3 Foundational level: digital literacy and thinking

4.3.3.1 Core competencies

At the foundational level, students perceive digital literacy not only as a technological skill but also as a practice of social integration. They recognize that the use of digital tools is influenced by the institutional context, fields of expertise, and social discourses. Discussions on issues such as privacy, digital rights, and technological limitations are framed within a broader social context, helping students understand the different interpretations and debates surrounding these concepts. This approach encourages students to view their digital actions as part of a larger framework of social and ethical practices.

4.3.3.2 Evaluation and future development

The evaluation methods at this level align with the concept of social practice, focusing on students' critical thinking abilities in both the societal and technological dimensions of digital literacy. The assessment tools include:

Digital ethics reflection journal: This tool draws inspiration from Harvard courses, where such journals encourage students to critically reflect on the ethical dimensions of their use of digital tools. Similarly, during its Ethics Awareness Week, Utah Valley University encourages students to think about the societal impacts of digital technologies. Within the DI-IDEA framework, students will record their Digital Ethics Reflection Journals to assess their insights into digital technologies as a means of social integration.

Scenario-based ethical decision-making: Stanford University employs this method in its "AI and Digital Ethics" course, where students confront complex ethical dilemmas, such as balancing data privacy with the demands of AI-driven healthcare systems. These exercises help students apply ethical principles in real-world scenarios. Under the DI-IDEA framework, students will also explore similar scenarios, balancing ethical priorities such as data privacy against public health.

Digital citizenship portfolios: In the "Sustainable Products and Business Model Innovation" course at Steinbeis University in Berlin, students create Digital Citizen Portfolios to showcase their understanding of the social and ethical impacts of digital work. Within the DI-IDEA framework, students will compile similar portfolios to demonstrate not only their technological skills but also their ability to understand and address the challenges of digital work in social and ethical practices.

Case studies

The following cases illustrate the implementation of the DI-IDEA framework across various educational stages. Although these scenarios are based on fictitious institutions, they draw from real practices reported at universities like Stanford, Harvard, and the University of Maryland. These case studies provide concrete examples of how digital literacy, computing skills, AI innovation, and ethical responsibility are cultivated through socialized practices.

Case study 1: Foundational Level—Digital Literacy and Thinking

Institution: University A

Scenario: Enhancing awareness of digital citizenship and ethical responsibility

Overview:

At University A, freshmen participate in a foundational course titled "Digital Citizenship and Ethics." This course aims to introduce students to digital literacy, critical thinking, and ethical issues arising from the use of digital technologies. The university places a strong emphasis on contextualized learning, adapting the course content to the local social and cultural context.

Application:

In this course, students are encouraged to reflect on how their use of digital tools interacts with social norms, local regulations, and cultural values. They engage in scenario-based ethical decision-making exercises, exploring local issues such as data privacy in public systems or the use of social media by adolescents. The course also incorporates digital ethics journals, encouraging students to critically assess their interactions with technology and the broader societal impact of these interactions.

Institution background:

Located in a region with specific data privacy regulations, University A integrates local laws into its case studies and decision-making scenarios. This underscores that digital literacy and ethics are not just abstract concepts but are deeply rooted in the students' daily lives and the institutional setting.

Outcomes:

By the end of the course, students will have developed not only technical skills but also an ethical awareness for responsible conduct in digital environments. Through contextualized case studies, students gain an understanding of the importance of digital citizenship within their social context and prepare themselves to be active participants in broader social practices.

4.3.4 Intermediate level: intelligent computing skills and interdisciplinary application

4.3.4.1 Interdisciplinary integration, algorithmic thinking and ethics

At the intermediate level, students are encouraged to view algorithmic thinking as a practice that interacts with their specialized communities, material technologies, and societal discourses. As they develop their technical skills, they are also promoted to deeply consider the societal implications of their work, with a particular focus on issues like algorithmic fairness, data privacy, and social justice. This approach ensures that their learning is embedded in real-world applications of digital tools, highlighting the critical roles of collaboration and social responsibility.

4.3.4.2 Evaluation and future development

The evaluation methods at this level align with the theory of social practice, focusing on how students integrate ethical and social considerations into their algorithmic tasks. The following cases demonstrate the real-world application of similar methods.

Algorithmic ethics audits: For instance, Stanford University and Northeastern University's Khoury College of Computer Sciences incorporate algorithmic ethics audits in their courses to assess the fairness, bias, and social impacts of algorithms. Stanford, in particular, emphasizes ongoing assessments to mitigate algorithmic risks and ensure fairness and transparency. The algorithmic audits uncover potential biases at various stages of modeling, laying the foundation for students to perform their own algorithmic ethics audits under the DI-IDEA framework. This also encourages them to design computational solutions that are socially responsible and equitable.

Interdisciplinary project presentations: Drawing on experiences from Khoury College, universities promote interdisciplinary projects that require students not only to showcase their technological solutions but also to deeply analyze the societal impacts of these solutions. These projects demonstrate how students' work is influenced by the interplay between technological systems and social structures. Similarly, under the DI-IDEA framework, students showcase their work through social practice, illustrating how their technological solutions are influenced by social and institutional contexts.

Case Study 2: Intermediate Level—Intelligent Computing Skills and Interdisciplinary Application

Institution: International Technical College B

Scenario: Interdisciplinary data analysis for urban planning

Overview:

At International Technical College B, sophomores participate in an interdisciplinary project run by the Departments of Computer Science and Urban Planning. At the core of the project lies the use of algorithmic thinking and programming skills to develop data-driven solutions aimed at optimizing the urban transportation system.

Application:

Students use a real-world dataset provided by the municipal transportation department, covering traffic flow and public transit usage. The project requires students to conduct algorithmic ethics audits to ensure that their algorithmic solutions are not only technologically viable but also fair and socially responsible.

Institution background:

Recognizing that the urban transportation system serves a diverse population, the project asks students to examine potential unintentional biases in their algorithms that could impact various demographic groups. The college encourages engagement with local community representatives to deepen students' insights into the social implications of their work, thus integrating algorithmic competencies into the social fabric of the city.

Outcomes:

Through such interdisciplinary projects, students can not only gain algorithmic thinking but also acquire a deeper understanding of the ethical implications of their work. Engaging students with the local community ensures that their solutions are attuned to citizens' needs and values, which fully demonstrates the deep integration of algorithms with social practices.

4.3.5 Advanced level: AI innovation and digital entrepreneurship

4.3.5.1 AI innovation, digital entrepreneurship, and ethics

At the advanced level, students engage with broader social, technological, and discursive contexts as they participate in AI innovation and digital entrepreneurship. They not only examine how technological factors influence innovation but also analyze the ethical and social implications of their work. Specific challenges, such as algorithmic bias, AI transparency, and data privacy, are critically addressed to ensure that students' innovations positively impact society. Students are encouraged to view themselves as members of specialized communities, recognizing that their innovations can significantly influence both market dynamics and social structures.

4.3.5.2 Evaluation and future development

Assessments at this level focus on students' ability to integrate ethical and social practices into their entrepreneurial efforts. The evaluation methods include:

Ethical Business Model Canvas: For instance, universities like Stanford have incorporated ethical principles into their business model innovation courses. Stanford's Technology Ventures Program includes the Lean Launchpad initiative, which utilizes the Business Model Canvas approach, while courses like "Principled Entrepreneurial Decisions" emphasize the importance of integrating ethical and social considerations in the development of new business models.

Social entrepreneurship competitions: For example, an initiative from the University of Maryland focuses on social entrepreneurship, providing students with hands-on experiences to develop business models centered around social impact. Such initiatives ensure that students can not only create profitable businesses but also generate measurable positive social outcomes.

Case Study 3: Advanced Level—AI Innovation and Digital Entrepreneurship

Institution: International College C

Scenario: AI start-up focused on medical innovation

Overview

During their final year at International College C, students team up to develop AI-driven medical solutions as part of a digital entrepreneurship project. The project focuses on creating start-ups that leverage AI to enhance patients' health, especially in terms of diagnosing rare diseases.

Application

Students collaborate with healthcare providers to develop AI algorithms tailored for specific patient groups. Throughout the project, they employ an Ethical Business Model Canvas to ensure their start-ups integrate principles of fairness, transparency, and social responsibility from the outset.

Institution background

Since the regional healthcare system serves a diverse population, including vulnerable groups, students need to address how their AI solutions tackle medical inequities. They work with medical professionals, patient rights organizations, and policy experts to ensure their innovations are accessible and socially responsible.

Outcomes

By the end of the project, students have successfully created AI start-ups that push the boundaries of technological innovation while adhering to ethical and social standards. The social entrepreneurship competition showcases their ability to integrate AI innovation with social responsibility, highlighting how digital entrepreneurship can succeed with the synergy of technology and social practices.

4.3.6 Implementation and Scalability

4.3.6.1 Universities' strategies

The DI-IDEA framework focuses on embedding digital intelligence education within real institutional environments, guided by the theory of social practice. This approach encourages universities to promote interdisciplinary collaboration, ethical reflection, and specialized development, ensuring that both students and faculty engage in digital tasks within a broader institutional, technological, and social context.

Implementation strategies include tailored participatory pilot projects that reflect the cultural, social, and technological backgrounds of each university. These projects prioritize adaptability to specific contexts while remaining aligned with international standards. Through continuous feedback from faculty, students, and stakeholders, the DI-IDEA framework will continually enhance its scalability to ensure its effectiveness and relevance across diverse educational environments.

4.3.6.2 Program for teachers' professional development

Built on the social practice framework, this program encourages educators to view their professional development as a collaborative process shaped by both the material aspects of technologies and specialized discourses. It is tailored to the unique contexts of member universities and is designed to be continually refined in response to institutional needs and global trends.

Drawing on reflective practices from leading institutions, the program encourages teachers to employ participatory inquiry methods and integrate digital tools that fit for their specific institutional, social, and cultural contexts. Educators are expected to perceive digital literacy as encompassing not only technological skills but also a profound understanding of the ethical, social, and cultural dimensions of technology. This approach aligns with the overarching goals of the DI-IDEA framework.

The key components of the program includ

Educational resources and courses: To equip teachers with the latest teaching methods and tools, enable them to view digital work as a practice of social integration, enhance their digital literacy, and increase their awareness of the societal impacts of AI innovations.

Seminars and lectures: Regularly hold seminars and lectures to assist teachers in innovation through collaborative and interdisciplinary teaching and encourage them to ponder how they can contribute to the societal and cultural impacts of technology. These sessions also provide teachers with opportunities for self-reflection, prompting them to consider how digital tools affect their professional practices within particular institutional settings.

The role of teachers as knowledge creators: The program encourages teachers not only to disseminate knowledge but also to become innovators in the field of digital intelligence and actively promote the development of social and ethical practices. The theory of social practice requires teachers, and students to examine the materiality, context, and ethics of emerging technologies, as well as the narratives that shape their use and understanding.

Research assistance: Help teachers advance the application of new technologies, provided that these technologies contribute to social welfare. Encourage teachers to focus on the societal effects of digital work.

Peer support and collaboration: The program fosters global collaboration among educators by creating a network for the sharing of teaching experience and best practices. It promotes the integration of technology with social practices and assists teachers in continuously improving their professional skills in a rapidly changing digital landscape.

4.3.7 Conclusions

The DI-IDEA framework presents an approach that integrates digital intelligence into the educational system, based on the understanding that learning and innovation are deeply embedded in institutional and social contexts. This framework highlights the relationships among technology, ethics, and social background, equipping students and teachers to effectively navigate the ever-changing digital environment to become reflective and socially responsible practitioners. This method ensures mastery of technological skills while balancing the ethical and societal implications of their work, thereby fostering a more comprehensive model for digital intelligence education.

4.4 Shared digital intelligence education platforms

The DI-IDEA platform for digital intelligence education is designed to foster collaborative creation and sharing of digital intelligence education and research outcomes. Big data and generative AI are gradually reshaping the educational landscape. They are evolving at a pace that outstrips the updates to existing curricula and the required skills for teachers. Unlike more established technologies, these new tools do not yet have a robust pedagogical framework or extensive case studies to effectively guide their use, making their classroom applications largely experimental. There is scant guidance on how to incorporate these tools to improve learning outcomes. Specifically, generative AI is often seen as both a disruptive force in education and as a potential risk to academic integrity. The situation underscores the need for structured methods to explore how emerging technologies can better meet educational objectives, especially from the perspective of teacher-led research.

DI-IDEA responds by creating a systematic plan to collect and share teachers' experiences and insights in using these technologies, and by building a platform for academic knowledge exchange and teachers' professional development through the work of its member, Camtree.

4.4.1 Digital intelligence education platforms

Camtree, the Cambridge Teacher Research Exchange (https://www.camtree.org), is a partner of DI-IDEA. It is dedicated to assisting the teaching community in conducting close-to-practice research, enhancing teaching practices, and sharing their achievements. Based at Cambridge's Hughes Hall, the Camtree team collaborates closely with the Faculty of Education and other partner institutions. What sets Camtree apart is its approach; it not only facilitates teachers' research through training programs, online learning, and collaborations with educational organizations, but also publishes their findings through its digital library.

This library provides a permanent, globally accessible repository for teachers' reports and educational resources. It also hosts collections generated and curated by specific interest groups, communities, and educational organizations. Subscribing partners can host their collections in the library, securing a permanent digital archive. Currently, no other platform offers opportunities on such a scale for teachers worldwide. The library is developed on the DSpace 7 digital repository platform which is widely adopted by leading research institutions and universities around the world. Furthermore, the library is customized to meet the particular needs of users conducting research on practical education or seeking access to relevant findings. Its main purpose is the long-term storage, retrieval, and integration of research reports on teachers' practices within educational settings. These reports usually range from 2,000 to 5,000 words and may include supporting materials such as research tools, ethical protocols, or datasets; learning resources developed during the research or evaluations; digital content such as images, audio files, videos, and apps; and longer documents underpinning the reports, like dissertations or theses.

The library serves as a multilingual platform: research reports can be submitted in any language, provided that they are accompanied by a 350-word structured English abstract. This enables library users to easily locate reports and assess their relevance to their own work, facilitating the analysis and synthesis of research findings. Additionally, the library can act as a "virtual repository," guiding users and search tools to other sources of information through shared metadata, thus becoming a "hub" in an "open" digital ecosystem. Therefore, the managers of other collections, online journals, and archives can expand the reach and impact of existing materials. The ever-expanding digital library also lays the foundation for semantic databases, providing data support for generative AI applications, including enhanced search tools and chatbots. These tools, through interfaces similar to ChatGPT, provide educators with reliable and sourced recommendations.

Camtree's work align with the aims of DI-IDEA in two respects:

- Camtree is able to provide training and support for teachers in the kinds of practice-based research which is currently required to explore and evidence the potential of emerging technologies and the development of digital intelligence. The programmes of digital intelligence education outlined previously will require participants to design and apply appropriate models of inquiry and to gather compelling evidence of outcomes if their knowledge is to be effectively mobilised.
- The Camtree Digital Library provides a platform for hosting, sharing and synthesis of teacher knowledge, acting as the hub of an international ecosystem of 'intelligence about digital intelligence'. As well as publishing conventional reports of teacher innovation and inquiry, it can also host accounts of digital objects and innovations located elsewhere (web platforms, online learning tools, applications, code, datasets, language models). Such multimodality would allow teachers, researchers, developers and policy actors to explore new technological tools alongside the authentic accounts of their development and deployment in educational settings.

4.4.2 Establishing an ecosystem for digital intelligence research

The dissemination of teachers' knowledge, particularly regarding emerging technologies, is constrained by the lack of a robust digital infrastructure. While fields like epidemiology, public health, and climate science are opening up by treating knowledge as a "global public good," this approach is rarely applied systematically to gathering and sharing knowledge about teaching practices.

The decentralization of digital platforms and the lack of interoperability between systems hinder the propagation and reuse of knowledge. Moreover, these infrastructural deficiencies exacerbate educational inequalities, especially for teachers in technologically underdeveloped environments who find it challenging to engage with broader specialized communities. The consequent lack of advancements in teaching practices and collective professional development underscores the need to create a digital ecosystem that includes people, digital tools, and a wealth of shared practical experience.

Such an ecosystem will facilitate deeper interactions among teachers, technical experts, and policymakers. Currently, designers of technology platforms, curriculum developers, and educational system builders find it difficult to access the collective knowledge and comprehensive insights of teachers. As a result, they rely too heavily on isolated cases or feedback from "ideal users," rather than leveraging the valuable experience teachers gain in real educational settings.

Although teachers are actively exploring generative AI, their innovative outputs and findings are seldom shared, which results in a weak evidence base. Despite frequent appeals from journals, publications, government agencies, and international organizations for relevant evidence and case studies, the dissemination of research achievements remains limited.

Digital intelligence education platforms situate teachers' practice at the confluence of skills, the materiality of technologies and their contexts, and relevant discourses. This enables teachers to play a pivotal role in exploring emerging technologies and digital intelligence within real educational settings. Model-based action research, design research, and pedagogical research are crucial, as they reflect the unique perspectives of teachers. As education practitioners, teachers can adeptly understand student needs and classroom realities. Engaging in independent research allows them to customize big data and generative AI applications to meet specific educational challenges. This creates a practical knowledge system directly related to teaching environments.

Furthermore, digital intelligence education platforms foster ongoing specialized development and a culture of innovation. In the exploration of emerging technologies, teachers not only contribute to the broader educational community but also enhance their own skills and adaptability. By encouraging proactive research, we ensure that teachers remain at the forefront of instructional innovation, rather than passively adhering to externally imposed guidelines. The platforms significantly mitigate the challenges associated with haphazard adoption of new technologies, such as data privacy, bias, and ethical use of technology in classrooms. Through proactive research, teachers can identify and address these challenges early on, ensuring that the application of generative AI in education is both effective and responsible. In other words, teacher-led research not only fosters best practice development but also shapes ethical frameworks for the application of Generateive AI and other digital innovations n education.

Postscript

With the acceleration of global digitalization, digital intelligence education is emerging as a key driver of innovation in higher education. November 2023 saw the official establishment of the Digital Intelligence International Development Education Alliance (DI-IDEA). This alliance unites global experts and scholars committed to exploring and advancing digital intelligence education. Through the collaborative efforts and strong support of its member institutions, Peking University and Wuhan University have taken the lead in authoring *White Paper on Digital Intelligence Education Development*.

The White Paper aims to comprehensively summarize the current status, challenges, and opportunities in digital intelligence education, while offering recommendations and perspectives on how to build an efficient, equitable and sustainable digital intelligence education system. It outlines the fundamental concepts and characteristics of digital intelligence education in higher education and explores the requirements for talent cultivation in the era of digital intelligence. Additionally, it provides an in-depth analysis of the essential components of a digital intelligence education framework, including the disciplinary system, curriculum system, textbook system, support system, and evaluation system. Through case studies, the White Paper showcases the contributions of world-class universities in digital intelligence education practices, focusing on areas such as courses, platforms, teaching assistants, evaluations, and collaborations. It then proposes several action plans aimed at enhancing leadership, establishing standards, developing frameworks, and sharing platforms for digital intelligence education.

The preparation of the White Paper was an interdisciplinary and cross-domain collaboration that brought together the expertise of experts and scholars from fields such as pedagogy, data science, AI, and management and incorporated cases from leading universities across Asia, Europe, the Americas, Oceania, and Africa. I would like to extend my sincerest gratitude to all experts and scholars who participated in the creation of the White Paper. Your profound insights and exceptional contributions have culminated in a valuable repository of knowledge that serves as a guide for the digital transformation of higher education worldwide.

I am grateful to the over thirty international member universities of DI-IDEA, whose active engagement has been fundamental in enriching the content of the White Paper. Special thanks go to Gong Qihuang, Chairman of DI-IDEA and President of Peking University, for his robust support and guidance throughout the development of the White Paper. I would also like to extend my heartfelt thanks to Zhang Pingwen, Director of the DI-IDEA Advisory Board, President of Wuhan University, and an Academician of the Chinese Academy of Sciences. His direct guidance on the content of the White Paper and his personal contribution to the Preface have provided unique insights and profound inspiration to our readers. Appreciation is also extended to Prof. Wu Dan and Prof. Zhang Lefei from Wuhan University for their diligent efforts in preparing the final draft, as well as to Dr. Patrick Carmichael and Dr. Ji Ying from Hughes Hall, University of Cambridge; Prof. Zhang Jiuzhen from Peking University; and Sam Smidt from King's College London for their significant contributions to the action plan of the White Paper. Additionally, gratitude is expressed to the staff of the DI-IDEA Secretariat for their tireless work in drafting and revising the White Paper. Each of you has played an indispensable role in enhancing the quality of the White Paper. Last but not least, I would like to extend special thanks to all my colleagues who contributed to the successful release of the White Paper.

I hope the White Paper will strongly support the digital transformation of global higher education and inspire further thoughts and actions. Looking ahead, we are convinced that digital intelligence education will play an increasingly vital role in universities worldwide. We look forward to expanding our collaboration with universities, research institutes, and educators to advance digital intelligence education, thereby making greater contributions to the development of innovative talent for this era.

Thank you to every reader of the White Paper. Your feedback and suggestions are invaluable to our future work.

Prof. Sun Hua

Secretary General of DI-IDEA

Director of Office of the Provost and Center for Excellent Teaching and Learning at Peking University

September 2024

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Digital Intelligence
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序　言

在数智时代，人类面临众多重大复杂问题，需要加强国际间的合作，以多学科视角，运用数学方法和信息化手段提供解决方案。数智教育是以大数据与人工智能技术为主要载体，培养学生数字思维、数字素养与智算技能、解决数智时代问题的数字能力为目标的交叉型人才教育模式。数智教育天然具有交叉学科特征，许多学科的最新发展都与数据和智能密切相关。数智时代的大学既是科学技术的探索者和发现者，也是文化知识的生产者和改革者，为创造知识、传承文化、促进人类文明进步，构建起全纳、公平、高质量、可持续的教育体系。

为应对数智时代对全球高等教育带来的新机遇、新挑战，“数智教育发展国际大学联盟”（DI–IDEA）在全球30所高校的共同发起下，于2023年在北京成立。一年来，联盟以“致力人类进步、创新教育未来”为愿景，在加强国际高校间交流合作、共同探索数智教育的理论与方法、为人类社会进步提供学术支撑及政策建议等方面进行了非常积极的探索。联盟此次发布的《数智教育发展白皮书》，对数智教育的概念内涵、人才现状、教育体系等进行了系统梳理，汇集了世界各国的知名高校在数智教育方面的优秀案例，为促进数智教育的共同发展提出了四个方面的行动方案。

一是提升数智教育领导力。DI–IDEA致力于构建一个包容性、高效能的教育教学发展国际化网络，促使高校教育领导者在人工智能时代，具备战略

思维、技术洞察力和创新能力，能够推动其机构的变革和创新，确保所有学生和教师能够充分利用数智技术，实现教育的个性化和最优化。

二是建立数智教育规范。DI-IDEA 提出的数智教育规范，旨在为参与的高校和研究机构提供发展数智教育项目的规范指南。该规范为数智教育利益相关方负责任、合乎伦理地使用数智技术提供了全面的伦理原则与规范、使用边界和保障措施，从而促进数智教育健康、可持续发展。

三是开发数智教育框架。DI-IDEA提出的数智教育框架，旨在为参与的高校和研究机构提供发展数智教育项目的前瞻性指导。该框架为在数智教育中培养创新、伦理责任和社会参与提供了坚实的概念基础和实用的实施策略，以及具体的结构和评估方法。通过在不同背景和机构环境中的协同开发，这一框架将不断演进和完善。

四是共享数智教育平台。DI-IDEA提出的数智教育平台，旨在共建共享数智教育研究成果。这个系统收集并分享全球高校教师在使用数字化和智能化相关新技术过程中积累的教学经验和数智教育案例，指导教师有效利用生成式人工智能（GenAI）等各种新兴技术革新教学方式，基于DI-IDEA成员Camtree打造教学学术和教师发展的国际高校合作平台——DI-IDEA HUB。

当前，数字技术和人工智能正以前所未有的速度引领产业创新浪潮，数字化作为推动社会进步、促进经济繁荣的核心驱动力，不仅重构了全球资源配置的版图，还深刻重塑了经济结构的面貌，并悄然改变着国际格局。如何把握机遇、驱动数字变革与创新，是全人类共同面对的课题，需要高素质数智人才的广泛参与和深度贡献。在联盟《数智教育发展白皮书》的撰写过程中，我们看到各国在数智人才培养上均取得了显著成效。我们相信，通过白皮书的发布，将进一步提升社会各界对于数智教育的理解、支持和重视，吸引更多的国际高校和专家学者投身于数智教育工作

中，为全球持续输送优秀数智人才，为人类社会的可持续发展和共同繁荣贡献更多数智力量。

数智教育发展国际大学联盟（DI-IDEA）咨询委员会主任

武汉大学校长

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1 数智教育概况

1.1 数智时代的高等教育

随着全球新一轮科技革命和产业变革的深入发展，数据作为关键生产要素的价值日益凸显，社会数智化转型深入推进，数字经济的发展改变了职业结构和人才知识技能结构，推动了教育的数智化转型。以数智化转型推动高等教育的高质量发展，符合当今高等教育的发展需求。

1.1.1 发展数智教育推动社会转型进步

当今世界，数智技术正在加速重构经济社会发展与治理模式。智能化既是方式和手段，也是方向和目标。数智化发展体现了社会和经济向新范式的根本转变，带来产业组织模式、现代基础设施体系、科技人才培育体系、社会发展治理模式等的革新与重构。

发展数智教育不仅能提升公民的数字素养与技能，也能为各国数字经济高质量发展、社会数智化转型提供源源不断的人才支撑，促进数智技术创新成果转化应用。

1.1.2 发展数智教育促进学科交叉融合

在数智技术加速演进的背景下，数智时代的穿透力对几乎所有学科都有巨大影响。发展数智教育、培养数智人才可助力多学科交叉融合发展，并催生一批新的交叉学科。以“数字人文”为例，一方面，数智技术可以为人文研究提供新的研究手段、研究对象、研究议题，开拓新的场景，为开展数智

赋能的人文研究提供技术支撑；另一方面，人文研究支撑了数智化技术发展的伦理规范，同时在虚拟仿真、情感算法、计算美学等领域发挥着更积极的作用，有助于营造人文精神引领、先进技术支撑、丰富多元的数智化生态。

1.1.3 发展数智教育赋能拔尖人才培养

发展数智教育不仅需要搭建跨学科平台作为教学支持，还需要完善拔尖人才数智教育知识体系作为有效路径。在社会数智化转型背景下，拔尖创新人才应立足实践，将数字思维、数字素养、智算技能与所学专业有机结合，并在实际情境中培养解决问题的数字能力。

1.2 数智教育的概念

1.2.1 数智教育的概念及特征

数智教育是指以大数据与人工智能技术为主要载体，培养学生数字思维、数字素养与智算技能及解决数智时代问题的数字能力为目标的交叉型人才教育模式，主要具有以下特征：

一是数字能力成为终身学习的重要内容。数智化转型过程中所需要的人才，不仅要具备专业领域的知识和技能，更要具备数字思维、数字素养和运用智算技能创造性解决复杂问题的能力。因此，必须精准掌握数智化转型对社会劳动力素质的新要求，树立以数字能力为导向的人才培育理念。

二是数智技术教育和科技伦理教育并重。数智技术发展在推动生产方式变革的同时，给人类社会带来了复杂的伦理挑战。数智时代下的科技人才培育不仅仅是技术和理念的传承，更是推动技术和社会规范持续互动发展中的重要一环。因此，应强调共同推进技术能力培养和科技伦理教育，普及科技伦理知识，提升应对科技伦理问题的能力。

三是数智的培养和培养的数智化相结合。数智技术强调通过多元化的方式培养复合型人才，既需要以建立数据密集型科研范式为牵引，培养具备数

智化转型系统性思维，能够将数据科学技能与专业领域知识紧密结合的科研人才，也需要积极推进产教融合、校企合作，培养具有扎实理论基础和丰富实践经验的技能人才。同时，人工智能等数智技术也为更加智能化的培养体系、更有针对性的培养内容和更加灵活的教学方式提供了支撑。

1.2.2 数智教育的内涵及要素

1.2.2.1 以培育数字素养为基础

发展数智教育，数字素养的培育是关键。数字素养是一个人能够有效、安全和负责任地使用数字技术来获取、评估、创建和通信信息的能力。培育数字素养不仅是为了让学生在现代社会中更好地生存和工作，更是为了增强社会整体发展的可持续性。

1.2.2.2 以提升智算技能为抓手

智算技能是数字素养基础上更高的能力。它是基于对人工智能的理解、分析和有效使用数据的智能化能力。在数智时代，数据对于决策制定、问题解决和思路开拓至关重要。智算技能的提升需从掌握基本的数据处理技能起步，并进一步学会运用统计学、数据分析工具（包括机器学习与大模型）来解决实际问题。这不仅有助于个体更好地理解信息，还有助于组织更明智地制定战略和政策。

1.2.2.3 以数据科学为核心支撑

数据科学是利用科学方法、流程、算法和系统，从数据中提取价值的跨学科领域。它融合了计算机科学与技术、数学、统计学、信息资源管理等多个学科的基础理论。数据科学将成为培养数智人才的核心支撑，要求数智人才掌握数据科学的理论、方法和技术，具备业务分析、数据建模和应用、智能算法设计等全方位的数据价值实现能力。

1.2.2.4 以培养具备数字思维与数字素养的交叉人才为目标

学科交叉融合是当前科学技术发展的重大特征。数智教育天然具有交叉

学科特征，许多学科的最新发展都与数据和智能密切相关。发展数智教育，要重视培养学生的知识与能力，构建与数智时代相适应的全纳、公平、高质量、可持续的终身教育体系，培养具备数字思维、数字素养与智算技能的数智人才。

1.3 数智人才培养的需求分析

1.3.1 实现科技创新的需求

创新驱动发展，科技引领未来。在数字经济时代，数字技术的革新会为未来教育带来重大机遇与全新挑战。未来教育的最大特点就是人机结合的数智教育。因此，高校需要加快推进形成以人机协同为引领的未来教育新形态，建设全民化、终身化学习型社会，提升数字竞争力。

1.3.2 数字产业发展的需求

相关研究显示，2013年至2021年，以传统和新兴数智人才培养高校和专业数量为评价指标的数智人才指数增长了5.44倍，但数智人才的数量仍然远不能满足数字经济发展的需要。据预测，到2025年，数字经济核心产业增加值占GDP比重将达到10%。随着数字产业化和产业数字化的快速推进，数智人才的缺口还将继续扩大。

1.3.3 数智化社会转型的需求

数智时代的数据、信息和知识具有流动性、场景性、社会性等特点。互联网技术和即时通信技术的发展，将进一步推进新的虚实结合的社会性空间和更精细化的社会分工的形成。数智技术未来将覆盖各行各业，如城市大脑、智慧矿山、智慧路网、无人码头、物流机器人等。

1.3.4 参与数字治理的需求

全球数字治理是指针对具有跨国属性的数字议题，围绕建构全球治理体系和治理机制，以应对国际公共风险、释放全球公共价值的理论研究与政策

实践。数字治理既包含“基于数字的治理”，也包括“对数字的治理”。当前，全球数字治理问题日益凸显。大学应充分发挥学科优势，积极参与解决全球性数字问题，助力搭建公平高效的全球数字治理框架，推动数智时代的全球发展和安全。

2 数智教育体系

本书编写专家组采用网络调查法对全球60所知名高校展开了综合调研，分析了各高校的培养目标、专业设置模式、课程体系等人才培养现状。调研涉及计算机科学与技术、数学、统计学、信息资源管理等4个学科。

2.1 学科体系

2.1.1 培养目标

2.1.1.1 掌握扎实的基础知识

既包括通过通识类基础课程培养学生的数字思维，也包括通过数据科学专业基础知识课程培养学生的数字素养。部分高校以开设“数据科学导论”等通识类基础课程的方式，培养学生的数字思维。

2.1.1.2 注重交叉的融合应用

注重数据科学方法和技术在各学科的交叉应用，结合不同专业的学科特点进行分类培养。

2.1.1.3 培养解决问题的能力

本科生阶段要求学生掌握学科相关基础知识和技能；研究生阶段更加注重学生对某一研究方向的深入研究和创新能力。此外，部分学校还开设了实践课程或开展项目实训。例如，麻省理工学院开设小班研讨课程，鼓励学生实践，在课程中设置实验室项目，要求学生参与涉及计量经济学与数据科学相关知识和交流密集的实践项目。

2.1.2 专业设置发展现状

在调研的60所高校中，共有54所高校开设了数据科学专业，其中25所高校同时开设本科生、研究生的数据科学专业，25所高校通过多个院系联合开设或者在跨学科研究所开设该专业，占开设该专业高校数量的40%。数据科学专业的跨学科特征，使得各高校逐步将数据科学专业由依托单一学科转变为跨学科交叉联合办学，以培养交叉创新人才。

2.2 课程体系

各高校根据不同学历层次梯度设置培养课程，通常采用基于模块的课程体系，面向不同学科学生提供专业课程。同时，支持学生按学位、辅修、培训等不同学历层次的需求选择课程模块。

2.2.1 本科生课程体系

在数据科学领域的教育中，各高校核心课程在本科生阶段注重专业基础课程，使学生掌握数据分析、挖掘、可视化等方法和技术，倾向于实际应用能力。具体而言，高校普遍设置了以数据科学专业通识基础、数据处理基本方法与技术为核心的专业课程体系。专业必修课程包括通识类课程和学科必修课程，前者如“数据科学导论”，后者则包括“线性代数”“计算机编程基础”、“机器学习”等关键课程，旨在为学生奠定坚实的理论基础和技能储备。同时，数学、统计学和信息资源管理等相关学科的基础课程也被纳入必修课程体系，以确保学生能够建立起扎实的专业理论基础。在专业选修课程方面，各高校提供了一系列深入的技术课程，如“科学计算导论”“统计学习导论”“数据管理系统”“高级大数据解析”“大数据存储与管理”“数据结构与算法应用”等，让学生可以根据个人兴趣和发展方向选择适合自己的课程。

值得注意的是，各高校的实践课程在课程体系中都占据了重要地位，如数据管理综合实践、数据分析实验、大数据实践等。这些课程不仅有助于学

生将理论知识与实践相结合，还能提升其解决复杂数据问题的能力。麻省理工学院的高峰体验（Capstone Experience）项目和个人研究项目，旨在通过实际案例研究或实验性项目，培养学生的实证分析能力和解决实际问题的能力。

2.2.2 研究生课程体系

在数据科学领域的研究生教育中，硕士或博士阶段课程体系通常分为专业必修课和专业选修课两部分。硕士阶段必修课覆盖数据科学、数学与统计、计算科学三大模块，如“大数据分析与处理”“数据挖掘”“数据科学概率与统计”“数据科学计算基础”等课程，旨在为学生构建坚实的基础。硕士阶段选修课分为数据科学及学科领域两大模块，前者侧重于前沿方法与技术，如“动态规划和强化学习”；后者涉及多个交叉学科领域，如“企业数据挖掘”“生物医学统计”“地理信息技术”等，旨在拓宽学生的知识面。博士阶段必修课深入探讨高级理论，如“随机过程”“高级概率”“统计推断”等，旨在深化学生对数据科学核心理论的理解。博士阶段选修课则与学科研究领域紧密结合，包括“算法分析”“高级机器学习”等课程，有助于学生在特定领域深入研究。

此外，研究生课程还包含研究项目、专业实习等实践活动，旨在培养学生解决复杂问题的能力。例如，麻省理工学院要求为期4周以上的专业实习，牛津大学则要求参与讲座、高峰体验项目、课程研讨会或讲习班，帝国理工学院和伦敦大学学院则注重参加数据科学领域的研究项目或研讨会。这些实践课程不仅强化了学生在数据分析领域的专业知识，还引导他们探索数据科学的最新进展和应用。通过系统学习这些课程，研究生能够在理论与实践相结合的过程中，获得必要的技能和经验，为未来的学术研究或职业发展奠定坚实的基础。

2.2.3 科研情况

在数智领域的教学活动中，各高校不仅致力于基础理论的探索和算法的

创新，还注重将研究成果应用于实际问题的解决。在机器学习与深度学习领域，各高校发表了大量关于新算法和模型在图像识别、语音识别、自然语言处理等领域的应用研究论文，提升了各高校的学术声誉；在大数据分析与数据管理领域，提出了多种大数据处理与分析的新方法，解决了在医疗、金融、电商等领域中的实际问题，并通过学术论文和专利申请体现了其研究成果；在人工智能与智能决策系统领域，通过开发智能决策支持系统，在医疗健康管理、金融风险评估、智能交通管理等领域实现了一系列成功的应用，促进了相关行业的智能化进程；在计算统计学与数据可视化领域，在理论和应用上取得了重要突破，提高了数据分析的效率和结果的可视化展示，服务于科研和工程实践；在跨学科研究与应用领域，通过跨学科的合作，解决了复杂问题，并在多个学科领域中推广和应用了数据科学的方法和技术。上述教学科研成果不仅推动了学术界的进步，也为行业创新和社会发展提供了重要的支持。

2.3 教材体系

在数智人才培养方面，相关教材的选择和使用因学校和课程设置而有所不同。一般来说，各高校主要使用一些经典和权威的教材作为主要教学资源，以下是大多数高校选取的英文教材：*Introduction to Statistical Learning*、*Pattern Recognition and Machine Learning*、*Deep Learning*、*The Elements of Statistical Learning*、*Bayesian Data Analysis*等。相关的中文数智科学教材主要从国外引进，不仅涵盖了基础理论和方法，还结合了实际案例和应用场景，旨在培养学生的理论素养和实际操作能力，以应对日益复杂和多样化的数智领域需求。关于基础理论与方法的相关教材有《机器学习》《数据挖掘与分析》《人工智能基础》，前沿技术与研究领域的相关教材有《深度学习》和《大数据技术与应用》，实践案例与项目领域的相关教材有《数据科学导论》

和《机器学习实战》，关于跨学科融合与国际化视野的相关教材有《计算机视觉与图像处理》和《自然语言处理》。

2.4 保障体系

2.4.1 实验平台建设

在全球范围内，数智科学领域的高等教育机构正引领着数据科学、人工智能和机器学习等领域的创新与突破。各高校通过设立前沿实验室和研究中心，汇聚顶尖学者与研究团队，在数智人才培养实验平台建设方面展现出了多样化和深度化的趋势。这些实验平台不仅配备了高性能计算设施、先进的传感器和机器学习算法，还与科技公司保持着紧密的合作关系，从而为学术研究提供了丰富的应用场景和资源支持，促进了科研成果的转化和技术的商业化。

以英国牛津大学为例，该校在计算机科学和人工智能领域拥有多家重要实验室，其中，Oxford Robotics Institute致力于机器人技术和自主系统的研究，覆盖了从感知和规划到控制和操作的各个环节；Oxford-Man Institute of Quantitative Finance则结合数学建模和计算机科学技术，对金融市场进行量化分析和预测。清华大学智能技术与系统国家重点实验室汇聚了该校在计算机科学、人工智能、机器学习等领域的顶尖学者和研究人员，实验室配备了包括超级计算机、分布式存储系统、高性能服务器在内的先进设施，支持大规模数据处理和复杂算法计算。该实验室不仅承担了多项国家级和行业合作的研究项目，还在智能系统设计和大数据分析等领域实现了学术研究与工程应用的深度合作，为社会输送了大量高素质的学术研究人才和工业技术人才。此外，北京大学信息科学与技术学院的计算机视觉实验室以其在图像识别、模式识别和人工智能应用方面的研究成果闻名，为学生提供了世界领先的研究环境和技术支持，促进了该领域的人才培养和技术创新。

2.4.2 师资队伍力量

为了应对复杂的数智挑战，各高校不仅聚集了顶尖的学术力量，还注重教师的跨学科研究和实际应用能力的培养。教授们的研究团队在各自的领域内开展了众多具有影响力的研究项目，为学生提供了丰富的学术资源和实践机会。这些团队不仅涵盖计算机科学和数学领域，还包括统计学、工程学、生物学等相关学科。跨学科团队能够更好地整合不同领域的专业知识，推动前沿研究和创新应用。

例如，牛津大学在机器学习、计算机视觉和数据科学等领域拥有多位国际知名的教授和研究人员，如Michael Osborne、Phil Blunsom等。这些学者在学术界和产业界的贡献突出，并对学术研究和教育质量起到重要的推动作用。哈佛大学拥有多位在数据科学、计算机科学和人工智能领域领先的教授和研究人员，如Yoshua Bengio等。这些教授和研究人员在推动深度学习、自然语言处理等领域的研究方面具有显著的影响力。

2.5 评价体系

各高校在数智人才培养中注重多维度的学生评价体系。这种评价体系不仅注重学生的理论知识掌握，还重视学生在实际项目中的应用能力和解决问题的能力，旨在全面评估学生的学术能力、实际技能和职业发展潜力，以此不断优化教育质量和课程设计，并确保教育与市场需求接轨。

个人发展计划和反馈机制。一些高校采用个人发展计划（PDP）或反馈机制来帮助学生制定个性化的学习目标，并定期评估他们的进展和成就。

实习和项目评估。评估标准包括项目成果的质量、解决问题的能力、团队合作与沟通能力等方面，不仅仅考察学生的编程能力或数学建模能力，还能够反映他们的团队合作能力和创新潜力。

学术竞赛与证书考试。作为评估学生能力的一种方式，帮助学生建立自

信，拓展学术视野。

导师评价和建议。导师的评价和建议够提供个性化的指导，帮助学生在学术和职业发展上做出更好的选择。

行业合作和雇主反馈。高校经常与行业合作，获取雇主对毕业生技能需求的反馈。

3 数智教育案例

随着全球教育数字化转型的加速，数智教育已成为推动高等教育创新与变革的重要力量。全球各高校纷纷响应时代号召，通过构建智慧虚拟课堂、优化课程体系、打造教学实验平台、创新教学评价与师资建设，以及深化人工智能赋能高等教育等多维度举措，探索数智教育的新路径与新模式。本报告通过详尽分析各高校在数智教育提升教学质量、促进教育公平、培养创新人才等方面的显著成效，揭示数智教育的核心价值与未来趋势，为全球高等教育的高质量发展贡献智慧与力量。

3.1 课程案例

3.1.1 数智教育课程建设

案例一：浙江大学“人工智能通识课程体系”

浙江大学于2024年3月成立了人工智能教育教学研究中心，旨在构建多层次、高质量的人工智能类本研通识公共课程体系，深化人工智能教材、实践教学和师资队伍建设。浙江大学的人工智能课程体系分为两个主要部分：一是AI+X学科交叉课程群，旨在通过建设不少于100门与各学科深度融合的人工智能课程，让学生在跨学科的视角下探索人工智能的新理论、新技术和新方法，拓宽学术视野，增强跨领域创新能力；二是人工智能通识课程群，针对理工农医和人文社科两大类学生群体，开设不同层次的“人工智能基础”通识课程，满足不同专业背景学生的需求。其中，“人工智能基础（A）”侧

重于理工农医领域，强调理论与实践相结合，培养学生运用人工智能解决专业问题的能力；“人工智能基础（B）”则面向具有一定编程基础的人文社科学生，引导他们掌握人工智能基本原理及其在本领域的应用；“人工智能基础（C）”专为无编程背景的人文社科学生设计，重在普及人工智能基础知识，激发学习兴趣，培养人工智能伦理意识和社会责任感。浙江大学“人工智能引论”构建了系统化的人工智能知识图谱和课程内容，形成了十大知识模块63个知识点的完备体系，覆盖了从基础理论到实践案例的广泛内容。配套的教学资源丰富多样，包括2000多分钟的教学视频、近千页的PPT课件和上百个实践题目，为学生提供了沉浸式、互动式的高质量学习体验。

案例二：中山大学“人工智能课程体系”

中山大学于2021年与华为技术有限公司共同启动了“智能基座”产教融合协同育人项目，旨在构建一个贴合产业需求、适应不同学科背景学生的数智教育体系。该项目秉持“通识+专业”“理论+实践”“融通+创新”的设计理念，设计了一个多层次、多维度的课程体系。课程体系的核心是五大类别：通识课程、基础课程、核心课程、实验实践课程以及应用课程。它们覆盖了从理论到实践的全过程，不仅提供了人工智能领域的基础知识，还深入到具体的技术应用和实践操作。通识课程如“人工智能导论”“数据安全与隐私保护”面向全校学生开放，旨在普及数智化时代的基础概念与伦理原则。基础课程则深入到机器学习、数据挖掘等专业领域，为学生打下坚实的理论基础。核心课程聚焦于深度学习、模式识别等尖端技术，而实验实践课程则通过程序设计、人工智能实践等，让学生动手，将理论知识转化为实际技能。应用课程如“ROS智能机器人操作系统及应用”“物联网技术与应用”等，则引导学生将所学知识应用于解决真实世界的问题，强化创新思维和解决复杂问题的能力。该项目已成功建设85门课程，融入了华为的鲲鹏、昇腾、华为云等前沿技术，使得学生能够接触和掌握行业最新动态。目前，已有超过3200名

学生参与其中，逾百名学生通过了相关技术认证，更有50余名佼佼者荣获奖学金及“未来之星”称号。

案例三：复旦大学“AI大课”

复旦大学于2024年启动人工智能课程体系建设和教育模式改革，简称“AI大课”，旨在加快构筑科学智能创新生态，开创AI+融合创新人才培养的新局面。基于人工智能发展特点及全校“普及圈”“核心圈”“进阶圈”的AI和AI+人才培养需求“画像”，复旦大学本研一体化高质量构建了AI-BEST进阶式课程体系，包括AI通识基础课程、专业核心课程、学科进阶课程和垂域应用课程4个序列。预计在2024—2025学年，推出不少于100门AI领域课程，实现AI课程覆盖全体本研学生、AI+教育覆盖所有一级学科、AI素养能力要求覆盖所有专业，达到3个100%的渗透率。这种全方位、多层次的课程布局，既满足了不同层次学生的学习需求，又强化了学科交叉与实践创新能力的培养。复旦大学还积极探索AI+人才培养的新模式，致力于为AI赋能千行百业。“AI大课”计划以AI-BEST课程为基座，分类组合课程群，设立“X+AI”双学士学位、“X+AI”博硕双学位、AI和AI+微专业等3种AI+教育模式，为不同背景的学生提供灵活多样的学习路径。这一系列创新举措，不仅拓宽了学生的学术视野，还为他们提供了跨学科学习的机会，使学生能够在掌握本专业知识的同时，深入理解AI技术及其在特定领域的应用。

案例四：北京大学“本科数智教育课程体系”

北京大学推出《本科数智教育教学实施方案》，旨在构建一个多层次、多路径的教育体系，培养学生在数学和计算机科学方面的基础，使其掌握人工智能与数据科学的理论方法，并提升数智素养与创新实践能力。该方案通过“基础融入、通识融通、专业融合”的教育模式，培育具备未来竞争力的创新人才。《本科数智教育教学实施方案》的重点任务涵盖数智领域专业建设、多路径本科数智教育课程体系构建、人工智能教育赋能以及数智教育质量监控。

课程体系将完善人工智能或数据科学相关领域从公共基础到专业核心的递进式课程，并针对不同基础的学生，建立全覆盖的数智公共课程群。重点升级计算机等公共基础课程，融入人工智能内容，提升学生数字思维、人工智能素养。继续加强数学和计算机基础教育，修订本科生计算机公共基础课课程大纲，在“计算概论B/C”“数据结构与算法”等计算机必修课中融入人工智能等新一代信息技术内容，提升学生数智素养和应用能力；升级“问题求解与程序设计”课程，将其调整为“人工智能与计算思维”系列课程组，以解决问题为导向，将每门课程与具体的科学和哲学社科问题相结合，培养学生运用人工智能解决学科问题的能力。北京大学着力建设一批人工智能或数据科学通识教育课程，融通学生跨学科思维和数智应用能力。同时，开设“博雅人工智能讲堂”，邀请专家学者讲授人工智能领域的学术思想与前沿成果，进一步拓宽学生视野。

案例五：剑桥大学“人工智能伦理与社会硕士课程体系”

剑桥大学继续教育学院推出的“人工智能伦理与社会”硕士课程体系，致力于培养能够深刻理解并应对人工智能伦理和社会挑战的领导者。该课程体系涵盖了隐私、监控、公正性、公平性、算法偏见、错误信息、大数据和负责任创新等关键议题，由剑桥大学未来智能Leverhulme中心与继续教育学院联合开发，汇聚了哲学、机器学习、计算机科学、政策和法律等多个学科的专家知识，曾荣获2022年CogX“最佳人工智能课程”奖项。该课程体系的主要特点体现在其多学科融合的方法论、对伦理议题的重点关注、对专业能力发展的重视，以及对知识在现实世界中应用的强调。课程内容跨越技术、哲学、法律和社会科学等多个领域，旨在为学生提供一个全面而深入的知识结构，使他们能够在人工智能快速发展的今天，有效地识别、分析并解决伴随其而来的伦理和社会问题。该课程体系强调实际应用，鼓励学生将理论知识与实践相结合，通过面对面授课、案例研究、研讨会、论文工作坊和实际

操作等方式，培养学生理解人工智能伦理与社会挑战的能力，使他们能够运用跨学科理论和方法来解决这些挑战。这种教学模式不仅增强了学生的批判性思维，也锻炼了他们的创新能力和领导力。

案例六：南京大学“1+X+Y”人工智能通识核心课程体系

南京大学于2024年推出了“1+X+Y”三层次“人工智能通识核心课程体系”。该体系以培养具备数据思维、计算思维和智能思维的未来领军人才为目标，旨在让每一名南大学子都能适应智能时代的挑战，成为各行各业的拔尖人物。“1门人工智能通识核心课”由中国科学院院士谭铁牛、欧洲科学院院士周志华教授等人工智能领域的顶尖学者领衔，以“集体施教+小班主题研讨+实习实践+AI助教”的教学模式，激发学生对人工智能的兴趣，普及基础概念，引导学生正确认识智能时代。课程设计紧密贴合专业，通过趣味问题引出讨论，如“人工智能是如何看世界的？”“人工智能如何战胜人类？”等，让学生在思考中探索AI的奥秘。“X门人工智能素养课”着眼于“交叉”，主要面向低年级学生，旨在引导学生从不同角度认识、理解、思考人工智能。课程内容覆盖自然科学、数字人文、数字经济、社会科学等多个领域，如商学院的“人工智能背景下学习与科研”、软件学院的“AI驱动编程”、外国语学院的“人类语言与大语言模型”等，共计100余门课程，旨在满足不同专业学生的进阶需求，加深他们对AI在各自领域应用的理解。此外，人工智能学院还特别开设了7门系统课程，专注于人工智能应用能力的培养，面向全校学生开放。“Y门各学科与人工智能深度融合的前沿拓展课”着眼于“无限可能”，主要面向高年级学生，以“课程+项目”为主要形式，引导学生动手实践和深度参与。学生还将直接进驻重点实验室等科研机构、头部企业等产业平台，亲身体验和参与最前沿的科学研究项目。该课程旨在培养学生面对未来智能化时代解决多学科领域复杂问题的创新能力，以及培养他们干事创业的创业家精神。

案例七：兰州大学“数字技术类微专业”

兰州大学于2023版人才培养方案中着重强化基于专业核心能力培养的信息素养和数据分析能力。为此，学校不仅在绝大部分专业中增设了编程类、大数据类、人工智能与机器学习类课程，还陆续推出了多个数字技术类微专业，如“认知科学与人工智能”“数字政府与智慧城市治理”“循证医学”“数字媒体设计”“智慧教育技术”“大数据应用–数字与智慧地球”。这些微专业的设立，不仅丰富了课程体系，更旨在培养学生的学科交叉能力，使其成为具备创新能力的复合型人才。例如，“认知科学与人工智能”微专业聚焦认知与AI前沿，旨在解锁学生思维领域的新天地；而“数字政府与智慧城市治理”微专业则致力于培养能够熟练运用行政管理学理论及数理统计等方法的复合型行政管理专业人才，以满足现代社会的需求。兰州大学还注重课程内容的实用性和前瞻性。例如，“循证医学”微专业通过提升学生的循证研究能力，使他们具备扎实的循证医学证据检索、评价以及综合知识和技能；“数字媒体设计”微专业则为学生提供了一个全方位掌握数字媒体艺术的平台，通过跨领域的教学与实践，使他们成为具有创新能力和实操技能的新媒体人才；“智慧教育技术”微专业则结合行业与市场分析，引入知名人工智能教育企业的岗位能力要求，旨在让学生掌握智慧教育技术的应用与教育技术专业素养；“大数据应用–数字与智慧地球”微专业则强调实践能力与创新思维的培养，使学生掌握大数据处理与分析技术，并了解人工智能在地球科学中的应用，从而获得跨学科的知识结构，更好地理解地球系统的复杂性及其与人类社会的互动关系。

案例八：香港岭南大学“文化研究课程体系”

香港岭南大学的文化研究文学士（BACS）课程旨在培养学生的数字技能、批判性数字素养，并为他们在媒体、文化和社区发展领域的数字社会创新做好准备。这一课程体系体现了3个核心特征：一是培养具有社会责任感的变

革者，通过理论与实践相结合的方式，使学生既能深刻理解社会与个人之间的复杂互动，又能运用媒体制作、工作室学习和毕业设计项目解决实际问题；二是课程结构灵活且以技能为导向，重点聚焦于媒体、文化和社区发展，提供“数字文化与媒体实践”和“文化共享、社会创新与创造力”两个专业方向，以满足不同行业的需求；三是采用批判性的非决定论方法对待数字智能技术，鼓励学生积极拥抱新技术，同时也培养其批判性思维，以便在快速变化的技术环境中保持敏锐的洞察力。为了实现上述目标，BACS课程设置了一系列必修课程，如“文化与现代世界”“文化研究方法”“文化研究视角”，为学生提供理论和方法论的基础。学生可以选择两个专业方向之一，每个方向都围绕理论、实践和政策与管理3个方面展开。例如，“数字文化与媒体实践”方向的课程会涉及数字媒体产业的发展趋势，而“文化共享、社会创新与创造力”方向则更侧重于探索数字智能时代下的新型经济和社会关系。此外，还有专门针对数字智能技术的课程，如“平台未来与开放合作主义”和“数字技术与知识共享”，旨在介绍数字社会创新和文化产业/文化共享的前沿理论和实践。“社会创新的反思方法”和“社会价值和社会影响评估：批判性导论”等课程，则帮助学生批判性地反思社会创新的过程及其影响。“食品、技术与环境”“城市文化”等课程则结合理论与实践，重点关注城市、环境、可持续发展等议题。这些都是文化共享和社会创新实践的重要领域。

3.1.2 数智教育教材建设

案例一：浙江大学“人工智能系列高水平教材体系”

浙江大学建成了涵盖科普—通识—专业—交叉系列的教材体系。该系列已涵盖了25本理论技术教材与11本实践应用教材，内容囊括了人工智能的基础理论、算法模型、技术系统、硬件芯片及伦理安全，“智能+”学科交叉及其实践等内容，为学生提供了全面而深入的学习资源。2023年，潘云鹤院士团队负责新一代信息技术（人工智能）领域的教材建设。团队牵头推进包括

《人工智能引论》《模式识别》《机器学习》《深度学习》在内的20门教材的编写工作。该教材集成了丰富的数字化教学资源，包括知识点讲解视频、教学案例、实践教材等，为师生提供了多元化的学习工具。教材设计了多个应用场景，如教学大纲生成、预习助手、复习助手等，通过智能化辅助服务，实现了从传统的“知识本位教育”向“能力本位教育”的转变，为教育现代化进程注入了新的活力。

案例二：中山大学“强实践、促交叉的人工智能教材建设”

中山大学积极推动“人工智能+”教材体系建设，已建成涵盖工科、文科乃至医科领域的约30本人工智能相关教材，实现了学科间的深度交叉与融合。例如,《人工智能原理与实践数字课程》作为一部全数字化电子教材，不仅系统阐述了理论知识，更引入了科研实践环节，通过实验演示、实践训练及典型学科交叉案例分析，激发学生的创新思维和解决问题的能力，体现了“理论与实践并重、学科交叉融合”的教育理念。中山大学深化教材建设的数字化转型，鼓励教师开发更多立体化、形象化、智能化的数字学习资源，以满足信息化时代教育教学的需求，旨在通过AI助教、在线互动平台等手段，实现个性化教学，提升学习效率与质量。

案例三：武汉大学“数智人才培养教育教材体系”

武汉大学将数智人才培养分为“通识、赋能、应用、专业”4种类型，贯通高中、本科、专业型硕士和博士4个学历层次，采取“分类+梯度”的模块化选课、“融通+创新”的灵活性设课、“基础+场景”的差异化授课的体系化分类培养思路。为了更好地契合不同层次和类型人才的培养，武汉大学数智人才培养课程采取“分类+梯度”的模块化设置，按难度递增依次为数据基础、数据智算、数据创新三大模块，以适应不同学历层次和不同培养类型的差异化培养需求。在课程设置方面，采取“融通+创新”的方式进行课程改革：一是融合现有课程，通过升级的方式落地课程教学，高效地实现课

程优化；二是根据数据科学本身规律开设新课程，如“数据采集”“数据管理”“数据可视化”等。这些课程以前没有开设，或者开设得较为简单。学校大胆进行知识体系梳理与重构，开发新的课程，实现对现有课程的创新。在课程内容教学方面，采取“基础+场景”的差异化方式，即采取统一的基础知识讲授和针对不同场景的差异化应用实训。武汉大学集中全校教育教学资源，建立全校数智人才培养课程体系，共开设18门数智教育课程。其中，本科生课程9门，包含通识教育课程3门，跨学院公共基础课程6门；专业型硕士课程7门；博士课程2门。通过系统构建全校共享贯通的人才培养体系，培养具备数字能力的不同层次、不同领域的数智人才。

3.2 平台案例

3.2.1 在线课堂教学平台

案例一：上海交通大学“好大学在线平台”

上海交通大学于2014年创立“好大学在线”平台以来，已汇聚205万注册用户、623所用课院校，促成约74万人次的学分认定，其影响力与日俱增。平台通过“MOOC+SPOC+本校教师”的混合式教学模式，结合在线课程学分互认机制，多次开展“MOOC西行，同步课堂”活动，通过直播共享上海交通大学的精品课程，为西部地区师生提供了宝贵的学习资源，助力缩小区域教育差距。在实验实践类课程教学改革中引入数字人技术，通过线上理论学习与线下实操相结合，丰富了教学手段，提高了学生实践能力和创新能力。数字人技术则不仅能够提供全天候的教学服务，还能通过互动方式增强学习效果。

案例二：兰州大学“SPOC网络教学平台”

兰州大学构建了校内SPOC网络教学平台，该平台依托于超星“一平三端”的技术架构，与“云上兰大”全校信息互通、资源共享、统一门户的大

平台相融合，为全校师生提供了“一人一空间”的网络教学与学习环境，有力支持了“课前—课中—课后”的全方位教学活动。兰州大学高度重视在线课程资源的建设和共享，鼓励教师自主创新，利用该平台结合传统教学优势与在线教学优势，实现各类本科课程资源的线上化建设。截至目前，该平台已为校内36000多名学生、2700多名教师及500多名干部职工开通了网络教学空间，支持在线通识课程学习、日常教学（包括混合式教学和课程资源建设）、教学互动、专题培训等多种教学活动，积累了丰富的教学资源，总资源量达到70万份，题库量达140万份。兰州大学SPOC网络教学平台还具备学情分析、学生综合素质评价、教师线上培训学习和培训认证管理等功能，极大地促进了教育教学质量的提升和学生综合能力素质的发展。

案例三：中国科学技术大学“瀚海教学网”

中国科学技术大学打造了一体化线上教学门户——“瀚海教学网”，集教学平台、录播平台、资源平台于一体，全方位支持本科教育教学。教学平台支持课件制作、资料上传、交流互动、作业考试等功能；录播平台基于课表对接，实现自动直录播，并支持视频编辑和语音文字转写等功能；资源平台则承载各类教学资源，支持分层分类和标签检索等功能。瀚海教学网将课堂教学、录播教学与线上线下融合式教学融为一体，通过与教务系统、助教系统及ClassIn教学工具等系统的对接，利用人工智能、大数据等技术手段，实现了多种教学模式的有机融合。为了发挥学校优势学科特色，“瀚海教学网”建立了满足教学目标、符合教学需求、具备教学特色的在线资源体系。通过汇集各类电子资源，汇聚学校多单位力量，协同合作创建数字教学资源库，“瀚海教学网”已成为教学资源共建共享的重要载体。

案例四：香港中文大学“混合式自学平台”

混合式自学平台（Self-learning Platform for Blended Learning，简称BLISS）融合了香港中文大学、香港浸会大学及香港翻转教学协会的学术智慧和专业

实践，致力于深化混合式学习模式的实践探索与创新应用。BLISS以其卓越的教学效率和灵活性，成功激发了学生的自主学习能力和探索热情。BLISS为教师群体提供全面而深入的专业发展支持，包括但不限于证书课程、工作坊等多样化培训机会，以及科学教育顾问的专业咨询服务。BLISS通过构建一个资源丰富的自学平台，制作了涵盖多元学科的自学教材，不仅丰富了学生的学习选择，也为教师的专业交流提供了强有力的社群支持。此外，BLISS还关注教师混合式教学能力的发展，通过系统性文献综述法和质性元分析方法，构建了教师混合式教学能力发展模型。该模型包括原则层、准备层和策略层，旨在为区域、学校、教师教育机构规划设计相关教师专业发展项目，提升教师混合式教学能力提供参考。在实施混合式教学的过程中，BLISS强调了教师专业发展的重要性，认为教师应从知识传授者转变为学习活动的设计者和指导者，构建师生学习共同体。混合式教学模式覆盖了课前、课堂、课后环节，融线上与线下教学为一体，实现了师生实时互动，正逐步成为高等教育教学改革的“新常态”。BLISS的另一大特色在于其对学习进度的精准监控与反馈。通过电子徽章系统，学生的学习活动得到了有效的记录与激励。平台内置的笔记和自测功能，使学生能够在学习过程中随时记录要点、自我检测，从而更有效地掌握和巩固知识。视频播放速度的调节功能，更是考虑到了不同学生的学习节奏，体现了平台的人性化设计。

3.2.2 数智实践创新平台

案例一：西安交通大学“智能制造数字孪生虚拟教学平台”

西安交通大学机械工程专业搭建了基于数字孪生技术的智能制造综合实践平台。这一平台不仅集成了大数据分析系统和数控云平台，还实现了机械行为特征的数字孪生规划，使物理世界与数字空间无缝对接，为机械工程专业的数智化实践教学提供了坚实的硬件支撑。围绕这一核心平台，学校深入探索虚实协同的教学模式，构建了实景教学与虚拟探索相融合的孪生空间协

同教学实验室、包含真实先进制造设备和复杂生产工艺的智能产线实体平台，以及实质等效于真实车间的孪生车间，实现了实体端与虚拟端的数据同步。学生能够在虚拟环境中模拟真实物理实体的行为状态，进而对实体设备进行优化控制。这种创新的教学方式极大地丰富了实践教学的内容和形式，促进了学生对复杂工程问题的深入理解与解决能力的提升。同时，学校以能力培养为核心，以产业需求为导向，精心设计了一系列基于数字孪生技术的实践教学活动。依托智能制造数字孪生实验平台，学校构建了贯穿产品开发全生命周期的实践教学体系，涵盖了智能设计、制造、测控及运维等多个知识领域。通过将科研成果转化为教学项目，学校形成了以复杂工程问题驱动下“技术开发、工程验证”的全过程创新人才培养链条。此外，学校还创新性地实施了“线上异地教学+在线虚拟仿真+线下项目实践”的多维度虚实融合教学模式，为学生提供了更加灵活、全面的学习体验，有效提升了其解决实际工程问题的能力。

案例二：浙江大学“智海新一代人工智能科教创新平台”

浙江大学人工智能研究所于2020年7月发布了“智海新一代人工智能科教创新平台”（简称“智海平台”），核心特色在于其交互式教学工具Mo-Tutor创新性地整合了多媒体教学资源，包括文本、图片、视频、代码及演示文档，辅以视频播放、语音讲解、图文标注和代码执行等功能，构建了沉浸式的教学体验。首先，通过二维码链接，这些资源与纸质教材知识点紧密相连，实现了教材的数字化升级，开创了数字化出版新形态。其次，智海平台作为理论与实践的桥梁，降低了AI开发的门槛，提供了一体化的在线实训环境，助力教育从知识传授向能力培养转型。更为突出的是，智海平台与高等教育出版社、阿里及华院计算等合作伙伴共同研发了教育大模型智海–三乐，以应对生成式AI带来的教育范式变革。智海–三乐模型能够提供即时答疑、习题生成、案例扩展等个性化学习服务，通过高等教育出版社云服务平台赋

能教育，开创了AI赋能教育的新模式。智海平台始终贯彻“人工智能、教育先行”的理念，服务范围覆盖K12至高等教育，提供平台搭建、资源分享、智能模型赋能及实训项目创建等全方位支持，满足各阶段学习者的需求。

案例三：武汉大学实验创新教学“六个一”平台

武汉大学按照“共建共享、互联互通、交叉融合、开放运行”的总体思路，构建数智人才培养实验创新教学“六个一”平台，建设平台“标准体系”和“一站式门户”，汇集“数据、工具、算力”三大资源，支撑人才培养、科学研究、创新创业和社会服务。“一套数据集”，针对八大领域数智人才实习实践对数据资源的需求，建设具有学科特色的大数据、真数据的实验教学数据资源池，建立数据集元数据目录，提供可持续的大数据存储、处理和开发共享云服务。“一套工具集”，建设从数据采集、数据处理、数据管理、数据分析到数据应用全链路的工具和软件集；利用国际开放共享的数据算法资源，构建武汉大学开放共享的算法、模型、工具和软件集，支持学生参与从软件、工具操作到数据智算算法、模型的编程实习实训。“一个算力池”，遵循“开放、共享、可扩展”原则，在算力资源架构上，采用并行异构的计算框架，实现面向不同专业领域的数智实验需求动态扩展和弹性聚合；开发实验算力动态调配管理平台，分项分时的动态分配和调度计算资源，为各种数智实验开展大数据计算提供灵活的算力支持。“一套标准集”，遵循“有标贯标，多标择优，无标制定”原则，建设包括数据采集标准、数据存储标准、数据处理标准、数据质量标准、数据治理标准、数据管控标准、数据服务标准在内的标准规范体系。“一站式门户”，武汉大学师生可通过服务门户方便快捷地访问使用软件工具、算力存储、数据样本、算法模型、应用案例等数智资源服务，通过在线实验项目开展本科、硕士、博士等多层次数智实验实训教学活动，通过在线开放社区交流分享更多数智学习资源。“一个数智社区”，以“数智认知—数智实践—数智创新—数智创业”为

训创过程链条，采取“数智+”模式，以武汉大学训创中心为依托，发挥学院学科优势，鼓励交叉创新与校企合作，持续支持建设一批“数智+”创新创业分中心，全面支持师生开展创新、创造、创业实践活动，营造“数智+”人才培养环境。

案例四：香港中文大学“uReply学生互动学习系统”

香港中文大学推出的uReply是一款专为移动设备设计的网络化学生互动学习系统（Student Response System，简称SRS）。这一系统的核心在于通过移动技术手段，增强教与学的互动性，从而提升学生的学习主动性。该系统为教学双方提供了一个互动性强、参与度高的学习环境，推动了教育模式的现代化转型。uReply在香港地区高校中获得了广泛认可，经过不断的开发与扩展，已发展成为一个多功能教育平台。它不仅支持学生自主学习安排，还巧妙地将游戏化元素和地理位置互动融入教学中，极大地拓宽了教育的可能性。uReply的基本功能包括单题会话、多题会话、活动和评估等，构建了一个全面而深入的互动学习环境。其特色功能uReply GO和uShare进一步丰富了教学互动的形式，使学习过程更加生动、直观。uReply GO通过在线地图上的行动点与问题关联，创新性地为学生提供了一种基于地理位置的学习路径，增强了学习的实践性和体验性。而uShare则支持教师与学生之间的多媒体交流，极大地提升了信息传递的效率和直观性。uReply的设计充分体现了教学法的应用，允许教师根据教学目标和学生需求，灵活设计和实施教学活动。异步学习作为uReply的一个重要特点，为不同学生提供了个性化的学习体验。此外，游戏化学习活动如速度挑战和同伴评审，不仅增加了学习的趣味性，也提高了学生的参与度和学习动力。

3.2.3 智能教学实践平台

案例一：中山大学“超算习堂：人工智能驱动的超算在线教育实践平台”

中山大学与国家超算广州中心及相关院校共同打造了“超算习堂”教

学实验平台，旨在应对超算人才培养中的规模化教育与个性化指导之间的矛盾，弥补师资力量的不足，以及提升实践教学的智能化水平。教学实践平台实施特色主要体现在3个方面：一是人工智能驱动的实践能力培养引导模式，通过构建以学习者为中心的教育大数据实践平台，辅以个性化智能引导，为用户提供多样化的编程环境与模型支持，并利用人工智能技术定制个性化培养方案；二是基于精准评估的实践学习内容自动生成技术，利用人工智能方法深入分析学生的学习表现，自动生成适应学生能力水平的高性能计算学习内容，极大地提升了学习的个性化与自主化；三是知识图谱驱动的教育因果关联分析与知识推理技术，面向教育数据的固有特点和教育资源分配的普适原则，建立知识嵌入的智能决策与教育资源分配算法，提升了算法的知识分析、关联规则挖掘以及智能决策的能力。该平台不仅在中国31个省区市及港澳台地区普及，还辐射至“一带一路”沿线国家，累计服务超过2万人，访问量突破3700万人次。其广泛的应用与影响力，不仅促进了100余门高性能计算相关课程的实践教学，还推动了跨地域、跨文化的教育资源共享。

案例二：复旦大学“元·创中心融合创新实践平台”

复旦大学的“元·创中心融合创新实践平台”优化了各实验大楼的信息与智能化、大数据与可视化、光机电一体化功能，特别强调机器视觉、数字艺术、心理与行为科学等文理交叉领域的深度整合，为学生提供了一个紧随科技前沿的实践环境。其中，人工智能、VR/AR创新应用、数字艺术、激光雷达、机器视觉、仿生结构等主题实验室的建立，辅以数控加工与3D打印等公共服务，构建起一个全方位、多层次的创新实践生态系统，有效促进了知识的跨界融合与技能的多元化发展。复旦大学教学元宇宙（Fudanverse）是一个融入先进AI技术的多人沉浸式虚拟仿真平台。由复旦大学自主研发的三维虚拟空间中的各类装置和实验的底层物理算法，不仅达到了科研级的实时高

仿真效果，更解决了实际实验中意外辐照、仪器损坏等安全难题。Fudanverse采用广域网多客户端信息同步技术，支持百人以上同时在线互动，兼容多种设备，大大降低了沉浸式学习的门槛。在虚拟实验室中，学生们可以得到教师远程指导下的高自由度实验体验，甚至模拟操作失误的后果。这种无界教学模式极大地拓展了教育的时空边界，为教学效果与方式的关联研究开辟了新的路径。

案例三：北京大学“化小北AI智能伴学平台”

北京大学以受众面较广的化学基础学科为试点，依托化学学院、教发中心和信息学院联合组建的团队建设化学实验教学“化小北AI智能伴学平台”。该平台以化学这一基础学科为切入点，精心设计了知识问答、报告反馈、方案评估三大核心功能，为学生打造了一个全天候的智能学习环境。这一举措不仅拓宽了实验教学的边界，还为学生提供了个性化的学习支持，实现了学习个性化、服务智能化和管理精细化。“化小北AI智能伴学平台”基于先进的大语言模型，通过垂直领域内高质量数据的训练，显著提升了模型的精准度与实用性。平台采用启发式问答机制，不仅能即时解答学生在实验过程中的疑惑，如实验原理、操作流程、化学品安全等全方位内容，还能够依据学生提问的深度与广度，智能出题并评估学生作业，从而激发学生的主动学习意识与批判性思维。更值得一提的是，平台还具备写作论文与实验方案的智能评估功能，为学生提供专业指导与优化建议，极大地丰富了教师的教学手段，促进了教学质量的全面提升。此外，“化小北AI智能伴学平台”还运用了知识图谱与实验能力图谱技术，将分散的专业知识与实验技能有机整合，形成系统的教育智能支撑体系。平台通过收集与分析学生的学习行为数据，绘制出个性化学习画像，为每位学生提供定制化的学情分析报告，帮助教师精准识别学生的学习需求与潜在短板，为实施“一人一方案”的个性化教学设计奠定了坚实的数据基础。同时，平台还能根据学生的学习进度与能力水平，动

态调整实验内容与教学难度，确保每位学生都能在最适合自己的节奏下成长，探索因材施教的理想状态。

案例四：香港大学“数字化学习平台”

香港大学采用前沿的数字工具E-learning，不仅极大提升了教学资源使用的效率和学习流程的管理质量，更在培育学生的自主学习能力与批判性思维方面取得了突破性进展。E-learning平台的亮点之一是集成了聊天机器人。这一智能工具能够提供全天候的即时文本支持，有效解答学生关于课程内容的各种疑问。聊天机器人的引入，显著提升了学生获取反馈的速度，其全天候的服务获得了广泛认可，体现了个性化学习支持的教育技术应用。E-learning平台还将ChatGPT等高级语言模型纳入其中，这些工具为教学、学习和评估带来便利的同时，也提出了新的挑战。如何识别AI生成的内容成了教育者需要面对的问题。目前，包括GPTZero、Open AI Text Classifier和Writer AI Content Detector在内的多种检测工具，通过分析文本的复杂性和突发性特征来辅助识别人类作者。教师还可以利用计算语言学工具如Coh-Metrix，来比较学生提交的多篇论文的写作风格，确保评估的公正性。为应对AI工具可能带来的影响，香港大学鼓励教师设计能够促进学生深度思考和创造性写作的作业。这包括要求学生提交作业初稿或写作计划，并与最终作品进行对比；通过屏幕共享，记录写作过程；反思写作过程，评估学生的元认知能力。教师还可以设计评估题目，考查学生的推理技能如归纳推理和多步骤推理等——这些技能是当前AI工具尚难以完美模拟的。在允许学生使用ChatGPT等工具的情境下，教师可以要求学生进行反思性写作，探讨人类发展与AI辅助发展的差异、使用AI工具加速学习过程的体验，以及对AI辅助学习过程的改进建议。这不仅促进了学生对AI工具的深入理解，也强化了其在学术诚信和伦理使用方面的认识。

案例五：沙迦美国大学“AI Hub智能教育平台”

沙迦美国大学教学创新中心于2024年4月推出了AI Hub。该平台以三个核心目标为指导：致力于提升教育的卓越性，通过整合人工智能驱动的工具和方法，旨在提高教育质量，使学习体验更加个性化和有效；旨在培养创新精神，作为创新的催化剂，为教育者、学生和研究者之间的协作提供平台，拓展教学和学习的可能性；致力于构建一个社区——AI Hub的核心是一个充满活力的前瞻性思想者社区。他们共享探索AI潜力的热情，并通过讨论论坛、工作坊和协作项目，汇集了不同背景的个体，相互学习，共同成长。AI周作为AI Hub的重要组成部分，通过主题演讲、小组讨论和工作坊等形式，聚焦于AI在教育中的变革力量。小组成员深入探讨了高等教育中生成性AI的挑战，以及将AI有效整合到学术环境中的策略。工作坊让参与者有机会探索AI应用，从研究人员的GenAI到与AI教授的互动会议，从而获得实践技能和对AI在教育中变革潜力的深刻见解。AI展览会是AI周的亮点之一，展示了来自Casio、Urbi、Al Hathboor Bikal.ai、+twe、Saal.ai、Klickdata和almalearning.ai等领先组织的尖端技术和解决方案。这些展览不仅展示了AI技术的最新进展，也为参与者提供了与行业专家交流的机会，进一步深化了对AI在教育领域应用的理解。通过这些平台，沙迦美国大学正在塑造一个全新的教育模式。这个模式不仅能够适应快速变化的技术环境，而且能够激发和培养学生的创新能力和批判性思维。

案例六：密歇根大学“人工智能教学助手MAIZEY”

密歇根大学推出的人工智能教学助手MAIZEY，以其精准的大语言模型应用，成功地将复杂的课程资料转化为清晰、有条理的知识结构，极大地促进了学生的自主学习能力。MAIZEY的开发基于对课程大纲的深入理解，并与Canvas等学习管理系统实现了无缝对接，全面吸收包括讲座幻灯片、音频记录在内的数字课程内容。依托定制模型Landchain，MAIZEY能够高效地转录

和编目这些资源，确保在回答学生问题时迅速提供最贴切的信息。该系统的能力还体现在其快速、个性化的反馈机制上，它能够像拥有完美记忆的助教一样，深入挖掘课程档案，精选最相关材料，并以自然、易懂的人类语言进行表达。MAIZEY已吸引了超过40%的学生日常使用，并显著提升了学生的学业表现。自AI助手投入使用以来，学生的学术成绩平均提高了5%。MAIZEY之所以取得成功，不仅因为其高度的可定制性，赋予教师指导AI进行多样化教学的能力，更因为其经济高效的可扩展性，使其能够服务于更广泛的学生群体。平台的全天候服务确保了学生能够随时获得及时反馈，极大优化了教育的互动性和参与度。MAIZEY通过有效的索引和个性化设置，能够针对不同学生的需求提供定制化的学习体验。它能够理解并处理多种文件格式，进一步增强了其在教学中的应用潜力。MAIZEY的这些功能不仅为学生提供了一个强大的学习助手，也为教师提供了一个高效的教学工具，有助于提升教学质量和效率。

案例七：武汉大学“珞珈在线AI智慧教学中心”

武汉大学立足于“顶层设计、统筹规划、分类培养、稳步推进”的总体方针，通过发动“深度融合AI技术、推动教育模式变革、培养未来型人才”的强力引擎，实现教学应用、教育数据、校园服务高度共享的数智教育新生态，全力打造武汉大学参与研发的独立特色品牌——“珞珈在线AI智慧教学中心”。该中心覆盖了学生培养全过程，是专业转型升级的重要支撑。“珞珈在线AI智慧教学中心”一体化管理体系充分利用人工智能教学和人工智能教育管理领域的已有研究成果，以物联网、大数据、云计算、人工智能、微服务等高新技术为基础，以虚实结合的多维服务为发展导向，融合教室端、移动端、管理端各类教学应用，积极推动以智助学、以智助教、以智助管，建构起完整的智慧教学生态。武汉大学依托“珞珈在线AI智慧教学中心”研发了专业知识图谱体系、创建了AI教学智能体、构筑了教学大数据中台。专业

知识图谱体系打破了传统的专业知识图谱建设体系，融合知识体系、PBL教学方法和OBE教育理念，推动教育从知识传授向教学目标达成、能力目标达成的培养思路转变，并利用这种多维度、全方位的评价体系生成多元画像，完成学校的数字化转型闭环。AI教学智能体涵盖了“计算智能+教育”“感知智能+教育”“认知智能+教育”等多个层面。通过AI智能体于在线课堂、虚拟课堂、个性化学习路径设计、智能辅导、自适应学习系统等方面的应用，学校可以对海量教学资源进行智能管理、内容生成与推荐，提高了资源的利用效率，为师生提供了更加丰富、精准的教育资源。教学大数据中台通过整合全校教学相关数据资源，实现数据的统一管理、分析与应用，优化教育资源配置、提升教学质量、促进教学创新和决策科学化。不仅提升了教学管理效率，还深入挖掘了数据价值，为师生提供了更加个性化、高效的教学与学习支持，推动了教学模式的持续创新。

案例八：香港岭南大学“IDEAL-Gen.AI：教学设计与主动学习的AI平台”

“IICA-TDLE”项目是由香港特别行政区大学教育资助委员会资助的教学发展与语言强化跨院校协作活动。该项目由岭南大学牵头，联合香港科技大学、香港中文大学和香港理工大学等多所教资会资助院校共同推进，旨在通过开发名为IDEAL-Gen.AI的教学设计平台，促进虚拟教学和学习的广泛应用，并为教育工作者提供一个集成了人工智能技术的强大工具集。IDEAL-Gen.AI平台利用生成式人工智能和大语言模型的力量，使教学设计人员能够轻松创建高度定制化的学习材料，不仅极大地提升了教学效率，也为学生带来了更加丰富和个性化的学习体验。IDEAL-Gen.AI平台的推出，标志着教学设计和内容创建领域的一次重大飞跃。该平台的核心优势在于其独特的自动化教学设计功能，能够根据教育工作者的具体需求，快速生成个性化的学习活动、教案和评估任务。与传统的人工设计方式相比，IDEAL-Gen.AI平台极大地减少了教育工作者在内容创建上的时间和精力投入，让他们能够更专注

于提升教学质量。此外，该平台还具备自动提示生成器等功能，用户可以通过设置不同的筛选条件如学科、学习领域和学位水平等，轻松定制教学设计和学习内容。值得一提的是，IDEAL-Gen.AI平台完全免费向全球教育工作者开放。这不仅降低了使用门槛，也体现了项目团队致力于普及先进教学技术的决心。IDEAL-Gen.AI平台将不断拓展其功能和服务范围，以满足教育工作者多样化的教学需求。例如，平台计划引入更多模板和过滤选项，用于生成人工智能驱动的评分标准、考试问题和评估标准，从而进一步简化评估流程。此外，平台还将致力于构建一个教育工作者社区，鼓励分享和合作，共同推动人工智能在教学设计中的应用。

3.3 助教案例

3.3.1 AI赋能专业课程学习

案例一：东南大学“大学物理的人工智能化探索”

东南大学物理学院开发了“大学物理智慧AI助教系统”。该系统通过整合大量数据，自动提炼教案内容，并提供个性化的学习推荐，极大地提升了教学质量和效率。智慧AI助教系统不仅优化了学习路径，提高了教学效果，还通过实时评估与反馈机制，帮助教师精准定位学生的学习难点，为个性化指导提供了有力支撑。这种智能化的教学辅助手段，不仅促进了学生自主学习能力的培养，还为教师提供了教学策略调整的数据依据，实现了教学过程的可视化管理。

案例二：北京大学“AI助教‘博伴智学’赋能课程数学专业建设”

北京大学AI助教“博伴智学”（Brainiac Buddy，简称BB）自2023年秋季学期以来，已成功应用于数学院“图像处理中的数学方法”等多门课程。依托于生成式语言模型与检索增强生成技术框架，它不仅能够精准解析学生疑问，提供翔实的课程资料与参考文献，还能构建个性化知识库，帮助学生进

行深度预习与复习。BB内置的启发式问答功能，通过反问引导学生独立思考，激发其探究欲与创造力，有效促进学生的主动学习。对于教师而言，BB同样是一大得力助手，它能够协助制作教案，设计测试题库。

3.3.2 AI+X多学科创新应用

案例一：浙江大学“智海系列垂直领域大模型AI赋能型课程”

浙江大学于2023年8月成立了垂直领域AI+X学科基座模型研究联合体，目前已正式发布了智海系列垂直领域大模型三乐（人工智能教育）、录问（司法）、金磐（金融）、大禹（智能会计）等4个垂直领域大模型，同时开启了敦煌（敦煌学研究）、开物（智能设计）、知行（大模型协作）、知光（时空数据）、悟化（药物合成）、伏羲–万象（地理科学）、烛照（影视制作）等多个垂直领域大模型研究工作。该模型通过提供智能问答、试题生成、学习导航和教学评估等服务，构建了一个数字化和智能化的教学基座，为学生创造了更加智能和个性化的学习体验。截至目前，智海–三乐已服务于来自浙江大学、同济大学、哈尔滨工业大学、武汉大学、吉林大学、辽宁大学、大连理工大学、华中科技大学、北京师范大学等14所高校的530多名学生，累计提供了上万次高质量的问题解答、概念解析和个性化学习建议，显著提升了学生的学习效率。

案例二：密歇根大学“医学教育中的人工智能应用”

密歇根大学医学院在医学教育领域引入人工智能技术，组建了一个跨学科的专家团队，汇集了来自研究、临床、信息技术和教育评估等多个领域的专家学者，他们共同策划并实施了一系列创新的试点项目。这些项目将AI技术融入医学课程体系和评估机制，旨在明确AI在医学教学、学习及评估中的多元角色。该项目以多样性、平等、包容和正义（DEIJ）为基础，确保了AI技术在教育领域的伦理性与公平性。项目的核心目标之一是深入识别医学生及教师队伍在人工智能知识与技能方面的不足。这一关键步骤涉及对现有教育

体系的全面评估，以明确在AI技能培养方面存在的缺口和需求。基于此项评估，项目计划建立一个监管机构，负责监督和指导AI技术在医学教育中的整合和应用。同时，项目还将汇编一套全面的资源，形成一个多功能平台，用以传播AI使用的指导原则、最佳实践案例和教学材料，确保AI在学术环境中得到伦理和有效的应用。此外，项目着重于开发一系列教育项目，这些项目专注于利用人工智能技术来提升学习和教学模式。例如，智能闪卡的开发。它通过AI算法为学生提供个性化的学习材料和复习计划，从而提高学习效率和记忆力。生成性问题模块则允许学生通过与AI的交互，探索问题的不同解决途径，增强了学习的深度和广度。该项目建立在跨学科合作的基础上，与AI技术的快速发展保持同步，团队也致力于不断调整项目的理论和实践模式。密歇根大学医学院对AI的战略性应用，不仅确立了其在医学教育创新的领导地位，也为未来的医疗保健专业人员提供了在数字化和数据驱动日益增强的领域中成长的智慧。

案例三：剑桥大学“加速科学发现的AI赋能计划”

剑桥大学计算机科学与技术系发起的“加速科学发现计划”（Accelerate Programme for Scientific Discovery），通过一系列跨学科项目，如智能分析复杂系统、构建人类发育图谱、利用数据科学理解心理健康、研究弦理论中的复杂几何、开发用于个性化治疗推荐的数字孪生模型，以及探索大语言模型在跨学科研究中的应用，将人工智能技术与传统科学研究深度融合。这些项目不仅拓展了科学边界，也培养了一代具备人工智能思维的科研人才。更重要的是，计划强调专业发展与协作，通过组织学习小组、在线模块和工作坊，促进知识共享与技能提升，搭建全球性的科研合作网络，体现了数智教育赋能专业建设的前瞻性和实效性。

“加速科学发现计划”的成功实施预示着数智教育的未来趋势：一是跨学科知识的整合与创新，人工智能将成为连接不同学科的桥梁，催生出前所

未有的研究领域；二是实际应用技能的强化，年轻研究人员将在人工智能技术的助力下，成为引领科学进步和社会发展的主力军；三是合作机会的扩展，国际间的学术交流与合作将更加频繁，形成全球性的科研生态系统。

3.4 评价案例

3.4.1 教学质量监测与评价

案例一：西安交通大学“教学质量实时监测数智平台”

西安交通大学创建了教育教学质量实时监测数智平台，开创了“四精”模式的教学管理新机制，即精准数据采集、精准课堂评教、精准督导教师、精准帮扶学生，为提升教学质量与师资建设注入了数字化活力。首先，通过物联网与云计算融合，实时汇聚多源数据，构建了覆盖第一、第二课堂及学生生活全场景的庞大数据库，解决了数据精准采集的瓶颈。其次，结合专家知识与数据双驱动，研发出“教学评价助手”，根据不同授课类型与评价主体，实现了分类多维的课堂教学评价，显著提高了评教的精准度与效率。为进一步强化教师队伍，西安交通大学创立问题驱动式精准督导机制，构建了“校—院—处”三级智能教学质量督导体系，采用联合督导、约谈警示、递进式培训与专家会诊等手段，针对性地指导教师成长，有效解决了教师督导的精准性问题。此外，自2011年起，“智能帮手”系统在学业辅导、心理疏导、贫困资助、就业指导等方面，为学生提供了个性化诊断与精准帮扶，实现了学生成长发展的“一人一策”。这一系列创新举措，实现了所有课堂的精准采集数据、精准评价教学、精准督导教师、精准帮扶学生、教育教学质量的持续提升，形成了采评督帮“四精”模式教学管理新机制，真正起到了师生共同敬畏课堂、提质增效的作用。

案例二：上海交通大学“在线教学督导、教情学情数据分析和可视化平台”

上海交通大学构建了“校院协同的在线教学督导平台”与“动态感知、

全面可视、智慧生成的教情学情数据分析和可视化平台”。上海交通大学于2021年启动了在线教学督导新模式，旨在提高教学评价的效率与公正性。这一模式以校、院两级督导委员会为核心，摒弃了传统的“推门听课”方式，转而采用在线课程督导。在线督导平台全面覆盖了全校500余间教室，通过直观的地图界面，督导人员能够快速定位到目标课堂，实现课程的实时在线旁听及课后随时回放。该平台可提供多角度的课堂视角，包括教师授课画面、学生听课场景以及教学内容展示，使督导员能够全方位观察教学过程，从而在线提交详细、客观的评价反馈。2023年，学校进一步推出手机版听课系统，极大提升了督导工作的灵活性和覆盖面，至同年9月平台正式启用以来，已累计督导课程数千门，留下丰富的教学评价与意见，成为推动教学改革的重要力量。与此同时，上海交通大学还开发了教情学情数据分析和可视化平台，旨在用数据驱动教学革新，提升教学质量。该平台围绕教师、学生和教学管理三大维度展开，运用先进的数据挖掘技术，为各方提供精准的数据支持。对于教师而言，该平台能够提供详尽的教学情况报告，涵盖学生作业、讨论、测验、考勤等多个维度，帮助教师实时了解学情，及时调整教学策略，实现个性化教学。对学生来说，该平台则呈现个性化的学情报告，包括学习进度、成绩排名、教师评语等，同时通过“交我办”及时提醒作业截止日期，促进自主学习与自我管理。而对于教学管理者来说，该平台提供的决策分析报告涵盖了全校教学活动的关键指标，如学习平台访问量、学习资源使用情况、学生出勤率等，有助于优化教学策略，提升管理效能。

案例三：中国科学技术大学“智慧学情系统”

中国科学技术大学构建了智慧学情分析系统，能够量化课堂行为、提取教情学情群像数据，并在此基础上建立一套智慧评价体系，为教学管理和教学质量的持续改进提供了有力支持。系统通过与教学数据中心和教室视频设

备的对接，无感知地获取教室视频信号，并从中提取课堂行为信息。借助多视角骨架提取识别、多摄像头联合感知和隐私智能脱敏等技术，将直观的行为信息转化为可量化的数据，随后通过学习建模和过滤校正，生成具体的指标数据，进而完成课堂整体情况的智能分析。此外，该系统还能够实现教学过程中的异常预警，比如学生的到课情况、在堂状态，以及教师的迟到、缺课和早退等异常行为，确保及时发现并处理问题，促进教学管理的精细化与决策的科学化。最终，该系统构建了教情学情数据展示大屏，并生成各学院以及全校课程的数据分析报告，为教学管理者提供了直观的数据支持，帮助他们更有效地优化教学管理工作，全面提升教学质量。

案例四：武汉大学“AI+”专业图谱

武汉大学在数智教育理念引领下，研发并部署“AI+”专业图谱。通过构建“六层级、五主线、四画像、三图谱、二达成和一中心”的整体框架，打通了“教·学·管·评”全链路，对数智人才培养各个环节进行评价，实现了教育评价的数字化转型，提高了教育评价的科学性、专业性和客观性。“AI+”专业图谱，采用先进的自然语言处理和知识抽取技术，有效解决高校专业知识展示的可视化欠缺、课程考核的标准化依据缺乏以及达成度计算烦琐等问题。基于专业图谱，通过“六层级”系统构建，形成数智化专业建设与动态管理生态，实现了科学管理过程数据和教学监控，使专业定位更加实时准确。打开精细化“教学”转型切口，通过有效整合海量“五主线”过程数据，构建了能实时提供精准评估与反馈的系统，以便及时调整教学策略，创新教学模式。基于AI技术，开拓个性化、自适应、探索性“学习”有效途径，以“四画像”为落脚点进行课程设计，为评价提供依据。建设了知识图谱、能力图谱、素质图谱以实现综合化、全面化评价，重磅推出课程达成度、专业达成度两项评价体系，有效提升了评价体系的数智化和科学化。制定总体战略布局，形成全校合力，最终部署建设了

App、小程序、电脑端的“多端”统一、全链路贯通的一站式一体化珞珈在线AI智慧教学中心。

案例五：中山大学“AI赋能课堂教学评价改革”

中山大学构建了AI赋能课堂教学智能评估平台，全面提升教师数字化教学素养。该平台以图像识别、语音分析、文字识别等技术为支撑，通过全方位观测多媒体教案、师生活动影像、教师板书等信息，实时采集课堂教学情况，以数字化手段向教师和教学管理人员实时反馈教育教学的动态变化，帮助教师及时发现课堂教学不足，助力管理人员更好监测课堂过程。AI赋能课堂教学智能评估平台的实施特色在于其对整体评价过程的革新与优化。相较于传统的督导随机听课方式，基于数据驱动的评价模式针对课堂指标或综合AI评分异常情况可进行重点跟踪，纳入督导巡课任务，显著提升了评价的多样性、精准性和客观性。此外，该平台还实现了课堂教学的全程记录，通过分析教学活动中产生的行为、认知以及情感等多模态数据，如学生注意力、活跃度、教师授课风格等，为教师提供了详尽的教学反馈，帮助其深入了解学情与教情，进而调整教学策略，提升教学技能，构建起一个以数据驱动为核心，集综合评价、精准督导、多元助推、协同提质于一体的正向反馈机制。

3.4.2 数智教育下的教师发展

案例一：北京大学“国际化数智素养教与学研修”

北京大学广泛开展了以“生成式AI背景下的教育教学变革与对策”为主题的系列主题沙龙和研讨会，这些活动不仅汇聚了全校不同学科的一线教师，还邀请了业界专家和学术领袖参与，共同探讨人工智能技术在教学中的最新应用趋势及其带来的挑战与机遇。通过跟踪国际前沿、凝聚教师思想、达成共识并实施创新实践，这些研讨会促进了教师们对于新兴技术如何融入课堂教学的深入理解和实际操作能力的提升。此外，北京大学与

英国剑桥大学、美国密歇根大学等国际顶尖院校每年定期举办“数智素养”国际学术研讨会，专注于探讨人工智能在教学实践中的深度应用、推动科研范式的数智转型、推广教育数智化模式以及构建国际交流社区。特别是自2020年起，北京大学与美国密歇根大学展开了为期4年的密切合作，连续每年举办主题分别为“创新与基于证据的教学”“新时代与工科教学”“人工智能与高校教师发展”“生成式人工智能”教师数智素养提升系列培训。通过与密歇根大学为代表的国际知名院校的深度合作和围绕人工智能为主题的教学培训交流，不断为北京大学教师带来全球视野和最新技术趋势的洞见与启发。

案例二：复旦大学“质保体系数字化转型”

复旦大学积极探索拓展质保体系数字化转型新路径，构建了一个数据驱动的全链条、多维度的高等教育教学质量保障体系，推动本科教育教学管理向以数据为核心的模式转变。首先，学校通过系统集成教学相关数据，如学生评教、教学督导反馈、课堂实况、学生科技创新活动以及教学运行情况等，形成一套精准的本科教学画像系统。这套系统围绕“优师、优培、优课、优生、优管”的核心目标，对各院系的教育教学质量进行深度剖析，帮助院系明确优势与短板，进而实施精准施策，全面提升本科教育质量。其次，复旦大学注重个性化教学档案的建设，借助AI技术深度挖掘学生评教数据，洞察学生学习需求，为教师提供智能化教学建议，助力教师优化教学方法，提高教学实效。以此为基础，学校还构建了“教—评—助”闭环支持体系，依据学生评价与教学督导信息，为教师量身定制教学研修计划，配备教学导师，进行一对一指导，激发教师教学潜力，促进教师职业成长。与此同时，复旦大学智慧教学资源平台的建设，为师生提供了集直播回放、在线教学、教学评价于一体的便捷教学资源门户，满足了学生开放式、泛在式学习需求，加速了优质教学资源的流通与利用。

案例三：香港中文大学“在线课程《技术在高等教育教学与学习中的融合应用》”

香港中文大学《技术在高等教育教学与学习中的融合应用》课程为新教师（包括助教和博士生）提供了一个深入了解在线教学的平台。该课程通过KEEPMoodle平台向全球教育者开放，共设9个模块，系统地介绍了电子学习的理论基础与实践应用。课程内容涵盖从在线同步教学到多媒体内容创作，从激发学生参与到满足特殊教育需求，再到在线评估的运用，为教师提供了一个全方位的技术应用视角，旨在提升他们对在线教学的深入理解和实践能力。作为数字化教学的典范，该课程不仅提供了在线教学设计的前沿视角，更赋予教师必要的技术整合技能。教师将掌握如何运用游戏化学习、学习分析、人工智能和机器学习等尖端教育技术，以增强课堂互动和提高学习成效。

案例四：哈佛大学”利用生成式人工智能教学”研讨会

哈佛大学正在通过各种新兴技术如生成式人工智能、虚拟演讲、在线协作工具、微型机器学习等，积极革新其教学方式。这些技术不仅提升了教师的教学效率，还提供了更多个性化的学习体验。例如，生成式人工智能技术让教师能专注于课程设计；虚拟演讲工具提升了学生的公众演讲能力；在线教学平台使得全球学生能够灵活参与学习；科学、技术、工程和数学教学中的技术工具如数据可视化与在线实验平台，增强了学生对复杂概念的理解和实践能力。此外，人道设计项目结合技术手段解决全球问题，翻转课堂激发了学生的主动学习能力，声学工程中的技术创新让学生更好地掌握声学原理。总的来说，这些技术为哈佛教育带来了更高的参与度、更广泛的学术推广机会以及更深层次的学习效果。德里克·博克教学与学习中心举办了“利用生成式人工智能教学”研讨会，表明生成式人工智能技术正在进入哈佛的教学体系。这些技术如人工智能教育工具有可能通过辅助教师创造内容，生成个

性化的学习材料来影响教学方式，此外还能帮助学生快速获得学习资源和支持。同时，计算机科学助理教授Stephanie Gil博士为学生开展“人工智能中的规划和学习方法”课程，该课程涉及人工智能的规划和学习方法，通过新的人工智能工具和技术重塑学生对人工智能的理解。生成式人工智能技术让教师有更多时间专注于教学设计和互动，而不是重复性工作，同时学生也能够通过人工智能生成工具获得个性化的学习体验。通过人工智能学习类课程，学生将学会应用现代人工智能技术进行复杂问题的规划与解决，提升他们在人工智能领域的技术与实践能力。德里克·博克教学与学习中心的一篇文章《哈佛地平线视觉背后》中提到了利用虚拟演讲技术帮助博士生将他们的研究转化为5分钟的公共展示。该技术利用数字化工具来增强学生的演讲技能和视觉呈现，使得复杂的学术内容能够更容易被公众理解。此类技术提升了学生在现实世界中的展示能力，同时也促进了跨学科的交流和学术推广。这些工具可以帮助学生更好地传播他们的研究成果。德里克·博克教学与学习中心正在通过在线形式为教职工、学生和教研人员提供办公时间与辅导服务，体现了在线协作工具在哈佛教学中的应用。这种技术在跨时区、远程工作的背景下尤为重要。在线工具为学生和教师提供了更大的灵活性，可以随时随地参与学习和讨论。这种技术帮助哈佛在全球化教学环境中保持领先。德里克·博克教学与学习中心举办了名为“科学、技术、工程和数学教学基础”的研讨会，探讨了如何在科学、技术、工程和数学领域引入创新的教学工具。这些工具可能包括在线实验平台、数据可视化工具和自动化评估系统等。在科学、技术、工程和数学领域中引入新技术能够帮助学生更好地理解复杂的概念，并通过技术增强教学效果，提升教学效率和学生的动手能力。德里克·博克教学与学习中心强调了在学术讲述中“在专业故事中吸引听众”的重要性，可能涉及利用互动技术如在线调查、实时反馈工具以及多媒体技术来增强课堂的互动性。这些技术可以让课堂变得更加生动，从而激发学生的

参与感，提高学习效果。

3.5 合作案例

3.5.1 跨校合作与资源共享机制

案例一：浙江大学“华五六校联合AI+X微专业”

浙江大学与复旦大学、中国科学技术大学、上海交通大学、南京大学和同济大学于2021年1月联合发起了AI+X微专业这一创新性人工智能交叉人才培育项目（以下简称“AI+X微专业项目”），成为中国首个跨校课程共建共选、学分互认、证书共签、相互认定的微辅修培养模式。该项目打破高校、院系、专业学科壁垒，联动政校企力量，汇聚一流的学者与产业专家共同开设课程，实现了跨学校、跨学院、跨学科、跨专业的创新性教学与管理，使各交叉领域高校生能够更为灵活、高效地学习、了解人工智能基本知识体系，掌握人工智能核心理论，提升人工智能实践应用能力。在华东五校教学协同中心组织下，AI+X微专业项目面向浙江大学、上海交通大学、复旦大学、南京大学、中国科学技术大学和同济大学的学生开放，后续将进一步提高培养范围，面向其他高校、行业和社会开放。AI+X微专业项目的实施创新型构建了一种全新的科教融合和产教协同的育人模式，全面推动了人工智能人才培养、学科交叉和人工智能生态建设，促进了教育链、人才链、产业链和创新链的有效衔接。这一模式创新了面向长三角高等教育深度合作形式，保证了微专业课程的高质量与高水平。

案例二：中山大学“AI赋能多校联合虚拟教研西行”

中山大学“医学统计学课程虚拟教研室”构建了教学资源共建共享、教师线上线下的协作交流平台，实现了跨区域、跨校际的教育资源整合与优化。中山大学携手喀什大学和桂林医学院，共同探索医学统计学的“同步课堂+线上线下混合式”教学新模式。通过“中山大学同步课堂平台”，三校成功

实施了16次跨地域同步课堂教学，构建了教师间的学习共同体，实现了教学资源的互惠互利。数智教育的合作方向更加聚焦于个性化教学与智能化学习。中山大学依托国家高等教育智慧教育平台，引入人工智能技术，对课程数据进行深度分析，包括课堂规范、教师活跃度、师生互动等维度，生成课后智能分析报告，为教师提供教学反馈，助其调整教学策略。同时，通过对学生学习行为的数据画像，教师得以精准洞察学习效果，实施个性化教学，满足不同院校、不同学生的需求。此外，智能化构建的知识图谱不仅方便学生开展个性化学习，也为教师提供了教学反思依据，从而促进课程持续优化。

3.5.2 国际交流与课程共建机制

案例一：上海交通大学“交·通全球课堂”

上海交通大学于2021年启动“交·通全球课堂”计划，旨在通过与全球高水平战略合作伙伴高校的课程“共建”与课程“共享”，搭建一个跨越地理界限的线上国际课程平台。为了确保沉浸式学习体验，计划在技术层面进行了精心设计，利用软视频会议系统，实现线上线下的无缝衔接。教师与远程学生如同身处同一教室，即时互动成为可能，线上提问者能被清晰展示，线下同学亦可直接看到线上同伴。这种高度融合的现场感极大地促进了跨国界的思想碰撞与文化交流。至2024年春季学期，“交·通全球课堂”计划的“共建课程”子项目面向环太平洋大学联盟以及日本、新加坡、英国、法国、德国、俄罗斯、美国、澳大利亚等18个国家的50余所知名高校合作，推出了涵盖本科、硕士及博士层次的160门全英文特色课程。

案例二：首届全球数智教育创新大赛

“数智教育发展国际大学联盟”为了更好地促进联盟成员及全球高校之间的交流与合作，以赛促教，以赛促学，探索数智时代创新人才培养新范式，于2024年举办首届全球数智教育创新大赛。大赛设置了三大竞技领域——创新赛道、可持续发展与文化保护赛道、AI4Science应用开发赛道，旨在从不

同角度激发参赛者的创新思维和解决实际问题的能力。创新赛道聚焦如何用AI解决生命科学、材料科学、空天信息等学科领域的真实问题；可持续发展与文化保护赛道鼓励用科技解决可持续发展与文化保护进程中的相关问题；AI4Science应用开发赛道则自由探索人工智能在科学研究中的应用潜力。参赛资格面向全球高校的在校生及毕业三年内的学生，鼓励跨学科、跨校的团队合作。赛程安排紧凑而有序，整个赛事将历时数月，为参赛者提供一个充分展示自己才华和创意的舞台。大赛奖项设置丰富，以奖金形式激励参赛者追求卓越，表彰他们的创新精神和实践成果。首届全球数智教育创新大赛不仅是一场学术竞赛的盛宴，更是一个促进国际交流、探索教育创新、培养新时代人才的国际平台。

4 数智教育发展

在全球数字化转型的浪潮下，数智教育作为教育改革的重要方向，正逐渐展现出其巨大的潜力和价值。推动数智教育的深入发展，需要加强国际高校在数智教育领域的合作交流，通过跨国界的学术研讨与技术共享，共同探索数智教育的新模式与新路径，构建一个更加公平、高效、可持续的数智教育体系。

数智教育发展国际大学联盟（DI-IDEA）于2023年11月在北京成立以来，始终以“致力人类进步、创新教育未来”为愿景，不断加强全球高等教育对话、携手应对数智时代的重大挑战。为促进数智教育的共同发展，DI-IDEA提出以下4个行动方案。

4.1 提升数智教育领导力

DI-IDEA提出的数智教育领导力，旨在提升高校和研究机构在数智时代的教育高质量发展，通过多维度的努力，推动数智与教育的深度融合，提升数智教育领导力，促进高等教育机构适应并引领教育变革。

4.1.1 目标与愿景

4.1.1.1 目的与总体愿景

DI-IDEA致力于构建一个包容性、高效能的教育教学发展国际化网络，促使高校教育领导者在人工智能时代，具备战略思维、技术洞察力和创新能力，能够推动其机构的变革和创新，确保所有学生和教师能够充分利用数智

技术，实现教育的个性化和最优化。我们欢迎更多国际高校的加入，携手开展对话和合作，共同探讨如何培养具有全球视野的教育领导者，适应和引领数智时代的教育教学变革。

4.1.1.2 全球背景和重要性

在全球化的背景下，教育领导力的提升不仅是提升教育质量的关键，也是推动全球教育创新和合作的重要途径。DI-IDEA倡导：通过国际合作，成员高校共同探讨和实践如何培养具有全球视野的教育领导者，适应和引领数智时代的教育教学变革。这种合作不仅能够促进专业发展，而且促使成员高校能够在自己的机构内为教育和学生体验的发展做出贡献，满足当代教育不断变化的需求和优先事项。

4.1.2 培养数智教育领导力

4.1.2.1 培养基础

培养数智教育领导力的基础在于对教育领导者进行全方位的能力提升。这不仅包括战略思维、技术洞察力、创新能力以及对教育趋势的深刻理解，还包括营造一个支持数智教育的学习环境。DI-IDEA鼓励教育领导者保持前瞻性，洞察未来教育的发展趋势，积极探索和采纳新的教育模式和技术，并据此制定策略，以提高教育质量和效率。

为了实现这一目标，我们建议培养基础应包括以下几个关键要素：

安全：打造一个安全、开放的环境，让每位参与者都能畅所欲言，鼓励开放和坦诚的交流方式。

保密：高度重视每位参与者的隐私权，确保他们的意见和创意在保密的环境中得到充分的考虑。

共创：鼓励大家携手合作，构建学习共同体，以满足个人和机构在教育领导力发展上的需求。

项目：通过投身于实际项目，领导者将理论知识转化为实践行动，进一

步加深和巩固学习成果。

行动：通过反思和行动持续改进，助力领导者在职业生涯中不断取得进步，实现自我成长。

通过这些方法，DI-IDEA旨在为教育领导者提供一个全面、互动和实践导向的发展平台，以适应和引领数智时代的教育教学变革。

4.1.2.2 培养框架

为了系统地培养数智教育领导力，DI-IDEA致力于构建一个多维度的培养框架，包括以下几个关键组成部分：

战略规划与执行：教育领导者需要具备制定和执行战略规划的能力，以优化高等教育机构的学术研究与教学环境。

国际视野与合作：通过国际教育领导力项目，构建国际化的学术网络，促进全球教育领导者之间的交流与合作。

技术应用与创新：鼓励教育领导者探索AI在教育中的应用，通过案例研究和实践项目，了解AI如何助推教育教学。

教育质量与评估：运用AI工具和系统进行数据分析，以支持教育决策；使用AI进行教学评估和反馈，不断提高教育质量。

领导力发展平台：为教育领导者提供一个全面发展的平台，包括在线讨论、实地工作坊和线下研讨会等多种形式的沉浸式学习和深入交流。

借助这一培养框架，DI-IDEA将为教育领导者提供一个全面而系统的发展路径，帮助教育领导者适应并引领数智时代下的教育教学创新。

4.1.3 国际教育领导力项目

2023年11月，DI-IDEA成员学校英国伦敦国王学院同伦敦政治经济学院、莫那什大学、华威大学联合发起国际教育领导力项目（The International Education Leadership Programme，简称IELP），北京大学也已加入该项目。IELP旨在探讨如何培养具有全球视野的教育领导者，推动高等教育机构在数

智时代的高质量发展。

IELP通过精心设计的在线讨论、实地工作坊和线下研讨会等多种形式，为教育领导者提供了一个沉浸式学习和深入交流的平台。为期3天的线下研讨会是该项目的重要组成部分。2024年7月初，研讨会于剑桥Madingley Hall举行，来自5所全球顶尖高校的教育研究者就生成式AI对高等教育带来的革命性影响展开了热烈讨论。讨论之余，主办高校还组织学者们填写了对AI认识的调查问卷和趣味性格分析，活动现场轻松有趣。IELP通过形式丰富的交流活动，提升领导者的战略规划与执行能力，优化高等教育机构的学术研究与教学环境，增强教育领导者面对教育领域挑战的应对能力。

在数智化时代背景下，教育领导力的提升已成为推动高等教育机构适应并引领变革的关键因素。教育领导力的提升需要教育领导者具备战略思维，洞察未来教育的发展趋势，并据此制定策略，引领高等教育机构的变革方向。通过IELP项目，DI-IDEA为教育领导者提供一个深入探讨的平台，鼓励领导者积极探索和采纳新的教育模式和技术，全面而深入地培养数智教育领导力。

4.2 建立数智教育规范

DI-IDEA 提出的数智教育规范，旨在为参与的高校和研究机构提供发展数智教育项目的规范指南。该规范为数智教育利益相关方负责任、合乎伦理地使用数智技术提供了全面的伦理原则与规范、使用边界和保障措施，从而促进数智教育健康、可持续发展。随着数智技术的快速进步以及在数智教育的创新应用，数智教育规范也将持续更新和完善。

4.2.1 目标与愿景

4.2.1.1 目的与总体愿景

DI-IDEA数智教育规范从伦理规范和使用边界的视角促进数智教育的健康发展。该规范针对数智技术应用引发的伦理问题，从教育的本质出发，借

鉴国际组织、知名高校AIGC学术规范，为数智教育使用数智技术提供了一个基本原则的框架和指南，引导高校、科研机构就数智技术使用规范形成共识，确保学生和教育者以正确的态度和价值观来理解、使用并与数智技术互动。

4.2.1.2 全球背景和重要性

在全球数智化转型的背景下，DI-IDEA规范旨在将成员大学定位为负责任使用数智技术的领导者。通过伦理原则和规范，使师生在教育与科研中合乎道德地应用数智技术。为保持领导地位，DI-IDEA规范与国际规范（如联合国教科文组织发布的《在教育和研究中使用生成式人工智能的指南》）保持一致。规范的建立助力成员大学继续引领数智教育的发展，同时在应用数智技术时充分考虑社会影响和道德责任。

4.2.2 数智教育规范体系

DI-IDEA数智教育规范体系包括认知态度、伦理原则和监督机制3个部分。通过规范体系，使大学教育管理者、学生、教师充分建立数智技术素养，理解数智技术对教育的影响以及如何合理使用。该规范体系借鉴了麻省理工学院、剑桥大学、哈佛大学等一流大学的学术规范，为数智教育利益相关方的技术应用提供了科学系统的指引。

认知态度：大学对数智技术的接受程度和使用意愿，包括对新兴技术的开放性，对技术带来变化的适应性以及对技术发展的期待。

伦理原则：大学利益相关方使用数智技术的道德准则和行为规范，包括对数智技术应用引发的伦理问题的认识和对策，以及对技术使用的社会责任感。

监督机制：对数智教育过程、结果及相关主体进行风险监督和评估，确保数智教育活动的合法性、合理性和有效性。

4.2.2.1 认知态度

大学应对生成式人工智能（Artificial Intelligence Generated Content，简称

AIGC）等数智技术持开放包容和积极支持的态度。当前，QS2023世界大学排名前100高校普遍支持使用AIGC提升教学质量、提高科研效率、增强技术认知。大学积极引进和推广数智技术，可以专注于更高层次的学习目标、促进学科交叉融合、提高学术创新能力，在教学与科研方面保持领先地位。

4.2.2.2 伦理原则

数智技术为教育发展创造了机遇，重塑了教学、科研、人才培养与院校管理方式，但也带来了诸多伦理道德挑战。技术局限性导致数据隐私与安全风险、算法偏见、数字鸿沟等；大学应用数智技术引发科研诚信风险、学生认知能力下降、教育形式化等伦理问题。面对上述问题，大学应坚持公平包容、隐私安全、诚信透明、以人为本基本的伦理原则。

公平包容：大学需优化数智化公共基础设施，强化数智教育平台和智慧校园建设，保障学校有充足的算力和数据存储能力，以支撑日益增长的数智化教学与研究需求，确保每位学生可以公平地访问与获取高质量的数智教育资源。

隐私安全：大学应采取全面而严密的技术与管理措施，包括加强数据加密技术、实施严格的访问控制机制、定期进行安全审计与风险评估、加强师生信息安全意识教育，以及建立健全的数据泄露应急响应机制，以加强师生数据安全和个人隐私保护，防止数据滥用，维护教育环境的纯净。

诚信透明：在教学方面，教师应根据课程特点建立明确的数智技术学术规范，说明AIGC等技术的可使用与禁止使用场景、使用披露的规定、内容审核机制；学生应合理披露，清晰声明或者标注AIGC等技术的使用环节、使用程度，并对生成内容的准确性、可靠性等负责。在科研方面，学生和教育者使用AIGC等数智技术时，应坚守科研诚信，避免抄袭剽窃、传播虚假研究成果、用AI生成无实质贡献的论文、侵犯他人知识产权等学术不端行为。

以人为本：首先，大学数智技术的发展和应用离不开人文精神的引领，从而使数智教育生态更加包容，更有人文关怀。其次，数智教育的边界是解放而非奴役，要始终尊重、促进和保护学生和教育者的主体性。(1)培养以学生为中心的数智技术应用。教育者应探索人机协同的高效教育模式，同时引导学生批判性地使用数智技术，将培养学生的逻辑思维能力、独立思考能力和创新能力摆在重要位置。(2)强化教师在数智教育中的角色。数智化使传统的师生关系向学习伙伴转型，大学授课内容由事实性知识向科学观点、科学思维和路径转变。在此环境下，教师是技术指导者而非替代者的主体地位更加凸显，要始终将教师和学生之间的互动与协作作为教育的核心。

4.2.2.3 监督机制

为权衡数智技术教育应用与伦理风险，追求技术应用的最大限度，应积极探索技术应用的风险监督、评估和处理机制。

数智教育为教育评估带来了巨大的挑战。首先，人机协同的融合式教学效果应如何评估？其次，如何考核学生在课程中的学习能力和成效，即哪些核心知识和能力是学生应该掌握的，应通过什么方式来有效考核？

为解决上述问题，大学需要关注到数智技术教育应用重塑了教师的教学内容、方法、模式，对学生的身心发展、学习效率、创造力和批判性思维产生了长期影响，应顺应数智教育的变化趋势，建立合理的教学效果和学习成效的监督和评估规定。

4.2.3 大学保障举措

4.2.3.1 课程建设

大学根据数智技术的发展趋势，设计包含基础理论、核心技术、应用场景、伦理与社会影响等多个模块的课程体系。

4.2.3.2 师资培训

大学定期组织教师参加数智技术、教育技术、伦理规范教育等方面的培

训，提升教师的教学水平和专业素养。

4.2.3.3 伦理教育

大学应将数智技术伦理作为必修或选修课程，系统介绍伦理理论、案例分析、法律法规、伦理规范等内容，使学生对数智技术的应用深入到价值观和伦理观念的塑造，以及社会参与的引导。建立数智技术伦理教育资源库，收集国内外相关文献、案例、研究报告等资源，供师生参考学习。组织讲座、研讨会、辩论赛等形式的规范教育活动，增强师生的数智教育伦理意识和责任感。

4.3 开发数智教育框架

DI-IDEA提出的数智教育框架，旨在为参与的高校和研究机构提供发展数智教育项目的前瞻性指导。该框架为在数智教育中培养创新、伦理责任和社会参与提供了坚实的概念基础和实用的实施策略。虽然框架详细介绍了具体的结构和评估方法，但它目前仍然是一项供未来实施和调整的建议。通过在不同背景和机构环境中的协同开发，这一框架将不断演进和完善。

4.3.1 目标与愿景

4.3.1.1 目的与总体愿景

DI-IDEA数智教育框架通过“社会实践”方法理解数智教育，强调教学、学习和技术创新与其所处的社会及机构环境密不可分。该框架将学生和教育者与人工智能、大数据和数字工具的互动视为其专业、学科和社会群体中持续交流与反思的一部分，力求使他们不仅能够掌握技术层面的能力，而且能够深刻理解其工作的社会影响。

该框架借鉴了Gherardi（2000）和Nicolini等人（1998）的理论基础，并结合哈佛大学、斯坦福大学等机构的实际经验，力求确保学生不仅具备出色的技术能力，还能成为具备反思性和伦理意识的实践者。通过理解工作对社会

的深远影响，学生能够在未来的实践中实现技术创新与社会责任的平衡，确保其技术应用符合具体环境的需求与挑战。

4.3.1.2 全球背景与重要性

在全球数字化转型的背景下，DI-IDEA框架旨在将成员大学定位为在促进前沿创新、社会相关性和伦理责任方面的领导者。通过采用社会实践方法，框架使得教师的教学和学生的学习能够融入数字技术在更广泛的社会和制度背景中的实际应用。此外，这些实践和学习是在其专业社区中的协作实践，以及新兴技术所带来的物质性与伦理影响的共同作用下逐步形成的。

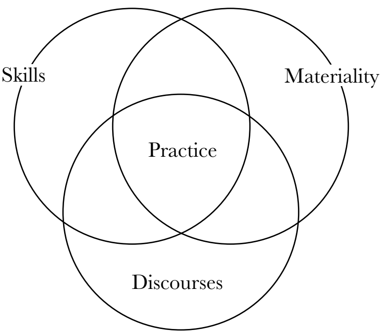

图1 社会实践方法（改编自Shove等人，2012年）将实践置于技能、技术和背景的物质性以及公共、学科和教育话语的交汇点上

为了保持这一领导地位，DI-IDEA框架与国际标准（如经合组织发布的《未来教育与技能框架》）保持一致，并与全球机构建立伙伴关系。这些努力将帮助成员大学继续走在数智教育的前沿，同时更加深入地理解技术创新的社会和文化影响。

4.3.1.3 核心价值与技术伦理

DI-IDEA框架将伦理视为数智实践中不可或缺的组成部分。该框架不仅与社会实践方法相契合，还借鉴了斯坦福大学等机构的实际应用，如“伦理

算法审计”和“数字公民档案”。该框架强调，伦理责任源于技术的物质性、相关话语的形成，以及嵌入其中的专业实践。通过这种方式，学生不仅能够培养技术技能，还能理解这些技能在他们的专业领域内如何受到社会、物质和话语实践的共同影响。

4.3.2 框架结构

DI-IDEA数智教育框架分为基础层、中级层和高级层3个层次，每个层次均基于社会实践方法的核心原则。通过这种方式，学生不仅能够培养技术技能，还能理解这些技能在其专业社区中如何受到社会、物质和话语实践的共同影响。该框架借鉴了斯坦福大学、哈佛大学等领先机构的实践经验，为学生应对复杂数字环境提供了坚实的基础。

基础层：侧重数字素养和批判性思维，帮助学生在更广泛的社会和伦理背景下有效使用数字工具。

中级层：强化算法思维与跨学科应用，鼓励学生反思其技术解决方案的伦理和社会影响。

高级层：培养AI创新与数字创业能力，强调将伦理考量贯穿于商业模式和技术发展的全过程。

这一框架结构不仅体现了Gherardi和Nicolini的实践理论，还促使学生将数智教育视为一种融入社会的实践，确保他们在应对技术挑战时始终保持对社会和伦理问题的敏锐洞察力。

4.3.3 基础层：数字素养与思维

4.3.3.1 核心能力

在基础层，学生不仅将数字素养视为一项技术技能，更将其看作一种融入社会的实践。他们认识到，数字工具的使用受其所处的机构环境、专业领域和社会话语的共同影响。例如，隐私、数字权利和技术局限等问题将在更广泛的社会背景下进行讨论，帮助学生理解这些概念在社会中的不同理解和

争论。在此过程中，鼓励学生将他们的数字行为视为更广泛的社会与伦理实践的一部分。

4.3.3.2 评估与未来发展

本层级的评估方法体现了社会实践的理念，着重评估学生在数字素养的技术和社会层面上的批判性思考能力。评估工具包括：

数字伦理反思日志：该方法借鉴了哈佛大学的实践。在哈佛的课程中，数字伦理反思日志被用来鼓励学生对其使用数字工具的伦理维度进行批判性反思。同样，犹他谷大学在其“伦理意识周”期间也采用了反思实践，鼓励学生思考数字技术的社会影响。在DI-IDEA框架中，学生将记录数字伦理反思日志，用以评估他们对数字技术作为一种社会融入性实践的洞察深度。

基于场景的伦理决策：斯坦福大学在其人工智能与数字伦理课程中采用了基于场景的伦理决策方法，学生需应对诸如平衡数据隐私与AI驱动的医疗系统需求等复杂伦理困境。这些练习帮助学生在现实情境中应用伦理原则。在DI-IDEA框架中，学生也将探讨类似场景，需要平衡数据隐私与公共健康等伦理优先事项。

数字公民档案：在柏林施坦贝斯大学的可持续产品与商业模式创新课程中，学生需创建数字公民档案，以展示他们对数字工作的社会与伦理影响的理解。在DI-IDEA框架中，学生将编制类似的档案，展示他们不仅具备技术能力，还能够理解并应对数字工作在社会和伦理实践中的挑战。

研究案例简介

以下案例展示了DI-IDEA框架在不同教育阶段中的实施。尽管这些情景基于假设的机构，但它们借鉴了斯坦福大学、哈佛大学和马里兰大学等大学中观察到的真实实践。这些案例研究提供了实际示例，展示了如何在社会化的实践中培养数字素养、计算技能、AI创新和伦理责任。

案例分析1：基础层—数字素养与思维

机构：A大学

场景：实施数字公民意识与伦理意识

背景：

在A大学，一年级学生参与一门名为“数字公民与伦理”的基础课程。该课程旨在向学生介绍数字素养、批判性思维以及在使用数字技术时涉及的伦理问题。该机构高度重视情境化学习，将课程内容调整以适应当地的社会和文化环境。

应用：

在这门课程中，学生被鼓励反思他们使用数字工具的方式是如何与社会规范、地方法规和文化价值观相交织的。他们参与基于情境的伦理决策练习，探讨如公共系统中的数据隐私或青少年使用社交媒体等地区性问题。课程还采用数字伦理反思日志，促使学生批判性地思考他们与技术的互动，以及这些互动对更广泛社会的影响。

机构背景：

由于A大学位于一个具有特定数据隐私法规的地区，课程将地方法律融入案例研究和决策情境中。这凸显了数字素养和伦理不仅是抽象的概念，还深深植根于学生的日常生活和所处的机构环境中。

成果：

课程结束时，学生不仅掌握了技术技能，还具备了在数字环境中负责任行事的伦理意识。通过情境化的案例，学生能够理解数字公民意识在其社会环境中的重要性，并为他们作为更广泛社会实践中的积极参与者做好准备。

4.3.4 中级层：智算技能与跨学科应用

4.3.4.1 跨学科融合、算法思维与伦理

在中级层次，鼓励学生将算法思维视为一种与其专业社区、物质技术和

社会话语相互作用的实践。在发展技术技能的同时，他们还需深入思考自己的工作对社会的影响，特别是在算法公平性、数据隐私和社会正义等方面。该方法确保他们的学习能够融入实际的数字工具应用环境中，强调合作与社会责任的关键作用。

4.3.4.2 评估与未来发展

本层次的评估方法反映了社会实践方法，重点评估学生如何将伦理和社会考量融入其算法工作中。以下真实案例展示了类似工具在实践中的应用：

算法伦理审计：例如，斯坦福大学和东北大学Khoury计算机科学学院将算法审计纳入课程，以评估算法的公平性、偏见和社会影响。斯坦福大学尤其强调持续评估，以减少算法风险，确保公平性和透明度。算法审计揭示了模型构建各阶段中可能存在的偏见，这为学生在DI-IDEA框架中开展自己的算法伦理审计奠定了基础，推动他们的计算设计具有社会责任感并保持公平。

跨学科项目展示：借鉴东北大学Khoury学院的经验，学校推动跨学科项目，要求学生不仅展示技术解决方案，还深入分析这些方案对更广泛社会的影响。这些项目展示了学生的工作如何受技术系统与社会结构之间相互作用的影响。同样，在DI-IDEA框架中，学生将通过社会实践展示他们的工作，说明其技术解决方案如何受到社会和制度背景的影响。

案例分析2：中级层—智算技能与跨学科应用

机构：国际技术学院B

情境：城市规划的跨学科数据分析

背景：

在国际技术学院B，二年级学生参与了一个跨学科项目，该项目由计算机科学系与城市规划系合作开展。项目的核心是利用算法思维和编程技能，开发数据驱动的解决方案，以优化城市交通系统。

应用：

学生们基于城市交通部门提供的真实数据集进行工作，包括交通流量和公共交通使用情况的数据。项目要求学生进行算法伦理审计，确保他们的计算解决方案不仅在技术上可行，还具备公平性和社会责任感。

机构背景：

鉴于交通系统服务于多样化的城市人口，项目要求学生考虑其算法可能无意中引入的偏见，这些偏见可能会影响不同的人群。学校鼓励学生与当地社区代表互动，以更好地理解其工作可能带来的社会影响，从而将算法技能更有机地融入城市的社会结构中。

成果：

通过这些跨学科项目，学生不仅掌握了算法思维的专业技能，还对他们工作中可能产生的伦理影响有了更深刻的认识。与当地社区的互动确保了学生的解决方案能够切实回应城市居民的需求和价值观，充分展示了算法工作如何深深融入社会实践中。

4.3.5 高级层：AI创新与数字创业

4.3.5.1 AI创新、数字创业与伦理

在高级层，学生置身于更广泛的社会、技术和话语背景下，参与AI创新与数字创业。他们不仅探讨技术因素如何影响创新，还深入分析其工作的伦理和社会影响。诸如算法偏见、AI透明性和数据隐私等具体挑战都会被重点解决，确保学生的创新能对社会产生积极的影响。学生被鼓励将自己视为专业社区的一员，认识到他们的创新不仅影响市场，也会对社会结构产生深远的影响。

4.3.5.2 评估与未来发展

这一层级的评估侧重于学生将伦理和社会实践融入其创业工作的能力。

评估方法包括：

伦理商业模式画布：例如，斯坦福大学等高校将伦理原则纳入其商业模式创新课程。斯坦福大学的科技创业计划（Technology Ventures Program）包括Lean Launchpad项目，该项目采用商业模式画布方法，并在《有原则的创业决策》等课程中强调在创业过程中融入伦理考量。这些课程要求学生在开发新商业模式时，将社会和伦理因素纳入考虑。

社会影响创业竞赛：例如，马里兰大学的项目专注于社会创业，为学生提供动手实践的机会，以构建以社会影响为核心的商业模式。这些项目确保学生不仅能开发出盈利的企业，还能创造出可衡量的积极社会成果。

案例分析3：高级层—AI创新与数字创业

学院：国际学院C

情景：专注于医疗创新的AI初创企业

背景：

在国际学院C的最后一年，学生组建团队，作为数字创业项目的一部分，开发AI驱动的医疗解决方案。项目的重点是创建利用AI改善患者健康结果的初创企业，特别是在罕见疾病诊断方面。

应用：

学生与医疗服务提供者合作，开发针对特定患者群体的AI算法。整个项目过程中，他们使用伦理商业模式画布，确保他们的初创企业从一开始就融入公平性、透明性和社会责任的原则。

机构背景：

鉴于该地区的医疗系统服务于包括弱势群体在内的多样化人群，学生需要考虑他们的AI解决方案如何应对医疗不平等问题。他们与医疗专业人员、患者权益组织和政策专家合作，以保证其创新具有可及性，并体现社会责任。

结果：

项目结束时，学生已经开发出了可行的AI初创企业，这些企业不仅推动了技术创新的前沿，还与伦理和社会目标保持一致。通过参与社会影响创业竞赛，学生展示了他们将AI创新与社会责任相结合的能力，展示了数字创业如何在技术与社会实践的双重推动下得以实现。

4.3.6 实施与可扩展性

4.3.6.1 高校实施策略

DI-IDEA框架的实施侧重于将数字智能教育融入实际的机构背景中，并以社会实践方法为指导。各大学将促进跨学科合作、伦理反思和专业发展，确保学生和教师在更广泛的社会、机构和技术环境中参与数字工作。

实施策略将包括针对每所大学的文化、社会和技术背景量身打造的参与式试点项目。这些项目将强调具体情境的适应性，同时与国际标准保持一致。通过教师、学生和相关方的持续反馈，框架将不断优化并具备更强的可扩展性，以保证其在不同教育环境中的有效性和相关性。

4.3.6.2 教师专业发展计划

教师专业发展计划以社会实践框架为基础，鼓励教师将专业发展视为一个由物质技术和专业话语共同塑造的社会化合作过程。该计划旨在成为一个灵活且不断发展的倡议，能够适应各成员高校的具体背景，并会根据机构需求和全球趋势进行进一步调整和优化。

借鉴领先院校的反思性实践，鼓励教师采用参与式探究方法，将数字工具的使用深植于其工作的特定机构、社会和文化背景中。教师将不再仅仅将数字智能视为技术技能，而是在教学中得到支持，培养对技术的伦理、社会和人文维度的深入理解，从而与DI-IDEA框架的整体目标保持一致。

该计划的主要组成部分包括：

教学资源与课程：为教师提供最新的教学方法和工具，帮助他们将数字工作视为社会融入型实践，教授数字智能技能、AI创新及其更广泛的社会影响。

研讨会与讲座：定期举办研讨会和讲座，支持教师在协作和跨学科教学中进行创新，并鼓励他们思考自身工作如何为技术的社会和人文层面做出贡献。同时，这些课程为教师提供反思空间，促使他们审视数字工具如何在特定机构背景下影响他们的专业实践。

知识创造者角色：该计划鼓励教师不仅是知识的传播者，还要成为数字智能领域的创新者，积极推动社会和伦理实践的发展。社会实践方法要求教师像学生一样，质疑新兴技术的物质、情境和伦理层面，以及围绕这些技术的各类话语。

研究支持：为教师提供研究支持，推动新技术的应用，确保这些技术有益于社会福祉，并关注数字工作的更广泛社会影响。

同行支持与合作：该计划促进全球教师的合作，打造一个共享教学经验和最佳实践的全球教师网络，推动技术与社会实践的融合，帮助教师在快速变化的数字环境中持续提升专业水平。

4.3.7 结论

DI-IDEA数智教育框架提出了一种综合方法，将数字智能融入教育体系中，基于对学习与创新作为社会和制度深度融合的实践的理解。该框架强调技术、伦理与社会背景之间的相互关联，赋予学生和教师应对不断变化的数字环境的能力，使他们成为具备反思性和社会责任感的实践者。这种方法确保了他们在掌握技术专长的同时，也能平衡对其工作伦理和社会影响的认识，进而培养出一种更加全面的数字智能教育模式。

4.4 共享数智教育平台

DI-IDEA提出的数智教育平台，旨在共建共享数智教育研究成果。随着大数据和生成式人工智能逐渐成为教育领域的变革性技术，其快速发展已经超出了现有课程体系和教师能力框架的覆盖范围。不同于那些已经成熟的技术，这些新兴技术尚未形成成熟的教学框架和案例研究，其在课堂中的应用依然主要处于实验阶段。目前，教师在如何有效整合这些技术以提升学习成果方面的指导仍然有限，尤其是有关生成式人工智能的建议，通常将其描述为对现有教学实践的颠覆性影响，并视其为学术诚信的潜在威胁。这种缺乏先例的情况表明，我们需要系统性的方法来探索新兴技术如何更好地服务于教育目标，特别是通过教师主导的研究视角。DI-IDEA正在建立一个系统的计划来收集并分享教师在使用这些新技术过程中积累的经验和发现，并基于DI-IDE成员Camtree打造教学学术和教师发展的交流平台。

4.4.1 数智教育平台

Camtree（剑桥教师研究交流平台，https://www.camtree.org）是DI-IDEA的合作伙伴，旨在支持教师群体进行研究、提升教学实践，并分享他们的成果。Camtree团队位于剑桥大学Hughes Hall，与剑桥大学教育学院以及其他合作机构密切合作。Camtree的独特之处在于，它不仅通过培训项目、在线学习和与教育组织的合作来推动教师研究，还通过其数字图书馆发布教师的研究成果。

Camtree为教师提供了一个平台，能够在其数字图书馆（https://library.camtree.org）中发布他们的研究成果。该图书馆为教师的报告和教育资源提供了一个永久、全球可访问的存储空间，同时还收录由特定兴趣小组、社区和教育组织生成并整理的作品集。订阅的合作伙伴可以在图书馆中托管自己的作品集，从而以较低的成本获得一个永久的数字档案库。目前，没有其他类似的平台能够在全球范围内为教师提供如此规模的机会。Camtree数字图书

馆基于DSpace7数字存储平台开发，并由认证的DSpace提供商Atmire托管。DSpace平台被全球众多领先的研究机构和大学广泛采用。然而，Camtree数字图书馆经过专门定制，以满足用户进行、获取和学习实践型教育研究的特定需求。该数字图书馆的主要功能是用于长期存储、检索和整合教师在其教学环境中进行的实践研究报告。研究报告通常为2000~5000字，但可能附带以下内容：研究工具、伦理协议或数据集等支持性文件；教师研究过程中生成或作为研究评估一部分的学习资源；图像、音频、视频和应用程序等数字材料；作为报告基础的较长文档，如学位论文或毕业论文。

该图书馆是一个多语言平台：研究报告可以用任何语言提交，但需附有一篇350字的结构化英文摘要。这使得图书馆用户能够轻松定位报告并评估其与自身工作的相关性，同时也有助于研究的整合与分析。此外，图书馆还可以充当“虚拟存储库”，通过元数据引导用户和搜索工具前往其他信息来源，成为“开放”数字生态系统中的“枢纽”。因此，现有收藏、在线期刊和档案的管理者能够扩大其现有资料的覆盖范围和影响力。不断扩展的数字图书馆还为语义数据库提供了基础，为生成式人工智能应用提供数据支持，包括增强型搜索工具和聊天机器人。这些工具能够通过类似于ChatGPT等平台的界面，为教师提供可靠且有出处的建议。

Camtree承担着DI-IDEA平台的两个主要职责。一是为教师提供培训和支持，帮助他们开展实践性研究，探索和验证新兴技术的潜力以及数字智能的发展。项目要求参与者设计并应用合适的研究模型，并收集有力的成果证据，以便有效推广知识的应用和传播。二是数字图书馆为教师知识的托管、共享和整合提供了平台，成为“数字智能知识”国际生态系统的核心枢纽。除了发布教师创新和研究的常规报告外，图书馆还可以托管其他平台的数字对象和创新成果（如网页平台、在线学习工具、应用程序、代码、数据集、语言模型）的记录。这种多模态特性使教师、研究人员、开发者和政策制定者能够

探索新技术工具，同时结合这些工具在教育环境中的开发和应用的真实案例进行研究。

4.4.2 建立数智能研究的生态系统

教师知识的传播，特别是关于新兴技术的知识，受到缺乏完善数字基础设施的制约。尽管在流行病学、公共卫生、气候科学等领域，“开放科学”和“开放研究”已经取得进展，并将知识视为“全球公共产品”，但这些方法在教师知识的传播与积累上却很少被系统性地应用。

数字平台的分散化和不同系统之间缺乏互操作性，阻碍了知识的传播和再利用。这些基础设施的不足不仅妨碍了知识的有效传递，还加剧了教育机会的不平等，特别是那些处于技术较落后环境中的教师，难以融入更广泛的专业社区。结果是，集体专业成长和教学实践的进步受到限制，这凸显了建立一个综合性的数字生态系统的紧迫性，该生态系统应涵盖人员、数字工具以及丰富的实践经验分享。

这样的生态系统还将促进教师、技术专家和政策制定者之间更深入的交流。目前，教师的集体知识和综合见解很难被技术平台设计者、课程开发者或教育系统构建者获取，使得他们过于依赖零散的案例或“理想用户”的反馈，而无法充分利用教师在实际教学情境中产生的宝贵经验。

尽管教师们正在积极尝试生成式人工智能，但他们的创新成果和研究发现很少得到分享，相关的证据基础依然薄弱。尽管专家学者、政府机构和国际组织经常呼吁提供相关的证据和案例研究，但实际分享的成果仍然有限。

数智教育平台将教师的实践置于技能、技术的物质性及其应用背景以及相关话语的交汇点上，使教师成为在真实教育环境中研究新兴技术和数字智能发展的关键角色。教师通过行动研究、设计型研究、教学研究等模型开展的研究十分重要，因为这类研究能够充分反映教育者的独特见解。作为实践者，教师能够敏锐地把握学生的需求以及课堂环境的实际情况。通过自主开

展研究，教师能够根据具体的教育挑战定制大数据和生成式人工智能的应用，从而构建与其教学情境密切相关且具有实用性的知识体系。

数智教育平台还能够推动持续的专业发展与创新文化：在探索新兴技术的过程中，教师不仅为更广泛的教育群体做出贡献，同时也提升了自己的技能与适应能力。通过鼓励教师主动参与研究，我们确保他们始终走在教学创新的最前沿，而不是被动接受外部制定的指导方针。数智教育平台能够有效减少不加审视地采纳新技术所带来的风险，包括数据隐私、偏见和技术在课堂中伦理使用等问题。通过参与研究，教师能够及早发现并解决这些问题，确保生成式人工智能在教育中的应用既有效又负责。通过这种方式，教师研究不仅有助于最佳实践的发展，还帮助塑造了生成式人工智能在教育中的伦理应用框架。

后　记

随着全球数字化转型的不断深入，数智教育正成为推动高等教育创新的关键力量。2023年11月，数智教育发展国际大学联盟（DI-IDEA）正式成立。该联盟汇聚了全球专家学者，致力于探讨和推动数智化教育发展。在联盟高校的协同努力与紧密合作下，北京大学与武汉大学牵头编撰了《数智教育发展白皮书》。

白皮书旨在全面总结当前数智教育的发展现状、挑战与机遇，并对如何构建高效、公平、可持续的数智教育体系提出了建议和展望。白皮书概述了数智教育的基本概念、特征及其在高等教育中的应用，探讨了数智时代人才培养的需求；详细分析了构建数智教育体系的关键要素，包括学科体系、课程体系、教材体系、保障体系和评价体系。白皮书通过案例分析，展示了世界一流高校在课程、平台、助教、评价和合作等方面的数智教育实践成果，进而提出了数智教育发展的行动方案，即提升数智教育领导力、建立数智教育规范、开发数智教育框架和共享数智教育平台。

白皮书的编写过程，是一次跨学科、跨领域的合作，汇集了来自教育学、数据科学、人工智能、管理学等多个学科专家学者的智慧，汇聚了亚洲、欧洲、美洲、大洋洲、非洲的一流高校数智教育案例。在此，我向所有参与白皮书编写的专家学者致以最诚挚的谢意，正是你们的深刻见解与卓越贡献，汇聚成了这本为全球高等教育数字化转型提供参考的知识宝典。

感谢DI-IDEA联盟30余所国际成员高校的积极参与，为白皮书内容的丰富性奠定了坚实的基础。我要向联盟理事长、北京大学校长龚旗煌院士表达深深的敬意，感谢您对白皮书撰写工作的大力支持和指导。我对联盟咨询委员会主任、武汉大学校长张平文院士表示衷心的感谢，您不仅对白皮书的内容撰写进行了具体指导，还亲自为本书撰写序言，为读者提供了独到的见解和深刻的启发。感谢武汉大学的吴丹教授和张乐飞教授在通稿方面的辛勤工作，感谢剑桥大学的Patrick Carmichael主任和纪颖博士、北京大学张久珍教授、伦敦大学国王学院Sam Smidit领导的四校团队为白皮书行动方案所做出的重要贡献，感谢联盟秘书处所有老师对白皮书的撰写、修改不遗余力的付出，你们对提升本书的质量起到了不可或缺的作用。最后，我要向所有在白皮书成功发布过程中付出努力的同事们致以特别的感谢。

我期待白皮书能够为全球高等教育的数字化转型提供有力的支持，并激发更多的思考与行动。展望未来，我们坚信数智教育将在全球高等教育中发挥更加重要的作用。我们期待与更多的高校、研究机构和教育工作者一起，共同推动数智教育的发展，为培养适应数智时代的创新人才做出更大的贡献！

感谢每一位白皮书的阅读者，你们的反馈和建议将对我们未来的工作至关重要。

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