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THE ROLE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION IN CHINA

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CONTENTS

INTRODUCTION

Generative artificial intelligence (AI) is significantly transforming higher education in China by personalizing educational experiences, optimizing operational processes, and enhancing student engagement, thereby instigating unprecedented changes within the sector. The recent advancements in natural language processing and machine learning technologies have facilitated the emergence of intelligent tools that not only modernize educational practices but also align closely with the strategic objectives of the nation. These tools aim to address critical issues such as regional disparities in educational resources, demographic shifts, and the shortage of skilled professionals.

Over the past two decades, China's higher education system has undergone substantial growth and transformation, evolving from a predominantly exam-oriented model to a more comprehensive system that emphasizes innovation, inclusivity, and digital integration. National strategic initiatives, including Education Modernization 2035 and the 14th Five-Year Plan, have explicitly advocated for the deep integration of advanced technologies, particularly artificial intelligence, into the educational framework. The objective is to enhance both the equity and quality of education while positioning China as a global leader in educational technology. Generative AI is pivotal in realizing these ambitious objectives by personalizing learning experiences, automating administrative tasks, and providing efficient assessment methodologies. These advancements not only mirror the global trend towards educational technology reform but also underscore the significant potential of technology to tackle complex challenges such as the unequal distribution of educational resources and the promotion of interdisciplinary learning.

Generative AI possesses distinct advantages over prior technological innovations. Rather than relying on static programming logic, it employs machine learning models trained on extensive datasets to facilitate dynamic, contextually relevant, and intelligent interactions. For instance, advanced tools like ChatGPT can respond to student inquiries in real-time, offering tailored learning feedback, elucidating complex concepts, and accommodating diverse learning styles. This high level of adaptability not only addresses the longstanding challenge of personalized instruction but also paves the way for novel approaches to collaborative and self-directed learning. Furthermore, generative AI can alleviate the workload of educators by automating repetitive tasks such as grading and document management, thereby enabling them to focus more on pedagogical innovation and student mentorship.

Nonetheless, the widespread implementation of generative AI in education

presents a range of challenges, including ethical considerations, data privacy concerns, and algorithmic bias. Consequently, it is imperative to establish a robust regulatory framework and policy guidance to balance the interplay between technological innovation and the principles of educational equity and privacy protection. In recent years, China's higher education system has made notable strides in digital transformation, with national policies actively promoting the integration and application of intelligent technologies, such as online courses, learning analytics tools, and AI-driven educational platforms. While these technologies demonstrate considerable potential in fostering personalized learning, interdisciplinary collaboration, and the development of global perspectives, they simultaneously impose heightened demands regarding ethics, data privacy, and algorithmic fairness.

This study aims to investigate the application and impact of generative AI within Chinese higher education, particularly its transformative role in enhancing educational quality, facilitating personalized learning, and optimizing management processes. The central focus is on the profound integration of generative AI with the Chinese higher education system, encompassing its practical applications, the challenges encountered, and the establishment of regulatory frameworks. The objective is to provide a comprehensive analysis of how generative AI can inform appropriate policy frameworks for improved integration with Chinese higher education by addressing systemic educational challenges, leveraging technological advancements, and aligning with national modernization initiatives. Additionally, this study will evaluate the effectiveness of generative AI's practical applications in Chinese universities, specifically assessing its influence on personalized learning, teaching efficiency, and educational management, while also exploring the ethical, technological, and practical challenges associated with its implementation.

By addressing these dimensions, this research aims to contribute to the expanding discourse on AI in education, providing insights into how generative AI can be leveraged to enhance educational quality, equity, and efficiency. It underscores the importance of balancing technological adoption with ethical considerations, ensuring that AI functions as a tool for empowerment rather than a source of disparity. The findings of this study will inform policymakers, educators, and technologists as they navigate the complexities of integrating AI into higher education while upholding the human-centered values that underpin effective learning. Ultimately, this thesis seeks to illuminate a pathway for the responsible and impactful utilization of generative AI in shaping the future of higher education in China. This dual emphasis on innovation and responsibility is essential for ensuring that generative AI contributes to a more inclusive and dynamic educational ecosystem.

MASTER'S THESIS SUMMARY

Keywords: GENERATIVE ARTIFICIAL INTELLIGENCE, HIGHER EDUCATION, REGULATORY FRAMEWORK, PERSONALIZED LEARNING, DIGITAL TRANSFORMATION, CHINESE UNIVERSITIES, INNOVATION IN EDUCATION.

The object of the study is generative artificial intelligence (GenAI) and its application in Chinese higher education.

The subject of the study is the strategic use of GenAI technologies to tackle systemic educational challenges in China.

The purpose of the study is to examine the implementation and impact of GenAI in Chinese higher education.

The objectives of the study are:

1. to evaluate the current levels of adoption and effectiveness of generative GenAI in Chinese universities;
2. to investigate the practical applications of GenAI in higher education;
3. to identify and analyze the challenges associated with the integration of GenAI in higher education;
4. to provide recommendations for improving policy frameworks that facilitate the responsible implementation of generative AI in higher education.

Methods used: this thesis employs a mixed-methods approach for its research methodology, integrating both qualitative and quantitative research methods. The specific methods used include general scientific methods as well as empirical methods – case studies of GenAI adoption in Chinese universities, surveys to assessing the perceptions of the impact of GenAI on teaching and learning by students and educators. In addition, in this research, the results of the author's earlier experiments were interpreted to explore the practical implications of GenAI in higher education, to assess its impact on student learning and engagement, and to identify the challenges and ethical issues associated with its use.

Scientific novelty of the results obtained lies of this research lies in its targeted examination of GenAI in higher education, in its focus on both the potential benefits and the ethical implications of GenAI integration in educational settings and in applying mixed-methods approach to process and interpret data collected from a diverse sample of 320 university students across multiple institutions in China.

Statements for the defense:

1. GenAI has the capacity to significantly enhance educational quality by facilitating personalized learning experiences.

2. GenAI can automate repetitive administrative tasks, which increases efficiency and allows educators to focus more on pedagogical innovation.

3. GenAI enables precise, scalable student evaluation systems that provide timely feedback for improved learning outcomes.

4. The strategic implementation of GenAI technologies can help address urgent challenges in Chinese higher education, such as population decline, regional disparities in educational resources, and the demand for innovative talent in a dynamic global economy.

5. Robust regulatory frameworks are essential to address GenAI integration challenges in education, including privacy, bias, and ethical concerns.

6. GenAI literacy empowers educators and students to effectively use GenAI as a complement to, rather than a replacement for, human interaction and creativity.

Areas of possible implementation of the results of the research: the research results can be implemented across various domains within higher education, including personalized learning, administrative efficiency, assessment practices, curriculum development, professional development, ethical governance, research initiatives, and community engagement.

The structure of the Master's thesis includes an introduction, three chapters, a conclusion, a list of references and one appendix. The volume of the master's thesis is 73 pages. The work contains 11 figures, 91 sources.

The author confirms that the work has been carried out independently, and calculation and analytical material cited in it correctly and objectively reflects the state of the process being studied, and all theoretical, methodological provisions and concepts borrowed from literature and other sources are accompanied by references to their authors.

ОБЩАЯ ХАРАКТЕРИСТИКА РАБОТЫ

Ключевые слова: ГЕНЕРАТИВНЫЙ ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ, ВЫСШЕЕ ОБРАЗОВАНИЕ, НОРМАТИВНО-ПРАВОВАЯ БАЗА, ПЕРСОНАЛИЗИРОВАННОЕ ОБУЧЕНИЕ, ЦИФРОВАЯ ТРАНСФОРМАЦИЯ, КИТАЙСКИЕ УНИВЕРСИТЕТЫ, ИННОВАЦИИ В ОБРАЗОВАНИИ.

Объектом исследования является генеративный искусственный интеллект (ГИИ) и его применение в высшем образовании Китая.

Предметом исследования является планомерное использование технологий ГИИ для решения системных образовательных проблем в Китае.

Цель исследования — проанализировать внедрение и влияние ГИИ в китайском высшем образовании.

Целями исследования являются:

1. оценить текущий уровень внедрения и эффективности использования ГИИ в китайских университетах;
2. исследовать практическое применение ГИИ в высшем образовании;
3. выявление и анализ проблем, связанных с интеграцией ГИИ в высшее образование;
4. предоставление рекомендаций по совершенствованию политических рамок, способствующих ответственному внедрению ГИИ в высшем образовании.

Используемые методы: в данной диссертации используется смешанный подход к методологии исследования, объединяющий как качественные, так и количественные методы исследования. В качестве конкретных методов используются как общенаучные методы, так и эмпирические методы – кейс стади (исследование отдельных случаев) внедрения ГИИ в китайских университетах, опросы для оценки восприятия влияния ГИИ на преподавание и обучение студентами и преподавателями. Кроме того, в данном исследовании были интерпретированы результаты более ранних экспериментов автора для изучения практических эффектов ГИИ в высшем образовании, оценки его влияния на обучение и вовлеченность студентов, а также выявления проблем и этических вопросов, связанных с его использованием.

Научная новизна результатов, полученных в ходе исследования, заключается в целенаправленном изучении ГИИ в сфере высшего образования, в концентрации внимания на потенциальных преимуществах и этических аспектах интеграции ГИИ в образовательную среду, а также в

применении смешанного метода для обработки и интерпретации данных, собранных на разнообразной выборке из 320 студентов различных университетов в Китае.

Положения, выносимые на защиту:

1. ГИИ способен значительно повысить качество образования, способствуя персонализированному обучению.

2. Генеративный ИИ может автоматизировать повторяющиеся административные задачи, что повышает эффективность и позволяет преподавателям уделять больше внимания педагогическим инновациям.

3. Генеративный искусственный интеллект позволяет создавать точные, масштабируемые системы оценки учащихся, которые обеспечивают своевременную обратную связь для улучшения результатов обучения.

4. Планомерное внедрение технологий ГИИ может помочь в решении насущных проблем в сфере высшего образования в Китае, таких как сокращение численности населения, региональные различия в образовательных ресурсах и спрос на инновационные таланты в условиях динамичной глобальной экономики.

5. Надежная нормативно-правовая база имеет важное значение для решения проблем интеграции ГИИ в образование, включая неприкосновенность частной жизни, предвзятость и этические проблемы.

6. Грамотность в области ГИИ позволяет преподавателям и учащимся эффективно использовать ГИИ в качестве дополнения, а не замены человеческого взаимодействия и творчества.

Области возможного внедрения результатов исследования: результаты исследования могут быть внедрены в различных сферах высшего образования, включая индивидуализированное обучение, административную деятельность, практику оценивания, разработку учебных программ, профессиональное развитие, этическое регулирование, исследовательские инициативы и вовлечение сообществ.

Структура магистерской диссертации включает введение, три главы, заключение, список литературы и одно приложение. Объем магистерской диссертации составляет 73 страниц. Работа содержит 11 рисунков, 91 источник.

Автор подтверждает, что работа выполнена самостоятельно, а расчетный и аналитический материал, приведенный в ней, правильно и объективно отражает состояние исследуемого процесса, и все теоретические, методологические положения и концепции, заимствованные из литературы и других источников, сопровождаются ссылками на их авторов.

CHAPTER 1
GENERATIVE AI OVERVIEW

Generative Artificial Intelligence (GenAI) and Natural Language Processing (NLP) have emerged as transformative technologies, garnering significant attention across various global sectors [1, 830]; [2, 151]; [3, 1]. While scholars have long explored the potential of artificial intelligence to imitate human communication, recent advances in deep learning architectures and neural networks have produced unprecedented capabilities in natural language generation and understanding. ChatGPT, developed by OpenAI, exemplifies a groundbreaking advancement in this domain, functioning as an advanced chatbot that employs AI and NLP methodologies to produce coherent and human-like responses [1, 833]. Utilizing deep learning and neural networks, this technology is adept at processing, analyzing, and generating responses to a diverse array of prompts, including inquiries, statements, and academic questions, within mere seconds. This literature review examines the current state of research surrounding GenAI and NLP technologies, with particular focus on their implications for higher education. By analyzing existing scholarly work, this review aims to identify key themes in current understanding of the potential and limitations of these technologies for use in higher education.

The influence of GenAI on higher education is increasingly pronounced, given its potential to enhance the learning experience and foster innovation in educational methodologies [4, 1]; [5, 692]; [6, 320]. These tools can motivate students to pose questions, articulate their needs, and engage in self-regulated learning, thereby facilitating deeper exploration of various subjects [7, 3253]; [8, 450]; [9, 14]; [10, 28]. For instance, a study by Ng et al. demonstrated that students could learn scientific concepts at home with the assistance of ChatGPT, which provided examples and explanations pertinent to science and aided in the organization of their learning processes by establishing goals, recommending learning strategies, and enhancing time management skills [11, 1348]. Another prevalent pedagogical application of GenAI is its role as a support tool for teaching and learning academic writing [12, 22]; [4, 1]; [13, 11]. These systems can assist student writers throughout the planning, drafting, and revision stages of academic writing, offering suggestions that address their specific writing needs, from linguistic subtleties to genre-specific characteristics [14, 12]; [15, 1]; [16, 9]; [17, 13963].

Notwithstanding its potential benefits, generative AI presents considerable challenges, particularly concerning academic integrity, bias, and privacy. The incorporation of AI-generated content in academic assignments raises issues

related to plagiarism and the authenticity of student submissions. It is imperative for educators to establish clear guidelines to ensure the ethical utilization of these tools [18, 1]. Additionally, algorithmic bias inherent in AI systems, which often reflects the training data, can perpetuate inequalities and adversely impact educational equity. For example, language models may unintentionally favor specific linguistic or cultural norms, thereby disadvantaging diverse learners [19, 1]. Moreover, the reliance of generative AI systems on student data raises significant privacy concerns and necessitates compliance with regulations such as China's Personal Information Protection Law (PIPL) and the European Union's General Data Protection Regulation (GDPR) [20, 1]. The formulation of appropriate policy frameworks is essential to ensure the responsible application of AI in educational contexts.

This study underscores the critical need for effective guidelines regarding the use of GenAI in higher education teaching and learning practices. To achieve a more systematic approach, there is a pressing requirement for the continuous optimization of existing policies and resources pertaining to GenAI across various educational environments. Focusing specifically on the context of higher education in China, this research addresses existing gaps by experimentally examining instances of GenAI utilization within Chinese higher education institutions. Based on these findings, the study discusses implications and offers recommendations for educators concerning policy development and pedagogical practices.

1.1 Concept of Artificial Intelligence

The concept of artificial intelligence can be traced back to Alan Turing, often referred to as the father of computer science, who posed the question in 1950: Can machines truly think? The formal recognition of AI as a distinct field originated from the Dartmouth Conference in 1956, where prominent figures such as John McCarthy, Marvin Minsky, and Claude Shannon introduced the term “artificial intelligence.”

Academician Li Deyi, the chairman of the Chinese Society of Artificial Intelligence, provides a comprehensive definition of artificial intelligence. He articulates that it involves the exploration of the mechanisms and principles underlying human cognitive activities, the development of artificial intelligence modeled after the human brain, and the investigation of methodologies to enable these intelligences to perform tasks traditionally requiring human intellect. Furthermore, it encompasses the establishment of foundational theories, methodologies, and technologies aimed at simulating human cognitive behaviors, as well as the creation of robots or intelligent systems capable of thinking and

acting in a manner akin to humans, thereby augmenting human intelligence [21, 1].

Within the domain of artificial intelligence, several key terms are frequently encountered: artificial intelligence, machine learning, and deep learning. These concepts are interrelated, with machine learning serving as one of the algorithms or methodologies employed to achieve artificial intelligence, and deep learning representing an algorithm or methodology grounded in deep neural networks that facilitates machine learning.

A significant advancement in generative AI emerged from developments in Natural Language Processing, particularly with the introduction of Transformer architecture. OpenAI's Generative Pre-Trained Transformer (GPT) series, first unveiled in 2018, marked a substantial progression in AI's capacity to generate human-like text. GPT-3, a subsequent iteration of this model, employs extensive pre-training and fine-tuning on vast datasets, enabling it to execute a diverse array of tasks, including automated writing, customer service, and code generation [22, 1898]. These models extend beyond text generation; they have also demonstrated remarkable proficiency in producing realistic images, as exemplified by models such as DALL-E and MidJourney, which generate images based on textual prompts [23, 1]. This multimodal generation capability has significantly broadened the scope and potential applications of generative AI, establishing it as a versatile instrument across various sectors, including media, education, and scientific research.

1.2 The Evolution of Artificial Intelligence

The development of AI has undergone three distinct waves. The first wave occurred during the 1950s and 1960s, initiated by Turing's 1950 paper “Computing Machinery and Intelligence,” which introduced the famous “Turing Test [24, 433].” This period saw the emergence of various AI programs and significant advancements in mathematical theorem proving. However, by the late 1970s, it became evident that AI was limited to solving relatively simple problems, leading to a decline in interest.

The second wave transpired in the 1980s and 1990s, marked by the introduction of the Hopfield neural network in 1982, which spurred advancements in areas such as speech recognition and language translation. Despite the progress, the limitations of computational power and algorithmic strategies prevented neural networks from becoming the dominant approach, allowing symbolic reasoning methods and statistical machine learning to flourish, resulting in the development of practical expert systems. A notable achievement during this period was IBM's Deep Blue defeating Garry Kasparov on May 11, 1997.

The third wave, beginning in 2006 and continuing to the present, was catalyzed by Geoffrey Hinton's introduction of the Deep Belief Network (DBN), which addressed optimization challenges in deep neural networks. The advancement of deep learning technologies, coupled with significant increases in computational speed, the adoption of Graphics Processing Units (GPUs), and the accumulation of vast amounts of data on the internet, has ushered in the deep learning era of AI. A defining moment of this wave was AlphaGo's 4-1 victory over Lee Sedol on March 15, 2016.

Throughout the evolution of AI, three major schools of thought have emerged: symbolic AI, connectionism, and behaviorism. The symbolic school employs symbolic representation and mathematical logic for intelligent simulation, achieving notable milestones in areas such as mathematical theorem proving and expert systems. A landmark event in this domain was Deep Blue, a groundbreaking chess-playing computer developed by IBM in the early 1990s [25, 1]. defeating chess champion Garry Kasparov in 1997. The connectionist school, on the other hand, is based on neural networks and their associated learning algorithms, with a significant application being AlphaGo's victory over Lee Sedol in a Go match in 2016. The behaviorist school focuses on “perception-action” models for simulating intelligent behavior, exemplified by Boston Dynamics' Atlas robot [26, 1].

In summary, while it is difficult to predict the future trajectory of AI, certain trends are evident. Early AI (during the first and second waves) primarily addressed problems within a deterministic framework, focusing on abstract and formalized issues that machines excel at, relying on human knowledge, logical reasoning, and knowledge systems through instruction-based programming. In contrast, modern AI (the third wave) tackles problems in an uncertain world, emphasizing the automation of knowledge acquisition and learning, which involves intuitive, experiential, and non-formalized challenges. This contemporary approach relies on data and models, utilizing data-driven programming where machines autonomously discover patterns and build models from data. The future of AI lies in effectively integrating logic with data, combining instruction-based programming with data-driven programming. Ultimately, the successful resolution of complex cognitive issues—of particular interest in the field of education—will depend on the synthesis of the strengths of the three major schools of thought.

1.3 Application areas of Generative AI

Applications of AI in Education

In the educational domain, generative AI is effecting transformative changes by integrating with advanced technologies such as the Internet of Things (IoT),

holography, virtual reality (VR), augmented reality (AR), big data, and cloud.

The application of artificial intelligence in education has evolved in parallel with the historical development of artificial intelligence itself, fundamentally aiming to enhance teaching effectiveness through computer-based technologies.

Computer-Assisted Instruction (CAI):

The inception of Computer-Assisted Instruction can be traced back to the 1950s, coinciding with advancements in computer technology. During this period, CAI began to flourish globally, with the PLATO system (Programmed Logic for Automatic Teaching Operation) emerging as a prominent example. In 1960, Dr. Donald Bitzer, head of the Coordinated Science Laboratory at the University of Illinois, collaborated with scholars from various fields, including education, psychology, and electronics, to explore personalized instruction through computers. By the 1990s, the PLATO system had connected over a thousand educational terminals, offering more than 200 courses and over 10,000 hours of instructional services [27, 1]. The PLATO system represented an early attempt to realize intelligent and personalized teaching, albeit with limited initial capabilities. PLATO was developed at the University of Illinois at Urbana-Champaign and initially operated in a single classroom. It was a significant contribution to the early years of eLearning.

Intelligent Tutoring Systems (ITS):

As the field of artificial intelligence began to emphasize expert systems, the development of Intelligent Tutoring Systems gained momentum within the educational sector. ITS are designed to enable computers to guide and assist students in their learning processes, potentially substituting for human instructors to some extent. In 1973, Hartley and Sleeman proposed a foundational framework for ITS, identifying three key components of knowledge: domain knowledge (Expert Model), which addresses what to teach; learner knowledge (Student Model), which focuses on who to teach by assessing students' cognitive levels and styles; and pedagogical knowledge (Tutor Model), which determines how to teach by providing personalized instructional strategies and appropriate tutoring actions [28, 41]. Over the decades, the exploration of ITS has indeed yielded effective tools for enhancing cognition and learning. Recently, breakthroughs in deep neural network-based artificial intelligence technologies have rekindled interest in intelligent tutoring systems, also referred to as AI teachers, which are currently experiencing rapid development.

Personalized Adaptive Learning:

There is a growing aspiration to achieve personalized adaptive learning through the integration of artificial intelligence, big data, and learning analytics technologies. The U.S. Department of Education defined personalized learning (PL)

in its 2016 National Education Technology Plan as an approach that tailors methods to meet learners' individual needs and cognitive characteristics, allowing them to actively or passively construct knowledge [29, 11]. Adaptive learning, often referred to as Adaptive Learning Systems (ALS), is typically associated with personalized adaptive learning in practice. Adaptive learning is a product of online education that facilitates personalized learning experiences, characterized by individualized teaching and learning behaviors that are not present in traditional classroom settings. Consequently, online education, personalized learning, and adaptive learning are inherently interdependent [30, 121].

In recent years, the rapid advancement of artificial intelligence and big data technologies has propelled the development of personalized adaptive learning (often associated with learning analytics) into a new phase. Numerous new technologies and concepts have emerged, with the “learning dashboard” being particularly noteworthy. The learning dashboard, also known as a learning analytics dashboard, records learners' online behaviors and outcomes, analyzes this data according to specific needs, and presents the results in visual formats such as graphs and charts, thereby assisting educators, researchers, and administrators. For instance, in September 2013, Khan Academy introduced a learning dashboard for its mathematics courses, segmenting the required mathematical knowledge into hundreds of discrete points and generating a “task progress” chart composed of 549 cells [31, 106]. Objectively, the learning dashboard initially represented a component of learning analytics focused on data presentation; however, due to its effective visibility, it has increasingly become synonymous with the entire learning analytics system. Nevertheless, the analysis of learning behavior data should extend beyond the learning dashboard to incorporate enhanced artificial intelligence decision-making capabilities, thereby creating an AI-driven analysis engine for learning behavior data.

In practice, people generally adopt the concept of personalized adaptive Learning. According to Zhang Jianping, Adaptive learning is a product of online education to carry out personalized learning, online education has the personalized characteristics of teaching and learning behaviors that classroom teaching does not have, and online education, personalized learning, and adaptive learning have a natural interdependence [32, 50].

Many scholars have proposed different adaptive learning models to achieve personalized adaptive Learning. Brusilovsky and Weber proposed an interactive web-based intelligent teaching system, ELM-ART [33, 74]. Yu Shengquan proposed an adaptive learning model based on three key aspects: learning diagnosis, learning strategy, and dynamic organization of learning content, and applied it to the learning meta-platform they developed [34, 14]. Zhao Wei et al.

proposed a learner-learning competency model with three dimensions, including personality traits, knowledge level, and application context, based on various competency construction models worldwide. Learner Learning Competency Model and developed a corresponding learning system [35, 109].

However, limited by technical reasons, the development of personalized adaptive Learning was slow before. In recent years, with the rapid growth of artificial intelligence and big data technology, the development of personalized adaptive Learning has entered the fast lane; new technologies and new concepts have been endless, especially the 'learning dashboard,' which is the most attractive. Learning Dashboard, also known as learning analytics dashboard, can record learners' online learning behaviors, learning outcomes, and other information according to the needs of the analysis and present the results of the study in the form of figures, charts, and other visual forms, to assist teachers and students, researchers and administrators. For example, Khan Academy launched a learning dashboard for maths courses in September 2013 [36, 106], in which the maths knowledge to be learned is cut into hundreds of knowledge points, and a 'task progress' chart consisting of 549 cells is generated. Objectively speaking, the learning dashboard was initially the data presentation part of learning analytics, but because of its visibility, it is now becoming synonymous with learning analytics as a whole. Of course, the analysis of learning behavioral data should not be limited to teaching dashboards. Still, it should be added to more artificial intelligence decision-making capabilities, such as the formation of learning behavioral data artificial intelligence analysis engines.

1.4 Regulation of Generative AI

The integration of Generative AI across various sectors has prompted the education industry to incorporate this technology into multiple facets of teaching, management, and assessment, aiming to enhance educational quality and efficiency. Nonetheless, the deployment of Generative AI also presents a range of ethical and legal challenges that necessitate resolution, particularly within higher education, where sensitive issues such as academic integrity, privacy protection, and algorithmic fairness are prevalent. The regulatory frameworks that are being progressively established in numerous countries offer guidance for the responsible utilization of Generative AI, with ongoing efforts in China to regulate its application in the education sector to ensure safety and compliance.

(1) Current Status of Global Generative AI Regulatory Frameworks

On a global scale, various nations and international organizations have initiated the development of regulatory frameworks governing the application of

Generative AI in education. These frameworks establish foundational guidelines for the use of AI technologies within educational systems, focusing primarily on transparency, data privacy protection, and ethical accountability. The Beijing Consensus on Artificial Intelligence and Education, published by UNESCO (United Nations Educational, Scientific and Cultural Organization), serves as a pivotal document that articulates principles for the responsible implementation of AI in educational contexts [37, 1]. This document emerged from the International Conference on Artificial Intelligence and Education, held in Beijing from May 16 to 18, 2019. During this conference, 500 representatives from various sectors, including education, technology, and policy-making, decided to develop a framework for leveraging AI technologies to enhance educational outcomes while ensuring that these technologies are used responsibly and ethically [38, 1]. By advocating for transparency and accountability, the Beijing Consensus underscores the necessity of disclosing the operational mechanisms of algorithms utilized in AI-driven educational applications to ensure their reliability and fairness in both teaching and management. Furthermore, the consensus posits that the deployment of Generative AI in education must adhere to ethical standards, safeguard the privacy of students and educators, and prevent data misuse. These principles offer a significant reference point for nations in the formulation of regulatory frameworks for AI in education.

The European Union's draft Artificial Intelligence Act (AI Act) proposed by the European Commission in April 2021, is designed to ensure that AI systems are safe, respect fundamental rights, and promote trust in AI technologies across EU member states. The act advances categorize AI systems according to varying levels of risk, imposing rigorous technical and compliance standards for high-risk applications, such as educational assessment systems [39, 1]. The legislation of the EU member states mandates that all AI tools employed within educational frameworks undergo thorough vetting to meet established compliance criteria concerning technical standards, privacy protection, and data transparency. Through this tiered management approach, the EU seeks to foster the advancement of AI technology while mitigating associated risks. This regulatory model is applicable not only to the education sector but also serves as a reference for AI applications in high-risk domains such as healthcare and finance, highlighting the necessity for AI technologies to adhere to stricter regulatory frameworks in high-risk contexts.

The United States, recognized as a pivotal origin of AI technology, has seen its government express significant concern regarding the development, application, and regulation of AI. Since 2016, the White House Office of Science and Technology Policy has published a series of reports that articulate a clear endorsement of AI, advocating for its standardized development to address the

challenges posed by international competition. In 2019, President Trump formalized the U.S. Artificial Intelligence Initiative, thereby elevating AI to a national strategic priority. This initiative marked a pivotal moment in recognizing AI as a critical component of national strategy and economic growth. Given the growing influence of generative AI on the educational landscape, the U.S. government has increasingly focused on delineating the application of AI within educational contexts. In May 2023, the U.S. Department of Education released a report titled "Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations [40, 1]" which thoroughly examines the value and potential applications of AI in education. The report posits that AI can enhance the adaptability and efficiency of both learning and teaching processes, facilitate formative assessments, and foster the creation of educational environments. It underscores the principle of "people in the loop" in its applications and advocates for the establishment of educational guidelines and protective measures. Furthermore, the report recommends that AI models be developed with an educational perspective, prioritizing the resolution of contextual challenges while enhancing credibility and safety, ensuring that product design adheres to optimal educational principles, and involving educators throughout the research and development process.

In contrast, Japan has faced a prolonged economic downturn since the collapse of its bubble economy in 1990, which has significantly impacted the nation's development. Issues such as an aging population, declining birth rates, labor shortages, and diminishing corporate competitiveness have become increasingly pronounced, resulting in a noticeable lag in the advancement of the AI industry compared to European and American counterparts. In response to intense international competition, the Japanese government has recognized the necessity of bolstering the global influence of digitalization and re-establishing the nation's competitive edge. In 2016, Japan introduced the concept of "Society 5.0," positing that AI will serve as the foundational technology driving this future "super-intelligent society." Subsequently, Japan launched the "Japan Renaissance Strategy 2016" and the "Artificial Intelligence Strategy 2019 [41, 1]," initiating vigorous efforts to promote the development of the AI sector. Regarding the educational application of generative AI, the Japanese government has adopted a proactive stance, with the Central Education Commission establishing a Special Committee on Digital Learning Infrastructure in April 2023 to discuss the management principles and application strategies for generative AI products. In June 2023, Japan enacted the "Basic Plan for Educational Promotion (2023-2027)," which identified the digital transformation of education as one of five key priorities for educational reform over the next five years [42, 1]. This plan specifically

emphasizes the need to enhance the rational application of generative AI while clarifying its roles and associated risks in educational settings. As a subsequent policy measure, the Ministry of Education, Culture, Sports, Science and Technology released two documents in July 2023: the “Interim Guidelines for the Use of Generative Artificial Intelligence in Elementary and Secondary Education [43, 1]” and the “Measures for the Implementation of Generative Artificial Intelligence in Teaching and Learning Activities at Universities and Colleges of Higher Education [44, 1].” These documents represent the world's first comprehensive national guidelines issued by a central government regarding the use of generative AI in educational contexts.

(2) Current Status of the Regulatory Framework for Generative AI in China

China has undertaken proactive measures to regulate generative artificial intelligence, particularly focusing on education and data protection. In 2023, the Cyberspace Administration of China (CAC) introduced the Deep Synthesis Management Regulation, officially known as the Administrative Provisions on Deep Synthesis in Internet-Based Information Services, which mandates that all content produced by generative AI must explicitly disclose its source to mitigate the spread of misinformation The law prescribes that the processing of personal information must be based on the voluntary and explicit consent of the individual [45, 1]. While China lacks national-level AI legislation, local governments have begun implementing their own regulatory frameworks. Leading this trend, both Shenzhen and Shanghai introduced local AI regulations in 2022, focusing on fostering AI industry development within their jurisdictions. The law prescribes that the processing of personal information must be based on the voluntary and explicit consent of the individual [46, 1]. This regulation is instrumental in safeguarding data authenticity and curbing the dissemination of misleading information.

In the educational sector, the regulatory framework surrounding generative AI in China emphasizes data privacy and the rights of users. The Personal Information Protection Law, the People's Republic of China is a comprehensive legal framework designed to safeguard personal data that is often compared to the European Union's General Data Protection Regulation (GDPR), stipulates that any AI system utilized in educational contexts must adhere to stringent privacy protection standards when collecting, storing, and processing student data. The law prescribes that the processing of personal information must be based on the voluntary and explicit consent of the individual. The law prescribes that the processing of personal information must be based on the voluntary and explicit consent of the individual [47, 1]. The PIPL specifically underscores the necessity

for generative AI employed in education to ensure the security of personal data, requiring consent from both educational institutions and parents. This legal framework provides essential protection for colleges and universities in the deployment of generative AI, thereby effectively safeguarding student privacy.

Additionally, the Ministry of Education (MOE) in China is actively developing guidelines for the implementation of generative AI in higher education institutions. By establishing data compliance standards and technical specifications, the MOE encourages universities to prioritize data security and ethical responsibility in the adoption of generative AI technologies. For instance, when employing generative AI for academic research, institutions are required to ensure transparency in data processing and adhere to national ethical guidelines regarding data usage to maintain the legitimacy of technological applications.

Thus, China has established a multi-layered regulatory approach to generative AI, combining national initiatives like the Deep Synthesis Management Regulation and PIPL with local government frameworks. The emphasis on data protection, transparency, and ethical implementation is particularly evident in the educational sector, where the Ministry of Education's guidelines work in tandem with privacy laws to ensure responsible AI adoption. This comprehensive regulatory framework demonstrates China's commitment to balancing technological innovation with data security and user protection, particularly in academic environments.

(3) Regulatory Challenges of Generative AI in Higher Education

The extensive integration of generative AI in higher education has introduced a range of regulatory challenges, particularly concerning academic integrity, data privacy, and algorithmic fairness.

Firstly, the pervasive use of generative AI can facilitate academic misconduct. Students may exploit AI technologies to automatically generate academic content, thereby evading traditional plagiarism detection mechanisms. This trend presents new challenges for universities in upholding academic standards and integrity, necessitating the implementation of more effective monitoring and management strategies for the use of generative AI. Some institutions have begun to utilize AI technologies for academic oversight; however, due to the intricate generative logic and technical characteristics of generative AI, traditional monitoring methods often struggle to accurately assess the authenticity of AI-generated content.

Secondly, the reliance of generative AI on personal data raises significant data privacy concerns. The involvement of substantial amounts of student personal data in educational AI applications introduces compliance risks related to the storage and processing of such data. Inadequate protection of this data could result

in breaches of personal information, potentially adversely affecting students. Globally, the challenges of data compliance and security management in the context of generative AI applications within universities have become increasingly prevalent.

Lastly, the utilization of generative AI in educational assessment and decision-making processes raises critical issues regarding fairness and transparency. The decision-making mechanisms of generative AI are often predicated on complex algorithms and deep learning networks, rendering their assessment processes difficult to fully elucidate. For instance, AI systems may unintentionally introduce biases in evaluating student performance, thereby compromising the fairness of student assessments. Educational institutions need to ensure that these AI systems operate with fairness and transparency to mitigate the risk of algorithmic bias.

To sum up, while the application of generative AI in higher education presents innovative opportunities, it simultaneously poses significant regulatory challenges. The integration of generative AI in educational contexts is progressively being governed by legal frameworks at both global and national levels; however, further research and innovation are necessary in the domains of ethics, privacy protection, and data security.

In conclusion, this chapter investigates the transformative impact of artificial intelligence on higher education, with a particular focus on its integration within the rapidly changing educational context of China. It commences with an exploration of the historical evolution and current landscape of higher education in China, emphasizing the significant shift from a rigid, examination-centric model to one that embraces digital transformation and innovation. The role of AI is situated within this broader modernization initiative, bolstered by national policies such as the “14th Five-Year Plan” and “China Education Modernization 2035”, which advocate for the incorporation of intelligent technologies to enhance the quality, accessibility, and efficiency of education. The applications of AI in higher education are categorized according to their effects on learning, teaching, management, and assessment environments. AI facilitates personalized adaptive learning by customizing educational experiences to meet individual student needs and assists educators by automating routine tasks, thereby allowing for more focused and innovative instruction. In administrative contexts, AI optimizes processes such as resource management and decision-making, while in assessment, it enhances the accuracy and efficiency of feedback through automated grading and analytics. However, the chapter also addresses various challenges, including technical limitations, data privacy issues, algorithmic biases, and the ethical considerations associated with AI-driven education. These challenges highlight the

necessity for robust regulatory frameworks and ethical guidelines to ensure the responsible and equitable implementation of AI in educational settings. Through its thorough analysis, the chapter emphasizes AI's dual role as both a driver of educational innovation and a field that necessitates careful governance and ongoing research.

CHAPTER 2
ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

2.1 Higher Education in China

2.1.1 World trends in higher education

Higher education refers to education that is typically provided by universities and colleges, focusing on undergraduate and postgraduate degrees. UNESCO defines higher education as encompassing "all types of education (academic, professional, technical, artistic, pedagogical, long-distance learning, etc.) provided by universities, technological institutes, teacher training colleges, etc., which are normally intended for students having co the law prescribes that the processing of personal information must be based on the voluntary and explicit consent of the individual [48, 1]. Higher education is a subset of tertiary education and is primarily aimed at academic and professional development. Tertiary education is a wider term, which refers to post-secondary education typically provided at universities, colleges, polytechnics, and other specialized institutions. This level of education follows the completion of secondary education and is aimed at preparing students for further academic pursuits or entry into the workforce. Tertiary education includes a broad spectrum of post-secondary educational opportunities, including vocational training and other non-degree programs.

After World War II, the number of students enrolled in higher education institutions grew significantly. This growth was driven by societal changes, economic demands for a more educated workforce, and government policies promoting access to education. Enrollment rates that had been stable at around 3-5% of the relevant age group before the war began to rise dramatically, with many countries experiencing doubling student numbers within short periods. Higher education transitioned from an elite model, which served a small, privileged segment of the population, to a mass education model that aimed to serve a larger portion of the population. This shift involved the transformation of traditional universities to accommodate a broader demographic, including those from various social strata. Following the mass education phase, many countries began to move towards universal access to higher education, where the goal was to provide educational opportunities to all individuals, regardless of their background or academic qualifications. This trend emphasized inclusivity and aimed to eliminate barriers to entry. Higher education institutions expanded their programs to include a wider range of disciplines, vocational training, and adult education. This diversification was in response to the changing needs of the economy and society,

as well as the demand for more practical and applied knowledge. There was a growing emphasis on vocational and technical education as part of the higher education landscape. This shift reflected the need for skilled workers in various industries and the recognition that higher education could serve both academic and practical purposes. The perception of higher education evolved from being viewed as a privilege to being seen as a right and, in many cases, an obligation for certain social groups. This change influenced student motivation and the overall intellectual climate within educational institutions [49, 275].

2.1.2 Status of Higher Education in China

Examining the historical development of higher education globally, it is evident that higher education, as a complex social system, continually seeks to achieve balance and innovation in response to rapidly changing global challenges. China possesses a rich educational heritage, which has evolved from the ancient official school system and the establishment of the “Four Great Academies”(四大书院), historically significant academies of classical learning in China, particularly during the Song (960-1279) and Ming (1368-1644) dynasties educational institutions, cultural and intellectual hubs that contributed to the preservation and dissemination of Confucian thought.

Modern higher education can be characterized as a distinctive higher education system. It is characterized by its rigorous structure, emphasis on examinations, and cultural significance. The structure of education in China is divided into several levels, including preschool, primary, junior secondary, senior secondary, and higher education. Education in China is compulsory for nine years, which includes six years of primary education followed by three years of junior secondary education. Children typically start school at age six, and the medium of instruction is primarily Mandarin Chinese, with some exceptions for ethnic minority schools [50, 1]. A defining feature of the system is the Gaokao, the National Higher Education Entrance Examination. This highly competitive exam plays a crucial role in determining students' access to higher education and is seen as a pivotal moment in their academic careers. China's educational system has been noted for its emphasis on rote memorization and test preparation, although China's educational system have been moving away from learning by rote in recent years. This shift is a part of broader educational reforms aimed at fostering critical thinking, creativity, and a more holistic approach to learning. In general, China's higher education system has undergone significant transformation over the past few decades, evolving into the largest education system in the world. Reforms improved accessibility and quality of education in China, especially in rural areas. As of recent years, the number of tertiary students surged from approximately 7.4 million in 2000 to nearly 45 million in 2018, reflecting a dramatic increase in

enrollment rates [51, 1]; [52, 1]. As of 2023, China had a total of 3,074 higher education institutions. This figure includes various types of colleges and universities, such as public universities and higher vocational colleges. Additionally, there are 252 adult higher education institutes operating in the country [53, 1].

As of July 2024, China boasts 112 universities ranked in the top 1% of the Essential Science Indicators (ESI) across 349 disciplines, and 22 universities ranked in the top 0.1% across 39 disciplines [54, 1]. More than ten Chinese universities are included in the global top 100 university rankings. Mainland China has two higher education institutions continuously ranked among the top 50 universities in the world. Tsinghua University in Beijing is the leading higher education school in China. Peking University, the second best in the country, is the oldest national university founded in 1898 as the Imperial University of Peking. Fudan University in Shanghai, University of Science and Technology of China in Hefei, Zhejiang University in Hangzhou, Shanghai Jiao Tong University, and Nanjing University are other prestigious schools consistently competing in China's top 10 university rankings [55, 1].

In recent years, the Chinese higher education system has experienced significant expansion. By 2023, approximately 3,074 institutions are projected to enroll over 47 million students, resulting in a gross enrollment rate of 60.2% [56, 1].

The Ministry of Education of China is actively promoting structural reforms in higher education to address the challenges and opportunities presented by global technological advancements. The 14th Five-Year Plan of the People's Republic of China, the strategic framework that outlines the country's economic and social development goals for the period from 2021 to 2025, explicitly emphasizes the necessity for higher education to enhance national competitiveness through innovation-driven growth, highlighting the importance of improving teaching quality and efficiency while actively integrating new technologies to support educational innovation [57, 1]. This technology-driven transformation encompasses the advancement of digital infrastructure within institutions, the implementation of intelligent learning systems, and the utilization of big data analytics to achieve higher levels of instructional support, ultimately fostering the development of innovative and technologically proficient interdisciplinary talents. Thus, the education system in China is characterized by being structured, exam-centered, and culturally relevant. It plays a vital role in shaping the future of its students and the nation, reflecting both traditional values and modern educational practices.

2.1.3 Digital Transformation in Higher Education in China

Technology plays a transformative role in higher education. Since World War II there has been a significant integration of technology into higher education, particularly with the advent of communication technologies. This integration has transformed how education is delivered and accessed, allowing for more flexible learning environments [58, 276]. In recent years, the domain of higher education has experienced a significant digital transformation, which has not only broadened the accessibility of educational resources but has also fundamentally altered pedagogical approaches and the student learning experience. Technological advancements have facilitated the emergence of platforms such as Massive Open Online Courses (MOOCs) and Small Private Online Courses (SPOCs), alongside the integration of social media, thereby contributing to the globalization of higher education and fostering new learning and social opportunities [59, 448].

Enhancing Accessibility in Higher Education

Digital technologies have markedly improved the accessibility of higher education. Online platforms, particularly MOOCs, empower students globally to transcend temporal and spatial limitations in accessing high-quality educational resources. These platforms allow students to select courses that align with their individual learning needs. This is particularly beneficial in regions where educational resources are limited, as online programs afford students the opportunity to obtain quality education, thereby mitigating the educational disparities among students from varying geographical and economic backgrounds. Furthermore, SPOCs enhance the depth and specificity of the learning experience by offering more personalized educational resources.

Diversification of Learning Modalities

The proliferation of MOOCs and SPOCs has also facilitated the diversification of learning formats. Renowned for their flexibility and comprehensive content, these digital courses not only extend traditional classroom experiences online but also grant students the autonomy to regulate their own learning pace. For instance, SPOCs amalgamate the benefits of small-scale online interactions with the dissemination of course resources, thereby providing a more interactive and contextually relevant learning experience. Additionally, tools such as video lectures, interactive quizzes, and real-time discussions further enrich the learning modalities, enhancing student engagement and commitment to their educational pursuits.

Augmented Socialization and Networking Opportunities

Digital technologies have transformed not only the learning process but also the avenues for socialization and networking. Through online educational platforms and social media, students can engage with peers and educators from diverse backgrounds, fostering the development of varied learning communities.

Social media and online forums have emerged as vital instruments for informal learning, enabling students to cultivate networks and broaden the scope of knowledge exchange. The interactive features of online platforms, including real-time discussions and virtual learning groups, facilitate cross-cultural and interdisciplinary socialization, thereby rendering higher education more inclusive and accessible.

Personalized Learning Experiences

Personalized learning represents another significant advancement attributed to digital technologies in higher education. Contemporary digital platforms offer students customized learning resources and individualized guidance, often utilizing algorithms that assess their learning behaviors and progress. This data-driven adaptive learning approach allows students to progress at their own pace and according to their specific needs, thereby enhancing educational outcomes. Technologies such as generative artificial intelligence and big data analytics can provide insights into students' learning trajectories and preferences, facilitating a more tailored educational experience. This personalized learning framework not only improves academic performance but also alleviates frustration stemming from varying levels of ability, enabling a broader range of students to achieve optimal learning outcomes.

Attracting a Global Student Body and Promoting Cross-Border Knowledge Sharing

The digital transformation has also enabled higher education institutions to attract a diverse international student population. Online courses, such as MOOCs, dismantle geographical and national barriers, allowing students from various cultural backgrounds to engage with the same courses and educational resources, thereby fostering a genuinely global learning community. This transnational exchange of knowledge enriches educational institutions with an international perspective and promotes cultural interactions among students. Moreover, these online platforms provide educational institutions with opportunities to engage with the global educational community, thereby advancing the diversification and internationalization of teaching and learning content.

Provision of High-Quality Learning Resources

Another significant contribution of digital technologies is the enhanced availability of high-quality learning resources. Through online courses, Open Educational Resources (OER), and digital libraries, students can access premier educational materials at any time and from any location. The evolution of digital technologies has enabled quality educational resources, which were previously confined to traditional campuses, to reach a broader audience, thereby elevating the overall quality of education. The widespread dissemination of digital resources not

only expands students' knowledge horizons but also enriches the depth and breadth of instructional content.

Streamlining Administrative Processes

In the realm of administration and services within higher education, digital technology plays a crucial role in optimizing processes. Through online enrollment systems, student management systems, and learning management systems (LMS), higher education institutions can more effectively manage student information, course schedules, and academic records. The implementation of these technologies not only enhances the administrative efficiency of colleges and universities but also alleviates the burden on students and staff, allowing them to focus more on teaching and learning. The simplification of administrative processes contributes to the creation of a more efficient, transparent, and student-centered educational environment, thereby further enhancing the overall student experience.

2.2 The Necessity of AI in Chinese Higher Education

The advancement of higher education in China is closely aligned with contemporary developmental trends. Under the influence of national policies regarding higher education, a decline in student enrollment, the characteristics of instructional methods, and prevailing societal trends, artificial intelligence has emerged as an asset in the evolution of higher education. AI is an indispensable avenue for the modernization of education in China.

2.2.1 Requirements for the Modernization of Higher Education in China

Currently, higher education in China is confronted with multiple challenges, including global competition, technological transformation, and domestic reforms, marking a critical period of transition. This transition involves a fundamental shift from “quantitative expansion” to “qualitative enhancement,” with an increasing emphasis on leveraging information and intelligent technologies to facilitate educational reform. The rapid advancement of modern information technology and its deep penetration into the higher education sector have underscored the significance of educational intelligence in the reform and development of higher education. The “Furter Report” advocates for the integration of technology into all stages of educational activities [60, 1]. Building on the insights of the “Furter Report,” the “Delors Report,” published over two decades later, emphasizes the need to fully recognize the impact of information and communication technologies on knowledge acquisition [60, 1]. The 2024 World Digital Education Conference, themed “Digital Education: Application, Sharing, Innovation,” aims to align with the trends of the digital age and establish a platform for international cooperation in digital education. In the context of educational digitization, global higher

education is increasingly focused on the comprehensive integration of intelligent technologies with the intrinsic values of higher education, aiming to construct a new educational ecosystem that is data-driven, human-technology integrated, and cross-disciplinary, thereby fostering a more open, equitable, and sustainable higher education system and achieving a fundamental transformation of the intelligent educational ecosystem.

In recent years, the reform and development of higher education in China have positioned the promotion of digital transformation as a crucial breakthrough for creating new development pathways and advantages. The 20th National Congress of the Communist Party of China for the first time included “promoting educational digitization” in its report. In 2019, the State Council of China issued the “China Education Modernization 2035” document, which explicitly proposed the establishment of a modern education system that serves lifelong learning for all citizens, alongside a vigorous push for the modernization of educational concepts, systems, institutions, content, methods, and governance, with a focus on improving educational quality, promoting educational equity, and optimizing the educational structure. During the 2022 National Education Work Conference, the Ministry of Education emphasized the implementation of a national educational digital strategy, and the 2024 National Education Conference reiterated the need for in-depth implementation of this strategy. Since the 18th National Congress, the development of education in China has elevated educational digitization to a national strategy, with higher education taking the lead in reshaping educational forms and expanding the temporal and spatial boundaries of education, thereby enhancing the quality of development through digitalization and intelligence.

Educational modernization is not only an objective but also a process, possessing rich theoretical and practical significance. Since the emergence of the concept of “educational modernization” in China, numerous scholars have explored and discussed it from various perspectives. The “China Education Modernization 2035” document indicates that modernization must occur across educational concepts, systems, institutions, content, methods, and management. Given that educational modernization encompasses both objectives and processes, scholars have categorized its characteristics into two dimensions: “objectives” and “process.” Yuan Zhenguo, representing the objective dimension, compares modern education with traditional education and identifies eight key characteristics of modern education, including the democratic and equitable nature of education, lifelong and all-time-space education, the productive and social aspects of education, personalized and creative education, diversity and differentiation in education, informatization and innovation in education, internationality and openness in education, and the scientific and legal nature of education [61, 1]. The

analysis of the process dimension emphasizes the historical, phased, relative, dynamic, and differential nature of educational modernization. Despite the various expressions of the characteristics of educational modernization, they can be synthesized into several main aspects: openness, democracy, scientific rigor, balance, lifelong learning, and personalization. Based on the scholarly interpretations of the connotation of educational modernization, this study defines educational modernization as a process of continuous reform, innovation, and improvement of educational activities to adapt to societal transformations and changes. It represents a transcendence of traditional education and encompasses a comprehensive transformation of educational development concepts, methods, systems, and institutions, including the modernization of ideological concepts, institutional frameworks, and material conditions across three dimensions.

2.2.2 The need to characterize the Chinese curriculum

In recent decades, China's higher education system has undergone an unprecedented transformation, characterized by the rapid expansion and diversification of academic programs. As of 2021, statistics indicate that China boasts over 2,900 higher education institutions, with student enrollment surpassing 40 million, clearly illustrating the vast scale and swift growth of the country's higher education sector [62, 1]. However, alongside this quantitative increase, critical issues have emerged that require urgent attention, including the quality of education, the alignment of curricula with practical demands, and the integration with international educational standards.

Currently, the curriculum framework within Chinese higher education predominantly reflects a traditional, teacher-centered pedagogical approach, which emphasizes knowledge transmission and preparation for standardized examinations [63, 760]. While this instructional method may exhibit certain efficiencies in specific contexts, it often stifles the development of students' critical thinking, innovative capabilities, and problem-solving skills—attributes that are increasingly essential in today's rapidly evolving job market [64, 29]. Furthermore, the lag in curriculum content updates hinders the ability to keep pace with global economic trends and technological advancements, resulting in a notable disconnect between education and industry needs.

Considering these challenges, the integration of artificial intelligence technology into the Chinese higher education curriculum has become particularly urgent. The application of AI can significantly enhance educational personalization by tailoring learning pathways to the unique characteristics and preferences of each student, thereby facilitating precise instruction [65, 22]. For instance, through AI-driven data analysis, educators can accurately identify students' strengths and weaknesses, allowing for flexible adjustments in teaching strategies to ensure a

high degree of alignment between educational content and student needs. This shift towards a student-centered teaching model aligns closely with the core objectives of educational reform in China, which aims to cultivate talents endowed with innovative spirit and critical thinking skills.

The incorporation of AI technology can markedly improve the timeliness and practicality of educational content, ensuring that curriculum design remains in sync with current industry dynamics and technological advancements. As AI technology becomes increasingly prevalent across various sectors, graduates equipped with AI knowledge and skills will possess enhanced employability and be better positioned to adapt to and drive changes in the future labor market [66, 493]. This close alignment between education and industry not only has the potential to significantly enhance students' employability but also provides a robust talent foundation for China's ambitious vision of leading in global technological innovation.

2.2.3 The need for the development of the zeitgeist

The rapid advancement of society is closely linked to technological revolutions, with the three industrial revolutions in human history significantly influencing the evolution of education. These revolutions have indirectly facilitated educational transformations through changes in social productive forces and production relations, particularly within the realm of higher education. This sector has experienced a redefinition of its functions, leading to discussions regarding its fundamental nature, which have given rise to perspectives such as the superstructure theory and the productive forces theory.

Currently, China's educational landscape is predominantly characterized by a batch-oriented, standardized, and centralized approach to talent cultivation, primarily reliant on the traditional classroom lecture model. In this context, artificial intelligence is increasingly recognized by scholars as a transformative technology propelling the fourth industrial revolution. Consequently, there is considerable anticipation within the academic community regarding the potential of AI to instigate significant changes in higher education, resulting in a surge of research focused on AI in educational settings. Key AI technologies, including natural language processing, affective computing, knowledge representation and reasoning, speech recognition, and scene understanding, have been extensively implemented across various scenarios in higher education, yielding notable outcomes.

AI introduces novel characteristics such as deep learning, cross-disciplinary integration, human-machine collaboration, collective intelligence, openness, and autonomous operation. These features are driving a shift in higher education from a mass education model to a more personalized approach. This transformation

encompasses not only localized changes within educational institutions but also comprehensive alterations across school education, family education, social education, formal and non-formal education, as well as online and offline learning modalities, including professional and lifelong learning. The impact of AI and other next-generation information technologies on society is profound, fundamentally altering traditional modes of social production and human lifestyles, thereby influencing economic and social structures and the organization of industries through technological alienation.

In the educational sphere, AI has transformed information interaction methods, facilitating knowledge dissemination and resource accessibility beyond temporal and spatial constraints. The COVID-19 pandemic has further accelerated the development and application of AI in education, expanding its application scenarios and enhancing societal acceptance of AI-driven educational initiatives. Moreover, AI has transcended the boundaries of higher education, revealing a deep and interconnected relationship between higher education and economic and social development. A thorough analysis of AI's impact on higher education is essential, considering both the inherent technical characteristics of AI and the broader trends of digital development within society.

Thus, the integration of AI into Chinese higher education aligns with contemporary trends and the modernization objectives of the Chinese educational system.

2.3 The Value and Prospects of Generative AI in Higher Education

To organically integrate AI into higher education, we should know what education problems exist. What exactly is the application value of artificial intelligence in higher education, and what problems can be solved? Comprehensively analyzing the previous analysis of the development history of the application of AI in education and combining the suggestions of other experts and scholars, the core values of AI in higher education are as follows.

2.3.1 Generative AI on learning environments

The primary aim is to promote personalized adaptive learning while cultivating the development of unique and innovative skills among students. Since Comenius proposed classroom teaching, the education field has gradually formed an education model based on classroom teaching and the school system, which has slowly evolved into the modern mainstream school management model. This approach greatly improved efficiency and produced much-needed talent for the Industrial Revolution. However, this kind of uniform training will inevitably bring about another problem: how to tailor teaching to achieve personalized learning. As

time passes and times change, personalized learning is increasingly valued today. The primary aim is to promote personalized adaptive learning while cultivating the development of unique and innovative skills among students. To realize the objective of “leaving no one behind,” it is essential to conduct a thorough analysis of the learning behaviors exhibited by each student. Subsequently, it is imperative to provide tailored guidance that is individualized to meet the specific needs of each learner, thereby maximizing their potential for achievement. However, in reality, teachers usually have to deal with dozens of students, and they do not have enough time and energy to analyze each learning behavior of each individual.

Considering the substantial student population in China, it is impractical to depend exclusively on the efforts of educators to accomplish this objective. so, is it possible to rely on computers? For example, with the help of auto-correction software, a teacher can carefully correct every piece of writing of every student over and over again [67, 22]. The enterprise field in this regard was used earlier; for example, more than 10 years ago, supermarkets relied on the analysis of shopping tickets and found that people who buy beer often buy nappies and other laws so they can decide what to purchase goods and how to arrange. In the field of higher education, in the past, a lot of data was not electronic, and it wasn't easy to analyze. Nonetheless, an increasing volume of data has transitioned to electronic formats, enabling the application of big data technologies for comprehensive analysis. This facilitates the identification of patterns that may not be discernible through experiential methods, thereby allowing for the provision of more scientifically informed and personalized guidance to students. Envision a prospective educational framework wherein computers, augmented by artificial intelligence and big data technologies, analyze a student's historical academic performance and classroom engagement to deliver tailored learning materials suited to the individual's needs. the student in the learning process will be based on the student's expression of the feedback will be adjusted appropriately (if the teacher to speak, will also be adjusted according to the system's prompts), after the lesson will be based on the level of each student, the classroom performance of each student to assign suitable, personalized homework After class, the computer will assign appropriate and customized homework based on each student's level and classroom performance, and the computer will also carefully correct students' homework, identify students' problems, and provide teachers with learning reports. In short, the realization of personalized learning is the goal of education; relying on traditional education methods in the past is difficult to achieve, and relying on artificial intelligence technology may not be able to achieve, but at least it is currently the most likely method, so the realization of personalized adaptive learning is also the most important and core value of artificial intelligence

education applications.

2.3.2 Generative AI on the teaching environment

Although personalized learning is the most important goal to pursue in education, it is clear from the previous historical development of AI applications in education that people initially valued the use of AI most to assist teachers in their work and to allow computers to instruct students like teachers. The reason is also very simple: people's pursuit of education quality is endless, but society's investment in education has a certain limit. There is a contradiction in the middle, and the solution is to let artificial intelligence assist teachers. Many scholars have studied the problem of university teachers' workload. For example, Shao Zhongxiang et al.'s survey on teachers in the ethnic areas of Qiandongnan, Guizhou Province, China, showed that more than 20% of teachers showed burnout because of a heavier workload and higher work pressure [68, 71]. To address the issue of elevated pressure on educators, one potential approach involves enhancing investment in the education sector. This could include increasing the number of teaching staff, reducing class sizes, and optimizing workflow processes, among other strategies. Conversely, artificial intelligence can be utilized to assist educators in managing certain transactional and ancillary tasks.

There are places to test the value of artificial intelligence teachers; in 2009, a Japanese school introduced a robot 'Saya' teacher, who can answer simple words and questions. In 2018, a Finnish school also introduced several robot teachers [69, 1]. In China, Yu Shengquan et al. tried to develop an AI-based parenting assistant system - 'AI Good Teacher [70, 33].' Fang Haiguang and others are also exploring the 'two-teacher classroom' supported by AI educational robots [71, 30].

In the face of such a phenomenon, people may question: can AI replace teachers? In early 2016, the Georgia Institute of Technology in the United States arranged a course with eight human teaching assistants and one robot teaching assistant, who answered a total of about 10,000 questions raised by about 300 students online. Only one of those students was skeptical about the identity of the robot teaching assistant [69, 1]. Of course, just because a robot can be a teaching assistant doesn't mean it can serve as a teacher, as Carl Benedikt Frey and Michael A. Osborne have conducted a systematic study in which they concluded that in the U.S., roughly 47 percent of jobs will be threatened by AI over the next 20 years. Nevertheless, there exists a perceived threat regarding the potential replacement of teachers, despite the probability of such an occurrence being relatively low, estimated at only 0.44 to 0.78 percent. The likelihood of teachers in other educational sectors facing replacement is also minimal [72, 267]. This can be attributed to the nature of teaching, which necessitates a range of competencies including strong social skills, empathy, creativity, aesthetic sensibility, and various

other abilities, making it challenging for artificial intelligence to effectively supplant human educators.

Of course, the fact that AI cannot replace teachers does not mean that AI is not important; teachers who know how to use AI may replace teachers who do not know how to use AI, and human-machine collaboration is the future trend. Artificial intelligence teachers can assist human teachers by automatically issuing questions, reviewing assignments, diagnosing student problems, personalized teaching guidance for students, assessing students' mental and physical health, and career development planning for students. In short, AI teachers should do what machines should do, and human teachers should do what people should do.

2.3.3 Generative AI on the management environment

Enhancing management efficiency and decision-making, realizing unseen services and management. Technology is indeed the most important value for teachers 'teaching and students' learning for education. However, it is also relatively difficult to realize, while the easiest to realize is probably its application in management. Scholars from Chinese universities Jiang Fengjuan and Wu Feng pointed out that 'the change of information technology for colleges and universities firstly starts from the management field, management information technology can reduce the management cost of colleges and universities, improve the management efficiency, expand the scale of the best students in colleges and universities, and prompt the colleges and universities to take the road of connotative development [73, 157].' Numerous universities and colleges are currently making efforts to apply artificial intelligence to canteens, shopping, access control, etc., which greatly improves management efficiency and, to a certain extent, helps improve decision-making. Compared to organizations such as governments, the military, and businesses, it is relatively easy for educational organizations to overlook efficiency. For example, in colleges and universities, the most attention may be paid to student training, scientific research, and other business work related to constructing first-class colleges and universities.

In contrast, infrastructure, logistics, finance, administration, and other day-to-day affairs work is often easy to be neglected. Therefore, management efficiency is not very high in colleges and universities worldwide [74, 1]. Of course, the management efficiency of colleges and universities may be relatively low, but they are run effectively, which is determined by the characteristics of intellectual organizations [75, 1]. We will not discuss this point in this paper. However, we need to think about how we can use technology such as AI to improve management efficiency and promote scientific decision-making simultaneously, on the premise of running an effective organization as far as possible. If we analyze carefully, colleges and universities, including primary and secondary schools, can do many things, especially in the administrative logistics service support system, because the students of all kinds of learning, catering, Internet access, and other information are recorded, so almost everything can be optimized through the process, combined with the data analysis can be greatly improved efficiency. Thus, invisible service and management can be realized through refined management, making service and management ubiquitous but invisible, thus saving much time for teachers and students and allowing them to do more world-class teaching and research work.

2.3.4 Generative AI on assessment environment

In recent years, artificial intelligence technology has been increasingly used

in education, especially in teaching assessment, and it is showing great potential. Compared with traditional assessment methods, AI improves assessment efficiency and provides personalized feedback to optimize teaching and learning further. In this paper, we will discuss the role and prospects of AI in teaching assessment from three aspects: automated scoring, personalized assessment and feedback, and the application of natural language processing technology in language assessment.

1. AI significantly improves the efficiency of teaching assessment through automated scoring systems, especially in large-scale exams and open-ended question scoring. Machine learning-based grading systems can correct many students' assignments in a very short period. Xu and Liu showed that AI can demonstrate high-precision grading ability in objective questions such as multiple-choice and fill-in-the-blanks and provide effective assessment in open-ended test questions and essay grading [76, 148]. This technological breakthrough makes scenarios such as massive online courses (MOOCs) more feasible and efficient. MOOCs, or Massive Open Online Courses, are web-based learning programs designed to provide free or low-cost access to high-quality educational content on a wide range of subjects. MOOCs are typically hosted by educational institutions, organizations, or platforms like Coursera, edX, and Udacity, allowing anyone with an internet connection to enroll without traditional entry requirements. They often feature video lectures, interactive forums, assessments, and peer-reviewed assignments, enabling large numbers of students to learn from experts around the globe [77, 1]. However, AI still has some limitations in dealing with complex thinking and creative expression, and it is not easy to completely replace teachers' professional judgment, especially when it comes to higher-order cognitive tasks, where teachers' subjective experience and detailed judgment are still indispensable.

2. The application of AI in personalized assessment and feedback greatly promotes students' personalized learning. AI can track students' learning trajectories, knowledge mastery, and learning habits through data mining and learning analytics and then generate personalized assessment reports. This approach adjusts the teaching content according to students' learning and provides targeted feedback to help students better understand and consolidate what they have learned. Zawacki-Richter et al.'s study points out that personalized assessment is effective in improving students' learning outcomes, especially in online education, and that this combination of automation and personalization provides teaching administrators and teachers with more insightful data support, making the teaching and learning process more flexible and dynamic [78, 39]. In this context, AI assessment systems are seen as one of the core technologies for promoting educational equity and personalized learning in the future.

3. AI's Natural Language Processing technology is crucial in language assessment. NLP automatically analyses students' oral and written expressions, identifies grammatical errors, logical incoherence, and other problems, and offers suggestions for corrections. In foreign language teaching and cross-cultural communication assessment, NLP technology has greatly improved the accuracy and speed of assessment [79, 40]. For example, through speech recognition and sentiment analysis, AI systems can provide in-depth analyses of students' linguistic expressions, helping teachers understand students' emotional fluctuations and comprehension difficulties in learning. In addition, Knörzer showed that AI can also assess students' emotional engagement and motivational factors through sentiment analysis techniques, thus helping teachers adjust teaching strategies in time and enhance the learning experience [80, 219].

2.4 The Strategies for the Development of Generative AI in Higher Education: International Standards and Chinese Implementation

Higher education institutions worldwide are developing strategies for implementing Generative AI in their educational processes. This development aligns with UNESCO's framework for AI in education, which emphasizes the need for human-centered AI implementation and ethical considerations in educational settings [81, 1]. As more universities adopt AI technologies, they require clear guidelines and implementation strategies that balance innovation with educational integrity [82, 42].

International frameworks provide crucial guidance for this development. UNESCO's comprehensive guidance document emphasizes the importance of conducting a benefit-risk assessment to critically evaluate how AI can be leveraged in education while identifying and mitigating potential risks. The document classifies current policies concerning AI and education into three distinct approaches: independent approach, integrated approach and thematic approach. An independent approach consists of standalone policies and strategies that operate independently of other educational or ICT (Information and Communication Technology) policies. Examples may include national plans that specifically address the effects of AI on education. Integrated approach is such an approach in which AI elements are incorporated into existing education or ICT policies and strategies. This indicates that AI is viewed as a component of a broader educational policy rather than as a separate issue. Thematic approach concentrates on a particular topic related to AI and education. For example, it might involve policies related to data protection in the context of AI usage within educational institutions. The document emphasizes four key areas: policy development, infrastructure

preparation, capacity building, and equitable implementation. Policy development highlights the importance of creating effective policies that guide the use of AI in educational contexts. The document discusses the need to establish the necessary infrastructure to support AI technologies in education. It stresses the significance of building the capacity of educators and institutions to effectively utilize AI tools and resources. It also underscores the necessity of ensuring that AI is implemented in an inclusive and equitable manner, so that all learners can benefit from these technologies [83, 1]. These principles have become fundamental for educational institutions worldwide.

The implementation of AI technologies in educational settings requires careful consideration of both technological and pedagogical aspects. Research by W. Holmes, K. Porayska-Pomsta, K. Holstein indicates that successful AI integration depends on systematic approaches that consider institutional readiness, teacher preparation, and student needs [84, 522]. This aligns with UNESCO's recommendation for developing comprehensive AI literacy programs within educational institutions.

In the context of higher education, specific attention must be paid to ethical considerations and quality assurance. A systematic review by Zawacki-Richter et al. (2022) found that while AI applications in education are increasing, there is a significant need for structured approaches to implementation that protect academic integrity while fostering innovation [85, 42].

Institutional preparedness is vitally important for AI implementation. Universities need structured frameworks that address both technical infrastructure and pedagogical innovation. Research by G. J. Hwang, H. Xie, B. W. Wah demonstrates that successful AI integration requires systematic policy development and clear implementation guidelines [86, 1].

The role of faculty development has emerged as a crucial factor in successful GenAI implementation strategies. Institutions investing in teacher training and support systems achieve better outcomes in AI integration. This aligns with UNESCO's (2021) emphasis on capacity building as a key pillar of AI implementation in education [87, 1].

Regarding policy frameworks, international standards have become increasingly important. UNESCO Ethics AI provides guidelines for the ethical use of AI, emphasizing the need for human rights and ethical considerations in AI development [88, 1]. UNESCO Education & AI initiative is designed to guide the responsible and ethical integration of AI in educational settings, fostering an environment where technology can be used to benefit all learners while addressing potential risks and challenges associated with AI. Beijing Consensus on Artificial Intelligence and Education outlines principles for the responsible use of AI in

education, promoting collaboration and shared values among stakeholders [98, 1].

This document, resulting from the International Conference held in May 2019, emphasizes the importance of integrating artificial intelligence into education to enhance learning experiences and outcomes. As part of the UNESCO, this consensus aligns with the global Education 2030 Agenda, particularly in its commitment to achieving Sustainable Development Goal (SDG) 4, which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all [89, 1]." The consensus recognizes the role of AI in reshaping education and lifelong learning systems, which is essential for meeting the targets set out in the Education 2030 Framework for Action. This integration of AI is seen as a means to innovate education and provide equitable, relevant, and quality lifelong learning opportunities, ultimately contributing to a shared future for mankind. The Beijing Consensus on Artificial Intelligence and Education outlines seven key strategies for integrating AI into education systems globally. These include developing coherent AI education policies, taking multidisciplinary approaches, ensuring adequate investment, promoting equity and inclusion in AI tools, building capacity through training programs, implementing monitoring systems, and fostering collaboration among stakeholders. These strategies aim to create an effective and equitable framework for implementing AI in education while considering ethical standards and diverse learner needs.

The Organization for Economic Co-operation and Development has developed guidelines, OECD Guidelines, that address the ethical implications of AI, particularly in educational contexts.

Some insights into the regulatory landscape for AI in education is provided by European Commission and European Parliament Reports that advocate for ethical practices and accountability in AI systems. They are focusing on ethical considerations, governance, and the promotion of inclusive and equitable educational practices. The European Commission emphasizes the need for AI systems in education to adhere to ethical guidelines that ensure they are trustworthy, transparent, and accountable. This includes considerations for data privacy, security, and the prevention of bias in AI algorithms [90, 4238]. These documents provide specific recommendations for data privacy protection, algorithmic transparency, equal access to AI tools, quality assurance measures.

These standards have been particularly influential in shaping institutional policies. Universities are adapting these guidelines to their specific contexts while maintaining alignment with international best practices. The main dimensions of the AI Education Policy Framework are Pedagogical dimension focuses on using AI to improve research, curriculum development, and teaching methods.

Governance dimension addresses student support services and administrative

issues, including privacy and security, ensuring that AI technologies are used responsibly and ethically.

Operational dimension involves matters concerning infrastructure and training, aiming to provide resources and support for effective AI implementation.

The institutional implementation of GenAI technologies requires careful consideration of student perspectives and needs. Student readiness and attitudes toward AI tools can vary across different disciplines. The development of appropriate assessment frameworks remains a critical challenge. Institutions should balance the benefits of AI-enhanced learning with maintaining academic integrity. It is important to develop clear guidelines for AI use in academic work.

Student engagement with GenAI tools has become a crucial factor in shaping institutional strategies. The integration of GenAI into teaching and learning processes requires careful consideration of pedagogical frameworks. Successful implementation strategies must balance technological innovation with established educational practices. Infrastructure development remains a critical component of successful implementation strategies. Universities need to focus on technical capacity building, data management systems, security protocols, support services.

The future directions for GenAI implementation in higher education point toward more integrated and adaptive approaches. According to a recent analysis in the Journal of Educational Technology & Society, institutions must develop strategies that can evolve with technological advancements while maintaining educational quality. This aligns with UNESCO's (2021) emphasis on sustainable and adaptable implementation frameworks.

Successful future strategies will need to address several key areas, such as developing flexible frameworks that can accommodate rapid technological changes, ensure equitable access to AI tools, and maintain high standards of academic integrity.

The role of international collaboration in shaping future strategies cannot be understated. Cross-border partnerships influence the development of AI implementation strategies, particularly in the Asian higher education context. Their research suggests that successful strategies often emerge from collaborative efforts between institutions across different regions.

Looking toward future developments, several key considerations emerge:

The need for continuous policy adaptation to keep pace with technological advancement.

The importance of maintaining ethical frameworks while pursuing innovation.

The critical role of stakeholder engagement in strategy development.

The strategic development of GenAI in higher education represents a complex and evolving challenge that requires careful balance between innovation and established educational values. As UNESCO (2021) emphasizes, successful implementation depends on institutional readiness, clear policy frameworks, and systematic approaches to development.

There are several key considerations for future strategic development:

The need for flexible yet robust implementation frameworks that can adapt to rapid technological changes while maintaining educational quality.

The importance of international collaboration and knowledge sharing in developing effective strategies.

The critical role of understanding and responding to student needs and usage patterns.

The necessity of continuous faculty development and support systems.

As institutions continue to develop their AI implementation strategies, the focus should remain on creating sustainable, ethical, and effective approaches that enhance educational outcomes while preserving academic integrity. Future research might productively focus on evaluating the long-term impacts of different strategic approaches and identifying best practices for various institutional contexts.

In summary, this chapter examines the current landscape, requirements, and obstacles associated with the integration of generative artificial intelligence in the realm of higher education in China. The chapter commences with an analysis of the structural and historical underpinnings of China's higher education system, which encompasses its rapid growth, internationalization, and alignment with global technological progress. It emphasizes the increasing focus on digital transformation as a means to foster educational innovation, a priority outlined in China's 14th Five-Year Plan, which seeks to enhance teaching quality and cultivate interdisciplinary technological talent.

Furthermore, the chapter addresses the imperative for AI integration considering demographic changes, curriculum modernization, and the rising demand for high-quality, accessible educational resources. The potential of AI to meet these challenges is highlighted, particularly in its capacity to transform learning environments, facilitate personalized teaching methodologies, and optimize management processes. However, the chapter also points out specific challenges unique to the Chinese context, including issues of educational equity across varying socio-economic backgrounds and the necessity for culturally sensitive implementations.

Additionally, the chapter explores the applications of generative AI in education, underscoring its role in fostering adaptive learning environments,

enhancing classroom interactivity, and improving administrative efficiency. The potential of AI to generate data-driven insights is recognized as beneficial for both instructional and management purposes. Nevertheless, the chapter discusses challenges related to privacy, data security, and algorithmic fairness, particularly considering the complexities involved in managing educational data and the significant implications of student evaluations. These challenges underscore the pressing need for ethical frameworks and regulatory compliance to ensure the responsible application of AI in educational contexts.

2.5 Regulatory frameworks, policies, and guidelines for using Generative AI in Chinese higher education

Following a comprehensive examination of the aforementioned studies, it is evident that the integration of GenAI within higher education has yielded significant advancements. These advancements encompass enhancements in teaching quality and learning efficiency, as well as the promotion of educational equity and innovation. Nonetheless, the implementation of GenAI is not without its challenges. To fully harness the potential of GenAI, it is imperative that existing policies are timely adjusted and optimized.

China has consistently recognized the pivotal role of emerging technologies in advancing educational development, having introduced a series of policies pertaining to artificial intelligence in recent years. Drawing upon the relevant policies from various countries and the developmental trajectory of generative artificial intelligence discussed in section 1.4 of this article, it is recommended that China further enhance its strategic planning, improve regulatory assessments, pursue educational equity, and bolster international collaboration.

In 2017, the State Council of China released the “New Generation Artificial Intelligence Development Plan,” which articulated the goal of establishing China as a leading global center for artificial intelligence innovation by 2030, thereby contributing Chinese solutions to the worldwide advancement of artificial intelligence. This plan delineates a clear direction for the long-term evolution of artificial intelligence.

With the ongoing progress in artificial intelligence technology, China established a professional committee for the governance of a new generation of artificial intelligence in 2019 and published the “New Generation Artificial Intelligence Governance Principles - Developing Responsible Artificial Intelligence.” This report underscores the necessity for safety, controllability, and reliability in the development of artificial intelligence, while also advocating for sustainable economic, social, and ecological development. Concurrently, China has

enacted a series of laws and regulations, including the Data Security Law of the People's Republic of China, to provide a legal framework for the governance of artificial intelligence.

The report from the 20th National Congress of the Communist Party of China in 2022 explicitly called for in-depth research into the role of emerging technologies, such as artificial intelligence, in facilitating the digital transformation of education, thereby aiding China's transition from an educational nation to an educational powerhouse. This report reflects the country's commitment to leveraging artificial intelligence in education.

As of 2023, with generative artificial intelligence becoming a prominent societal topic, seven ministries and commissions, including the Cyberspace Administration of China and the Ministry of Education, jointly issued the “Interim Measures for the Management of Generative Artificial Intelligence Services.” This initiative encourages the innovative development of generative artificial intelligence and outlines specific requirements for its application in education, such as assisting students with experimental operations and generating personalized teaching materials. Additionally, the Chinese government articulated the development concept of “people-oriented, intelligence for good” at the inaugural Artificial Intelligence Security Summit, advocating for enhanced technology risk management and increased representation of developing countries in the global governance of generative artificial intelligence.

In 2024, the Ministry of Education of China is expected to amplify its support for the application of generative artificial intelligence in education. The Ministry has conducted multiple press conferences indicating its intention to implement innovative application projects of generative artificial intelligence in higher education institutions, thereby promoting the integration of artificial intelligence across various professional fields. Furthermore, the “Government Work Report” introduced the “Artificial Intelligence +” initiative for the first time, emphasizing the deep integration of artificial intelligence across all sectors and the creation of a new developmental ecology.

In summary, China places significant emphasis on the application of generative artificial intelligence in education, promoting it through a series of policy measures. These policies not only provide robust support for the healthy development of artificial intelligence but also establish a solid foundation for future educational advancement and overall socio-economic progress.

Building on these extensive efforts, it is evident that China has laid a solid foundation for the integration of GenAI into higher education through forward-thinking policies and strategic initiatives. However, the rapid evolution of AI technologies and their increasing adoption in educational settings demand

further refinement and expansion of these frameworks. The following recommendations outline key areas for improvement, ensuring that the application of GenAI in education aligns with national development goals and global practices.

First, the government should enhance top-level design and establish a standardized framework for the educational applications of generative artificial intelligence. While China has made initial strides in formulating relevant policies and legal frameworks for artificial intelligence, there remains a lack of specific regulations, standards, or guidelines tailored to the educational sector. By drawing on international best practices, such as those from the United States and the European Union, China should expedite the development of national application guidelines and ethical frameworks, clarify application specifications through pilot projects, assess risks, and prepare for broader implementation. Additionally, in light of potential risks associated with generative artificial intelligence, such as intellectual property disputes and data security concerns, the government should incorporate specific regulations addressing these issues into existing laws, including the Data Security Law, to ensure the safe application of such technologies in education.

Second, the government should enhance the supervision and evaluation mechanisms while promoting the integration of industry and education. Currently, numerous generative artificial intelligence products have been introduced in China; however, these products are not specifically designed for educational contexts, and the sources of pre-training data are often complex. Therefore, the government must establish a long-term supervision and risk assessment framework to regularly evaluate product performance, safety, and transparency. Concurrently, enterprises should be encouraged to collaborate with educational institutions, allowing educators and students to engage in technology research and development, thereby facilitating the creation of technology products that meet educational needs and enabling the intelligent enhancement of the entire educational landscape.

Furthermore, the government should prioritize educational equity and work to bridge the digital divide. The development of basic education in China is characterized by disparities, with high-quality resources unevenly distributed. The government should increase financial support and policy guidance to ensure the application of generative artificial intelligence in education reaches all regions, schools, and student demographics, particularly in remote areas and among disadvantaged groups. By establishing online education platforms or data-sharing centers, the government can dismantle information barriers and geographical constraints, thereby facilitating the aggregation and sharing of high-quality educational resources.

Finally, the government should actively engage in international cooperation

and exchanges to foster the healthy global development of generative artificial intelligence technology. In areas such as technical standard formulation, data sharing, and security, China should collaborate with developed nations while also establishing cooperative platforms with developing countries to enhance the public welfare aspect of digital education and promote global educational equity.

The educational landscape, reshaped by artificial intelligence, is emerging. The future being envisioned should strive to balance the relationship between humans and artificial intelligence, rationally integrating organizations, culture, personnel, and the environment to create an adaptive educational ecosystem. The ongoing challenge for governments worldwide, including China, will be to effectively formulate and refine policies, regulations, and governance systems related to generative artificial intelligence, thereby promoting the standardized application of generative artificial intelligence products within the educational sector.

CHAPTER 3
GENERATIVE AI APPLICATION EXPERIENCES IN CHINESE HIGHER EDUCATION INSTITUTIONS

Generative Artificial Intelligence is significantly reshaping the landscape of higher education through its diverse applications, which provide innovative methodologies for enhancing teaching, learning, and administrative processes. By creating personalized and adaptive learning materials, GenAI addresses the varied needs and learning preferences of students, thereby augmenting the effectiveness and inclusivity of educational practices. It effectively bridges theoretical knowledge with practical applications, offering real-world examples while enhancing academic communication through tools that foster clarity, coherence, and standardization. Furthermore, GenAI promotes gamification and simulation, delivering immersive and interactive experiences that render complex concepts more accessible and engaging. Through virtual debates, critiques, and negotiation scenarios, it cultivates students' critical thinking, debating, and collaborative skills.

Moreover, GenAI is instrumental in skill development and cognitive enhancement. It democratizes access to technology education by enabling non-technical learners to acquire coding skills and assists students in achieving higher-order thinking by mitigating barriers to learning. In the realm of data literacy, GenAI instructs students in data hygiene and visualization, equipping them to effectively interpret and communicate intricate data sets. Its capacity to synthesize a range of concepts facilitates the exploration of complex theories, thereby fostering innovation and the establishment of new academic frameworks. Platforms such as Khanmigo at Khan Academy exemplify how AI tutors can deliver personalized learning experiences, allowing students to concentrate on real-world applications while the AI manages rote tasks such as memorization.

Additionally, GenAI addresses broader educational challenges by promoting lifelong learning and adaptability, thereby preparing students for a rapidly evolving technological environment. It contributes to bridging the educational divide by providing quality resources to underserved or remote populations and enhances cross-cultural understanding by eliminating language barriers through AI tools. By supporting continuous learning, enhancing digital literacy, and improving global accessibility, GenAI not only enriches the educational experience for individuals but also fosters a more inclusive and interconnected academic environment.

3.1 Status of Artificial Intelligence Application in Chinese Universitie

Considering the pervasive integration of generative AI in higher education, this chapter examines its status within Chinese universities and its alignment with

educational needs. To this end, I designed two principal experiments: the first investigated "the current status of generative AI use among Chinese university students," concentrating on the practical application of AI in student learning; the second employed semi-structured interviews to explore "the application of generative AI in teaching and management in Chinese universities," focusing on educators' perceptions and attitudes towards the future of AI, with particular emphasis on the increased utilization of AI applications by younger faculty members.

Description of experimental design:

This chapter delineates the experimental design tailored to the specific objectives of the study. The experimental data utilized herein are derived from authentic experimental settings, with a rigorous adherence to scientific research standards during the data collection process to ensure the accuracy and credibility of the findings. To maintain high data quality, the collection of experimental data is conducted through multiple channels. The information utilized originates from various higher education institutions, including the School of Art and Design at Luoyang Institute of Technology, Xi'an University of Electronic Science and Technology, Nanjing University of Aeronautics and Astronautics, Sichuan Academy of Fine Arts, and Nankai University, among others. The educational and research resources available at these institutions facilitate access to authentic and representative experimental data, thereby enhancing the breadth and reliability of the results.

The authenticity of the experimental data is paramount. All data are sourced from genuine teaching and research environments, with the teaching cases and student data being collected from the aforementioned universities. The experimental design and data collection processes adhere to ethical standards, thereby ensuring the integrity and reliability of the data. For instance, in investigating the application of artificial intelligence in the assessment of fine arts courses, the data and works of all participants were grounded in actual classroom practices, thereby reflecting the real-world application of AI technology in educational settings.

The practical considerations of the experimental design are closely aligned with the research objectives of this thesis, ensuring that each experiment yields sufficient evidence to address the research questions. The experiments encompass not only the effects of AI application in art courses but also the assessment criteria that align with the pedagogical needs of higher education.

Furthermore, the analysis of the experimental results integrates both the empirical data, and the theoretical framework established in the article, facilitating a multi-dimensional analysis. This comprehensive examination of the experimental

data provides deeper insights and practical conclusions. In assessing the impact of AI technology on student learning outcomes, all results are grounded in actual student work and performance evaluations, thereby illustrating the potential of AI to enhance the efficiency of personalized learning and teaching, as well as the challenges that accompany its implementation.

Targeted Experiment I:

The title of the experiment is 'The Current Status of Generative Artificial Intelligence Usage by Students in Chinese Universities'. This experiment investigates the utilization of generative artificial intelligence among Chinese college students, drawing upon the methodologies presented in the paper titled Refers to the study by Yan Li et al [91, 92]. As a new experiment, this experiment encompasses a sample of 320 students from various institutions, including Henan Normal University, Harbin Institute of Technology, Xidian University, Nanjing University of Aeronautics and Astronautics, and Luoyang Institute of Science and Technology. Data collection was facilitated through the Chinese survey tool "WJX," a questionnaire platform that providing functions equivalent to Amazon Mechanical Turk.(refer to Table 1) The research systematically examines the current landscape of generative AI usage and its implications for Chinese college students within specific contexts, with a particular focus on its applications in practical scenarios, academic writing, data analysis, and everyday problem-solving.

(1) Research Background

The experiment draws on the research method of 'the current situation and reflection on the application of generative artificial intelligence for university students - a survey based on Zhejiang University and designs a specific experiment according to the research method designed by it.

As of late 2023, many Chinese universities have yet to establish explicit guidelines regarding the use of generative AI by students and faculty. To address this gap, we conducted a study examining generative AI usage patterns among university students. What is the status of generative AI usage by college students in four typical scenarios? How does generative AI usage vary across different demographic factors, including gender, age, and field of study? What are the university students' suggestions for the use of generative AI?

(2) Data sources

This study selected 320 college students from Harbin Institute of Technology, Xi'an University of Electronic Science and Technology, Nanjing University of Aeronautics and Astronautics, Henan Normal University, and Luoyang Institute of Science and Technology of Chinese universities, whose majors were distributed as follows: 76 (23.75%) in Pedagogy, 89 (27.81%) in humanities, 21 (6.56%) in

psychology, 45 (14.06%) in art, engineering 7 (2.19%), Energy 2 (0.63%), Computer Science 70 (21.88%), Chemistry 3 (0.94%), and Biology 7 (2.19%).

(3) Questionnaire tools

Based on the existing literature, data was collected through Questionnaire Star, a commonly used questionnaire tool in China that is integrated into WeChat, China's largest social app, which facilitates information exchange and data collection. This study developed the 'Questionnaire on the Current Status of Learning in the Use of Generative Artificial Intelligence for College Students' (Table 1 in Appendix A). The questionnaire is divided into four parts. The first part is students' basic information, including gender, grade, major category, etc., with five questions. The second part aims to collect data for understanding the status of college students' use of generative AI with 3 questions. The third part is designed to understand how university students use generative AI in four typical scenarios, with 17 questions. The basic composition of the questionnaire is shown in Appendix A, Table 1, The questionnaire can be found in Appendix A, Form 11

(4) Experimental Hypothesis

We propose that the level of familiarity and acceptance of generative AI tools is generally high among the college student demographic. Additionally, we hypothesize that the frequency of utilization of these tools across four distinct application contexts—namely scientific research, academic coursework, daily life, and job search activities—will exhibit significant variations. Specifically, we predict that scientific research will emerge as the most prevalent application of generative AI tools, owing to their capacity to enhance research efficiency, particularly in areas such as formulating research questions, drafting and revising academic manuscripts, and other critical components of the research process. Conversely, while we acknowledge the potential benefits of generative AI in academic learning, we also contend that it may present certain challenges to the cultivation of students' higher-order thinking skills.

Regarding daily life and psychological support, we hypothesize that the relatively low demand for generative AI in these domains may indicate that the current technological applications are not sufficiently advanced or that user habits have yet to be established. Lastly, in the context of job search activities, we anticipate that the application of generative AI will primarily be directed towards supportive functions, such as optimizing and refining resumes and automating career planning tasks, rather than fully supplanting the essential decision-making processes and interpersonal interactions inherent in the job search experience.

This poll was distributed through a public online questionnaire platform, WJX, and the questionnaires were collected in the period of September 15-25, 2024, with a total of 320 online questionnaires collected. One-way analysis of

variance (ANOVA) was used to present the differences in the use of generative AI across the moderators.

(5) Data analysis

The use of generative AI by college students in four typical scenarios is shown in Tables 2 and 3.

According to the chart, 20.8% of college students use Generative AI to translate foreign academic articles or materials; 21.6% of college students use Generative AI to extract key information from documents; and 21.4% of college students use Generative AI to revise the text of a thesis or report. More than half of the respondents chose 'Comply' for all five questions, indicating that generative AI has become an important helper for university students' scientific research activities.

In the course learning scenario, 33.4% of university students use generative AI to access course content, 38.4% of university students use generative AI to assist them in completing course assignments, 36.2% of university students use generative AI to answer the teacher's questions, and 26% of university students use generative AI to evaluate their assignments and provide feedback. The proportion of using generative AI to access information and assist in completing assignments is the highest, followed by assisting in answering the teacher's questions, evaluating assignments, and providing feedback, which indicates that generative AI plays an important role in college students' course learning.

36% of college students will let Generative AI design diversified entertainment content (e.g., riddles, games, etc.) to relax; 21.4% of college students will let the Generative AI provide psychological counseling. Thus, generative AI plays a certain role in the daily life of college students.

In job seeking, 51% of college students would let Generative AI plan activities; 27% of college students would let Generative AI create or rewrite their CVs; and 63.8% of college students would interact with the Generative AI to simulate interviews. This suggests that college students will seek help from generative AI in further education and job seeking.

(5) Analysis of Experimental Results:

The findings of this experiment substantiate the hypothesis regarding the increased acceptance of generative AI tools among college students. The survey data indicate that participants generally exhibited familiarity with and favorable attitudes towards the utilization of generative AI tools, particularly in the domains of academics, research, daily activities, and job searching. Notably, a majority of students reported frequent engagement with generative AI for tasks such as academic writing, data analysis, and extracurricular learning, with specific emphasis on generating text, translating documents, and formulating queries for

academic resources. Furthermore, generative AI tools, including ChatGPT and Baidu Wenshin, have integrated into students' daily routines, serving not only as significant aids in academic endeavors but also offering personalized support across various facets of daily life, including information retrieval, psychological assistance, and entertainment recommendations

a. Familiarity and Acceptance of Generative AI Among College Students

The majority of participants of the study reported a strong familiarity with generative AI, utilizing it either frequently or occasionally. The most prevalent tools employed include ChatGPT, New Bing, SparkDesk, and Baidu Wenxin, with text generation being the primary function utilized. Other multimedia content generation capabilities, such as image, voice, and video generation, are also noted. This indicates a significant acceptance of generative AI technology among college students, who have integrated it into their academic and personal lives. As students enhance their ability to leverage AI for multimedia content creation, it is anticipated that an increasing number of students will adopt these functionalities. Furthermore, approximately 60% of students engage in learning activities related to generative AI, underscoring a robust demand for knowledge and skills in this area.

b. Variability in Generative AI Usage Across Different Scenarios

The frequency of generative AI usage varies across four typical scenarios: academic coursework, research activities, daily life, and job searching. Notably, generative AI is most actively employed in research activities, with over half of respondents indicating its alignment with their research needs (see Table 1 in Appendix A). This suggests that generative AI has become a vital resource for students engaged in research, particularly in assisting with the formulation of research questions. More than 70% of students utilize generative AI for writing and translating academic documents, reflecting their proficiency in these functions. The study affirms that generative AI can enhance researchers' access to information and facilitate the completion of time-intensive and repetitive tasks. Consequently, it is imperative for academic management and research departments to comprehend the evolving dynamics of student research activities and to establish appropriate guidelines.

c. Generative AI in Course Learning

Course learning represents the second most significant context for generative AI usage among college students. Approximately three-quarters of students utilize graphical user interfaces to access technical terminology or resources pertinent to their coursework. Generative AI has emerged as a crucial tool for completing assignments, with its text generation capabilities alleviating the burden of repetitive academic tasks. However, this reliance on generative AI raises concerns

regarding the development of higher-order thinking skills, prompting educators to reconsider assignment design. While fewer students employ generative AI for in-class question responses, likely due to their engagement with existing knowledge, some students do utilize it for assignment evaluation and feedback. This may indicate a lack of awareness regarding the evaluative potential of generative AI, highlighting the need for enhanced understanding of its capabilities.

d. Generative AI in Daily Life

Generative AI also serves a role in students' daily lives, with over half of respondents consulting it for general knowledge across various domains, including life, society, history, geography, and culture. Additionally, nearly 30% to 40% of students engage with generative AI for entertainment when experiencing boredom. When faced with challenges, students may request generative AI to create diverse entertainment content, and a quarter seek psychological counseling through these platforms. This aligns with scholarly observations that generative AI is evolving into a personalized companion for students, assisting them in addressing life challenges. Furthermore, generative AI is increasingly utilized for entertainment and psychological support, suggesting its potential to fulfill the individualized needs of college students.

Moreover, generative AI aids students in job-seeking endeavors, with half of the participants allowing it to assist in planning creative activities, and over 40% utilizing it for resume creation or mock interview preparation. However, the overall engagement with generative AI in job search contexts appears limited, potentially reflecting the specific needs of older students, such as seniors, while younger students exhibit less demand in this area.

Targeted Experiment 2

This study extends the findings from Experiment 1, which indicated a significant prevalence of artificial intelligence usage among contemporary Chinese college students, particularly in the context of thesis writing. The objective of Experiment 2 was to further investigate the utilization of AI in writing among college students. This study was titled “A Master's Degree Student from Henan Normal University on the Application of Artificial Intelligence” and specifically examined AI-assisted thesis writing. The research focused on a first-year master's student in economics at Henan Normal University, whose thesis was entitled “The Direction of Sustainable Development of China's Lithium Battery Industry.” This student possessed a foundational academic background and relevant research experience.

The findings of the study are categorized into two sections. The first section addresses the participant's perspectives on the application of artificial intelligence. As a master's student, the participant demonstrated the capacity for independent

thought regarding scientific research. Following the study, an interview revealed a positive disposition towards AI-assisted writing, which manifested in two primary ways: first, the student reported gaining new perspectives, with AI interactions prompting the generation of novel ideas and enhancing comprehension of the research topic; second, the student exhibited a forward-looking attitude, expressing enthusiasm for the ongoing integration of AI tools in future research endeavors and a strong interest in exploring the innovative potential these technologies may offer.

The second section of the study revealed a divergence from the initial hypothesis; a significant reliance on AI for article writing has not yet become mainstream practice. Researchers predominantly depend on their cognitive processes, with AI functioning primarily as a supplementary tool aimed at enhancing efficiency and the quality of expression. In the realm of advanced data analysis, AI tools exhibit certain limitations, as complex logical reasoning and in-depth analysis necessitate professional judgment and innovative thinking from the researcher. Consequently, the optimal application of AI involves a synergistic approach that combines AI capabilities with the researcher's subjective initiative, thereby achieving a balance between efficiency and academic rigor.

The case study clearly illustrated that AI can effectively assist students in thesis writing and data organization, as evidenced by increased writing efficiency, enhanced quality, and the stimulation of critical thinking among students. However, concerns persist regarding the implications of AI on academic rigor and authenticity, given that generative AI may produce inaccurate or misleading information. Therefore, it is imperative that any application of AI undergoes thorough screening and validation to ensure its reliability.

The title of this experiment is "Teaching and Management Applications of Generative Artificial Intelligence in Chinese Higher Education" In order to investigate the application of Graduate Artificial Intelligence in Chinese universities, this study used a semi-structured interview method (Table 4). Interviews were conducted with faculty and administrators from different institutions, including Henan Normal University, Sichuan Fine Arts Institute, and Luoyang Institute of Technology, covering a wide range of disciplines such as linguistics, art, and engineering.

Generative Artificial Intelligence is increasingly influential in the realms of pedagogy and administration within Chinese higher education. Interviews conducted with educators and administrators reveal a diverse array of applications for GenAI in areas such as curriculum development, student engagement, and administrative efficiency. This section provides a comprehensive analysis of the utilization of GenAI in teaching and management at Chinese universities, highlighting both its benefits and the challenges it presents.

Although artificial intelligence technology has shown promise in enhancing the quality of teaching and the efficiency of management within the education sector, its implementation in educational management in China remains nascent. A considerable number of education administrators possess limited understanding and acceptance of AI, which, to a certain degree, hampers the broader adoption of this technology. Nonetheless, the overall prevalence of AI remains constrained. Many senior education administrators continue to rely on traditional experiences and established operational frameworks, integrating human factors into their management practices. Among the few senior educators interviewed, there was a notable lack of exposure to or utilization of AI technology. In contrast, younger educators exhibited a significantly higher level of receptiveness to and engagement with AI. This generational disparity underscores the varied perspectives within the educational community regarding the adoption of AI and highlights the necessity of upholding fundamental educational values while advancing technological innovations. In conclusion, Generative Artificial Intelligence possesses considerable potential for application in both teaching and management within Chinese higher education, with generational differences being particularly pronounced in the acceptance and utilization of GenAI.

(2) Research Methodology

To thoroughly investigate the application of GenAI in Chinese universities, this study employed a semi-structured interview methodology. Interviews were conducted with faculty and administrative personnel from various institutions, including Henan Normal University, Sichuan Fine Arts Institute, and Luoyang Institute of Science and Technology, encompassing a broad spectrum of disciplines such as linguistics, art, and engineering. The research methodology was guided by Chiu's (2023) framework[1], focusing on the experiences of participants regarding the use of GenAI in educational and administrative contexts, its effectiveness, and associated ethical and operational concerns. The interviews aimed to gather specific case studies on the implementation of GenAI both within and outside the classroom, as well as to assess its strengths and weaknesses. The Interview Information Table can be found in Appendix A, Form 10, The transcripts of the interviews are attached as Table 5 in Appendix A.

(3) Research Hypothesis

This study posits that generative artificial intelligence will be extensively integrated into pedagogical practices by educators, particularly in the domains of curriculum development, personalized learning, and student engagement, with the aim of enhancing instructional efficiency. Furthermore, it is anticipated that educators will exhibit increased openness to the utilization of AI technologies, which will also be employed in administrative functions to bolster efficiency,

particularly in areas such as student management and data processing. Additionally, it is conjectured that the widespread adoption of generative AI may present challenges to academic integrity and undermine students' capacity for independent thought, particularly if there is an overreliance on AI-generated materials.

(4) Analysis of interview results:

a. Applications in Teaching and Learning

The efficacy of generative AI in the development of educational content is particularly noteworthy. Interview participants indicated that tools such as ChatGPT significantly diminished the time required for course preparation. For instance, a professor from Luoyang Institute of Science and Technology reported that ChatGPT autonomously generates study guides, quiz questions, and case discussions based on the provided syllabus. This rapid content generation allows instructors to modify course materials promptly to address student needs. Furthermore, generative AI can enhance the design of interactive learning experiences, including contextual simulations and case-based learning, thereby increasing student engagement.

The significance of generative AI in facilitating personalized learning is also emphasized. By analyzing student learning data, AI can offer customized learning recommendations that assist students in concentrating on areas requiring improvement. Nonetheless, some educators have expressed apprehensions regarding the reliance on AI for content generation, contending that it may impede students' capacity for independent and critical thinking as well as problem-solving. Consequently, certain educators have restricted the use of AI in curriculum design to ensure that students remain engaged in active learning while benefiting from technological support.

In creative and design disciplines, generative AI fosters creativity and collaboration among students. For example, at the Sichuan Fine Arts Institute, faculty members have integrated image-generating AI tools such as Midjourney into their courses, encouraging students to utilize AI for generating innovative images and concepts during the ideation and design phases. One professor noted that students have explored a variety of artistic styles and visual effects through Midjourney, thereby enriching their creative expression and promoting teamwork. However, educators underscored the necessity for moderation in the use of AI within the creative process to prevent students from becoming excessively reliant on AI-generated outcomes. While AI can assist in generating initial creative concepts, students must independently refine or personalize this AI-generated content to maintain autonomy in their learning journey.

The application of generative AI in linguistics and intercultural communication courses is also widely acknowledged, particularly in supporting

language learning and facilitating intercultural dialogue. Several educators at Henan Normal University noted that AI tools like ChatGPT can enhance real-time dialogue practice and provide immediate feedback, thereby aiding students in improving their foreign language skills within a virtual environment. Additionally, generative AI assists international students in comprehending and mastering terminology, thus enhancing their adaptability in cross-cultural learning contexts. However, interviewees cautioned that AI-generated content may be misleading or biased in complex scenarios, particularly concerning culturally sensitive material. To mitigate this issue, educators typically emphasize the limitations of AI and encourage students to critically assess AI feedback to cultivate independent judgment.

b. Applications in Management

The implementation of generative AI in university management is prevalent, particularly in streamlining administrative processes and enhancing efficiency. Interviews revealed that numerous higher education institutions employ AI for tasks such as student attendance tracking, automated grading, and grade management. For instance, the teaching department at Zhejiang University has adopted an automated grading system that significantly alleviates the workload associated with repetitive tasks while enhancing data processing accuracy. This application is especially beneficial for courses with large student populations, allowing educators to concentrate more on personalized instruction.

Moreover, generative AI is utilized for student information management and data analysis, enabling institutions to better comprehend student needs. For example, administrators can leverage AI to analyze student attendance, test scores, and course participation, thereby identifying potential learning challenges and providing timely support. However, some educators have raised concerns regarding the reliability of AI grading, particularly in liberal arts courses that necessitate subjective assessment, as automated grading may overlook nuances in student writing and creative expression.

C. Educators' expectations and considerations about AI

Educators hold optimistic views regarding the integration of generative artificial intelligence in educational settings, particularly in enhancing teaching efficiency and facilitating personalized learning experiences for students. Many educators anticipate that AI will assist in mitigating repetitive tasks, such as course preparation and assignment design, while also enhancing instructional relevance through the analysis of student learning data to generate tailored recommendations. Furthermore, AI is expected to significantly contribute to interdisciplinary collaboration and innovation, particularly in areas such as creative design and language acquisition, thereby fostering students' creative capacities and

encouraging independent thought.

Nevertheless, there are apprehensions among educators regarding the potential for excessive dependence on generative AI, particularly concerning its implications for academic integrity and the cultivation of independent thinking among students. A considerable number of educators assert that AI tools should function as supplementary resources rather than replacements for original student thought. In both creative and academic endeavors, educators stress the importance of maintaining student autonomy and caution against an over-reliance on AI-generated content, which may undermine critical thinking and problem-solving abilities. Additionally, educators acknowledge the limitations of AI in addressing certain complex tasks and advocate for a judicious application of AI to prevent a decline in the depth of student cognition.

In the realm of educational management, educators foresee AI as a means to effectively streamline administrative processes, particularly in areas such as student information management, grade analysis, and attendance tracking, thereby enhancing overall operational efficiency. However, there are concerns regarding the potential diminishment of personalized attention that may arise from the implementation of AI. Educators believe that while AI should alleviate administrative burdens, it must not compromise the quality of educator-student interactions. Ultimately, educators aspire for the deployment of AI to strike a balance between technological support and humanistic engagement, ensuring that technology consistently serves the fundamental objective of education: the holistic development of students.。

3.2 Academic Integrity Challenges Posed by Artificial Intelligence in Chinese Higher Education

This section provides a critical examination of the ethical and practical challenges associated with the application of artificial intelligencen higher education, particularly within the context of Chinese universities. It addresses concerns related to data integrity, academic honesty, privacy, and algorithmic bias, while also considering the alignment between the current deployment of AI technologies and the educational requirements of these institutions. The findings from various research initiatives indicate that the pervasive integration of AI in China's higher education system presents numerous risks.

One notable issue is the prevalence of AI-assisted essay writing among contemporary Chinese college students. Results from a targeted experiment (Experiment 1) reveal a significant incidence of AI utilization for this purpose. To further investigate this phenomenon, a subsequent study (Experiment 3) was

conducted, titled “A Master's Degree Student from Henan Normal University on the Application of Artificial Intelligence.” This research focused on AI-assisted thesis writing and involved a first-year master's student in economics at Henan Normal University, whose master’s thesis was entitled “The Direction of Sustainable Development of China's Lithium Battery Industry.” The participant possessed a foundational academic background and relevant research experience. The experimenter indicated that artificial intelligence did not significantly contribute to the completion of his thesis writing process, asserting that the AI's logical capabilities were insufficient to facilitate his writing. Observational data suggested that the utilization of AI in the development of their thesis was minimal, implying that AI continues to exhibit limitations in supporting creative endeavors. Furthermore, the content produced by AI was found to lack rigor, raising concerns regarding its alignment with academic integrity standards.

Additionally, the use of AI for routine classroom assignments has been frequently observed, raising concerns about its detrimental effects. Consequently, the study designated only the title of Experiment 4, Research on Using Artificial Intelligence to Generate Images for Art Assignments, which involved junior students from the Class of 2022 majoring in fine arts at the School of Art and Design of Luoyang Institute of Technology as the research subjects.

Targeted experiment 3

Experimental title: “A study on AI application by a master's student at Henan Normal University”

(1) Background of the study

In alignment with the research focus on AI-assisted thesis writing, a subject was selected: a first-year master's student in economics at Henan Normal University, whose master’s thesis is titled “Sustainable Development Directions for China's Lithium Battery Industry. This student possesses a foundational academic background and relevant research experience（table 6）. The student employed AI tools for conducting literature reviews, performing data analyses, and drafting the initial version of the thesis. At this stage, the student is engaged in research methodology and preliminary writing, utilizing AI tools to enhance research efficiency and writing proficiency. The selected student has had a favorable experience with AI tools (e.g., ChatGPT, SparkDesk, etc.) in academic writing and is prepared to provide explicit examples of successful applications. The student also reflect on the effectiveness and transformative impact of these tools on their writing process. Furthermore, the study encourages the exploration of various AI tools, rather than limiting the investigation to a single type, thereby facilitating a more comprehensive analytical perspective through comparative effectiveness assessments.

(2) Data sources

The data sources for this phase primarily consisted of self-authored transcripts from the interviewees, as well as information gathered through the interview and chat interactions with them. The interviewees documented their specific experiences and emotions associated with the utilization of the AI tool throughout the research process, which encompassed activities such as literature review, data analysis, writing, and language editing. Furthermore, the interviews included the interviewees' evaluations of the AI tools' effectiveness, particularly regarding their perceptions of enhanced writing productivity, improved quality of expression, and the stimulation of critical thinking. Ultimately, all data were systematically compiled and analyzed to provide a comprehensive assessment of the effectiveness of AI tools in academic writing and their overall impact.

(3) AI tools used in the study

Prior to the commencement of the study, the student conducted research to evaluate various AI-assisted writing tools and ultimately selected the following: ChatGPT, primarily for literature reviews, content generation, and language editing suggestions; ERNIE Bot (or other local Chinese AI tools), which focuses on sourcing and analyzing Chinese-language literature to facilitate an understanding of domestic and international market trends; Mendeley, utilized as a literature management tool to organize and accurately cite sources; and Microsoft Excel, employed for data processing and analysis, enabling the visual presentation of developmental data and trends within the lithium battery industry.

(4) Experimental Hypothesis

Prior to the commencement of the experiment, it was posited that the extensive utilization of artificial intelligence tools could enhance writing efficiency, refine the structural organization of literature reviews, and improve linguistic expression, particularly during the initial drafting and data analysis phases. This enhancement is anticipated to significantly reduce the time investment required by researchers. Furthermore, considering the experimenter's individual daily usage patterns, it is conjectured that there will be a substantial reliance on AI tools throughout the research process.

(5) Research Process

Utilization in Data Collection and Literature Review. During the literature review phase, this student employed platforms such as Google Scholar and ERNIE Bot to identify pertinent academic literature. They utilized keywords such as “lithium battery,” “sustainable development,” and “China's industrial policy” to gather information relevant to their thesis topics. Throughout this search process, this student leveraged artificial intelligence tools, including ChatGPT, to enhance his search queries and improve the precision and efficiency of the literature review.

For instance, this student posed inquiries to ChatGPT, such as “Please assist me in listing significant studies on lithium battery sustainability and their key findings from the past five years.” This methodology not only expedited the process but also facilitated a more systematic comprehension of the current research landscape.

Application during Data Analysis and Processing. In the data analysis phase, this student gathered relevant industry reports and statistics, subsequently utilizing Microsoft Excel to organize this information and create visual representations through charts and graphs. During the analysis, this student sought assistance from ChatGPT in interpreting the data, posing questions such as “What are the market trends for lithium batteries based on this data set?” The insights generated by the AI tool enabled students to conduct a more comprehensive analysis of potential market trends.

In the drafting phase, this student employed ChatGPT as a writing assistant to incrementally generate content, paragraph by paragraph. They provided ChatGPT with the topic and key points for specific sections; for example, please compose a paragraph regarding the current development of the lithium battery industry in China. ChatGPT then produced the relevant paragraphs based on the provided information, which this student subsequently revised to incorporate their personal insights and analyses. Throughout the writing process, this student consistently utilized AI tools for language editing and formatting, posing questions such as “Does this paragraph adhere to the language standards expected of an academic paper?” This practice ensured that the final manuscript maintained a professional and academic tone. Screenshot of the steps of Ai assisted thesis research can be found in table 6.

Organization and Reflection:

Following the completion of the initial draft and subsequent enhancements utilizing artificial intelligence, the student actively sought feedback from both the tutor and peers to further refine the work in accordance with their recommendations. Throughout this process, the student meticulously documented the experience of employing AI tools, noting successful outcomes, encountered challenges, and implemented solutions, which culminated in a thorough reflection on AI-assisted writing. The engagement with AI not only facilitated the enhancement of the student's writing skills but also fostered the development of critical thinking and judicious use of AI tools. The diverse array of AI tools employed by the student during various stages of the research process significantly augmented both the efficiency and quality of the writing, thereby establishing a robust foundation for the successful completion of the thesis.

(6) Experimental results

The findings of the study are categorized into two sections. The first section

addresses the participant's perspectives on the application of artificial intelligence. As a master's student, the participant demonstrated the capacity for independent thought regarding scientific research. Following the study, an interview revealed a positive disposition towards AI-assisted writing, which manifested in two primary ways: first, the student reported gaining new perspectives, with AI interactions prompting the generation of novel ideas and enhancing comprehension of the research topic; second, the student exhibited a forward-looking attitude, expressing enthusiasm for the ongoing integration of AI tools in future research endeavors and a strong interest in exploring the innovative potential these technologies may offer.

The second section of the study revealed a divergence from the initial hypothesis; a significant reliance on AI for article writing has not yet become mainstream practice. Researchers predominantly depend on their cognitive processes, with AI functioning primarily as a supplementary tool aimed at enhancing efficiency and the quality of expression. In the realm of advanced data analysis, AI tools exhibit certain limitations, as complex logical reasoning and in-depth analysis necessitate professional judgment and innovative thinking from the researcher. Consequently, the optimal application of AI involves a synergistic approach that combines AI capabilities with the researcher’s subjective initiative, thereby achieving a balance between efficiency and academic rigor.

The case study clearly illustrated that AI can effectively assist students in thesis writing and data organization, as evidenced by increased writing efficiency, enhanced quality, and the stimulation of critical thinking among students. However, concerns persist regarding the implications of AI on academic rigor and authenticity, given that generative AI may produce inaccurate or misleading information. Therefore, it is imperative that any application of AI undergoes thorough screening and validation to ensure its reliability.

Targeted Experiment 4

Based on the negative impacts of AI in the process of using it, the title of the experiment is “Research on the use of artificial intelligence to generate images of art assignments” This study is based on the third-year students of the art major of the class of 2022 in the School of Art and Design of Luoyang Institute of Technology.

(1) Background of the study

This study focuses on a junior student from the class of 2022, majoring in Fine Arts at the School of Art and Design at Luoyang Institute of Science and Technology, identified by the student number B19090827. The student specializes in oil painting, particularly participating in a course centered on oil painting still life. This course mandates that students submit life drawing assignments aimed at enhancing their observational and painting skills.

The primary objective of the Oil Still Life course is to cultivate students' awareness of color, form, and light, while also deepening their comprehension of oil painting techniques through practical life drawing exercises. Students are expected to engage in work outside the classroom and submit original creations. During the evaluation process, instructors assess students based on their drawing proficiency, compositional skills, and understanding of still life representation. The submitted works should be self-directed, reflecting the individual artistic expression and mastery of the course content. Throughout the course, the student was required to submit sketching assignments, which were later identified as AI-generated images rather than authentic oil paintings created in class. Consequently, the instructor, adhering to institutional policies and the consensus of the teaching and research team, assigned the student a failing grade. The student subsequently received feedback regarding this situation.

(2) Data sources

During the submission of life drawing assignments for the semester, the instructor observed that several works submitted by the student did not align with his classroom performance or artistic style. It was discovered that the student opted to utilize AI tools to generate artwork in response to course requirements, stemming from a lack of confidence in his drawing abilities. This decision was made without prior discussion or approval from the instructor. The AI tool employed by the student was DeepArt, which generated images of oil paintings without allowing for the selection or customization of painting styles, resulting in a simplistic and immature AI-generated aesthetic. Upon reviewing the assignments, the instructor noted discrepancies between the student's submissions and authentic paintings, indicating a failure to convey personal style and intent. A thorough investigation revealed that the oil paintings were likely produced using the AI generation tool rather than being created by the student. Evidence supporting this conclusion included: stylistic inconsistency, as the works exhibited significant divergence from the student's previous submissions and lacked coherence; absence of a creative process, as prior assignments included detailed documentation of conceptualization and sketching, which was notably absent in this case; and technical performance issues, as authentic oil paintings typically exhibit variation in brushstroke thickness and texture, whereas the student's submissions lacked such characteristics. Although the AI-generated works demonstrated technical proficiency, they failed to reflect the student's artistic exploration and personal style, appearing mechanically rigid. A face-to-face meeting was conducted between the instructor and the student, during which the student acknowledged the pressures and self-doubt that led to the decision to utilize AI-generated artwork.

(3) Institutional Regulations and Response

In accordance with the school's policies and following deliberation by the teaching and research team, the students' actions were deemed inconsistent with the principles of academic integrity. The essence of the art curriculum is to foster students' personal artistic expression and creativity, rather than relying on technological means such as AI to fulfill course requirements. Consequently, the student received a failing grade for not adhering to the course expectations and principles of academic honesty. Specific remedial measures included: recording a failing grade for the oil still life course, which impacted the student's semester grade point average; providing education and guidance on academic integrity, emphasizing the potential ramifications of utilizing AI-generated works on learning and career development; and requiring the student to prioritize personal creativity in future courses, ensuring that all submitted works are original. Oil Painting Still Life Sketching Course Images and Generating Oil Painting Still Life Assignments in AI See Appendix A Table 7, Table 8.

The findings of this study can be summarized in several key areas:

a. Motivational and Psychological Factors

Initially, students opted to employ AI for artwork generation (see TABLE 8) primarily due to a lack of confidence in their drawing abilities and a desire to alleviate academic pressure. Interviews revealed that students experienced anxiety and feelings of helplessness stemming from the demanding nature of the course requirements. Through personalized counseling and psychological support, students gradually recognized the significance of self-expression and creativity, which subsequently bolstered their confidence in their drawing skills.

b. Understanding of Academic Integrity

Through discussions and educational initiatives focused on academic integrity and the principles of original art creation, students developed a more profound comprehension of the ethical considerations surrounding the use of AI in artwork generation. Following these discussions, students expressed a commitment to prioritizing original work and demonstrated a willingness to challenge their artistic capabilities in the future. Furthermore, students began to actively document the processes and tools utilized in the creation of their subsequent works, indicating a heightened focus on the creative process and self-reflection.

c. Enhancement of Skills and Creativity

In post-intervention assignments, students' artworks increasingly exhibited originality, showcasing distinctiveness and individuality in their artistic styles. Educators evaluated the progress of students' work based on criteria such as composition, color application, and technical expression. Through sustained practice and instruction, students made notable advancements in their drawing skills, reflecting enhanced creativity and artistic expression.

d. Impact and Recommendations for Future Practice

Following the completion of the project, students maintained a positive outlook towards creativity, continued to engage in artistic practices, and expressed a desire to further explore the field of art. Additionally, the experiences of these students served as a model for promoting academic integrity within educational institutions. It is recommended that educational institutions implement more systematic instruction regarding the use of AI tools, integrating these technologies into the art curriculum to deepen students' understanding of the importance of originality. Concurrently, it is advisable to provide students with supportive resources to assist them in navigating the challenges posed by technology in their artistic pursuits.

This study not only elucidates the motivations behind students' decisions to utilize AI for artwork generation but also enhances their awareness of academic integrity and drawing proficiency through effective interventions. The overall process offers valuable insights into how art education can adapt to the challenges presented by AI technology, underscoring the necessity of upholding original creativity and academic integrity within contemporary educational frameworks.

(4) Experimental Results

The study examined the behavior of students utilizing artificial intelligence to generate images for art assignments, focusing on its detrimental effects on academic integrity, psychological well-being, and artistic creativity. The principal findings of the research are as follows:

a. Student Motivation and Psychological State

The motivations behind students' decisions to employ AI for artwork generation were primarily rooted in a lack of confidence in their drawing abilities and a desire to evade the pressures associated with course requirements. One student articulated feeling of anxiety and helplessness stemming from the demanding nature of the course and his inadequate drawing skills. To mitigate these pressures, he resorted to using an AI tool, such as DeepArt, to produce oil paintings without the educator's approval. This choice was intended to facilitate the prompt completion of course assignments while circumventing the challenges and frustrations associated with traditional painting. However, this approach did not effectively resolve the student's internal struggles; rather, it intensified his avoidance of genuine artistic creation. Although the AI-generated artworks exhibited a certain level of technical proficiency, they lacked individuality and creativity, failing to represent the student's authentic artistic exploration. Consequently, the student's self-expression remained constrained within the limitations of technical tools, preventing him from confronting and overcoming the challenges related to his creative capabilities.

b. Lack of Awareness of Academic Integrity

The student's initial decision to utilize AI for art creation was largely influenced by a lack of self-confidence and an aversion to creative pressures, resulting in an insufficient understanding of the significance of academic integrity. By employing AI tools to complete assignments without the educator's consent, the student disregarded principles of originality and academic ethics. With the guidance of educators, students gradually became aware that reliance on AI tools constituted a violation of academic integrity and began to appreciate the value of original creation; however, their understanding remained inadequate.

c. Enhancement of Skills and Creative Ability

Under the mentorship of educators, students' creations began to exhibit originality, and their skills improved, particularly in areas such as composition, color application, and brushstroke techniques. While AI-generated works demonstrated technical capabilities, students progressively developed their personal artistic styles through hands-on practice. Nonetheless, students continued to exhibit a tendency to depend on technical tools during the creative process, often lacking confidence when confronted with complex tasks, indicating a need for further development of their self-expression and creativity.

The findings of this study indicate that the use of AI in art creation has adversely affected students' academic integrity, psychological state, and artistic capabilities. Although the AI-generated works met superficial requirements, they failed to reflect the students' personal styles and creative thought processes, thereby hindering the development of their artistic skills and the establishment of academic integrity. Through educator-led coaching and interventions, students gradually recognized the importance of original works and made some progress in enhancing their artistic creation skills. However, this process was characterized by a reliance on external guidance rather than an intrinsic motivation for improvement. Consequently, future educational initiatives should prioritize the cultivation of students' self-confidence and independence in addressing creative challenges, as well as assist them in overcoming psychological dependencies on technical tools, thereby fostering a genuine enhancement of their artistic abilities and the depth of their self-expression.

3.3 Ethical Challenges of AI Algorithms in Chinese Higher Education

The integration of artificial intelligence within Chinese higher education has facilitated numerous advancements in teaching, assessment, and administrative management. However, it has concurrently unveiled a range of ethical concerns, particularly regarding the potential for discriminatory algorithms. The emergence of such risks is particularly pronounced in the contexts of automated assessment

and intelligent teaching. AI systems typically depend on extensive historical datasets for their training, which are frequently imbued with biases that can result in discriminatory outcomes in algorithmic decision-making. For instance, AI systems designed to predict and evaluate student performance may utilize training data that reflect historically lower achievement levels among specific demographic groups, such as those defined by region, gender, or ethnicity. If these issues persist, the application of AI in higher education in China could further exacerbate the inequitable distribution of educational resources. Moreover, the development of high-quality AI educational tools and assessment systems often necessitates substantial technical support and advanced hardware.

Targeted experiment 5

The exceptional data processing capabilities of artificial intelligence are prominently demonstrated in the preceding study. Consequently, experiment 6 is titled "Study on the Application of Artificial Intelligence in Art Curriculum Evaluation." This investigation centers on a comparative analysis of the discrepancies between AI-generated scores and those assigned by educators in the context of educational grading (refer to Table 9), thereby assessing the viability of AI as a tool for teaching assistance.

（1）Research background and issues

This research undertakes a comparative analysis of the scoring discrepancies between artificial intelligence and educators in the context of educational assessment. The study incorporates two distinct datasets: one comprising evaluations of student artworks by university instructors, and the other consisting of assessments conducted by AI, both adhering to the scoring criteria established within Chinese higher education.

The objective of juxtaposing AI assessments with those of human educators is to elucidate the respective strengths and limitations of AI in the evaluation of artistic works, particularly in subjective dimensions such as creativity, emotional resonance, and cultural context. Given that the evaluation of fine art is often contingent upon individual aesthetic judgments and interpretations, AI offers a mechanism for objective and rapid scoring, thereby presenting potential utility in large-scale classroom settings or distance learning environments. The study enhances the diversity and representativeness of its data by incorporating artworks from various institutions and artistic styles, thereby enabling a comprehensive assessment of AI performance across different contexts. This methodological approach aims to provide insights for the educational community regarding the potential and constraints of AI as an auxiliary assessment tool.

The specific methodological steps of this study include:

a. Sample Selection and Data Sources: Student artworks were sourced from

a range of institutions, including Sichuan Fine Arts Institute, Henan Normal University, and Luoyang Polytechnic Institute, ensuring a broad representation of artistic styles, including both abstract and realistic works (Table 10).

b. Comparison of AI and Teacher Assessments: The same set of student artworks was evaluated independently by AI (utilizing GPT-4o) and by human educators, based on the educational assessment standards of Chinese universities. The analysis primarily focuses on the discrepancies between the two evaluators in terms of technical assessment, creativity, and emotional expression.

c. Data Analysis: A quantitative analysis was conducted to compare the consistency and differences in grading between AI and educators, with particular emphasis on the efficiency of AI in technical evaluations and its limitations in assessing artistic creativity and cultural understanding.

d. Summary of Findings and Recommendations for Improvement: The study concludes by analyzing the advantages (e.g., enhanced assessment efficiency) and disadvantages (e.g., challenges in accurately evaluating creativity and cultural context) of AI in the assessment process. It also proposes future research directions, such as the development of emotion recognition algorithms and multimodal AI models, advocating for the use of AI as a complementary tool alongside traditional assessment methods to establish a more comprehensive and equitable evaluation system.

（2）Research Questions

a. What is the function of generative artificial intelligence in the evaluation of educational art programs? In what ways does it assist educators in assessing students' creative outputs?

b. What benefits does generative AI offer in the context of assessing art majors? For instance, does it enhance the efficiency of assessments and alleviate the workload of instructors?

c. What limitations are associated with AI-based assessments in the field of fine arts? Do these limitations have implications for the fairness and accuracy of evaluations?

d. In what ways can the algorithms used for generative AI assessments be refined to provide more effective support for art education?

（3）Subjects of the study

To guarantee comprehensive representativeness and practical applicability of the study, the research encompasses the artistic creations of students majoring in art from various regions and types of higher education institutions.

This approach aims to gather a diverse array of perspectives and data. The focus of the research is on the works produced by art major students across different educational establishments：

Sichuan Fine Arts Institute, located in Chongqing, a municipality directly under the central government, it is the only higher art institute in Southwest China with the right to confer master's degrees and doctoral degrees. The school is one of the 31 general higher art institutes independently established in China, and one of the eight major art institutes in China (a top art school in a first-tier city).

Henan Normal University, Henan Normal University is situated in Xinxiang City, Henan Province. The institution offers a first-level discipline in Fine Arts and has two authorized master's degree programs in the field of Art. Currently, there are 1,105 full-time undergraduate students and 135 full-time master's students enrolled at the university (fine arts department of a comprehensive university in a second- or third-tier city).

Luoyang Institute of Science and Technology, located in Luoyang City, Henan Province, the School of Art and Design of Luoyang Institute of Science and Technology has five undergraduate majors and currently enrolls more than 2,400 undergraduates (fine arts department of a local teacher training college or vocational and technical school).

（4）Data collection methods:

An analysis of assessment data was conducted involving the graduation projects of 2024 undergraduate art students from various institutions. A total of 10 artworks were selected from each school, comprising characterized by abstract styles and realistic styles. The evaluation criteria encompassed creativity, technical execution, and stylistic distinctiveness of the artworks. Subsequently, the scores generated by artificial intelligence were compared with those assigned by traditional educators to examine the degree of consistency and discrepancies following the AI assessment.

Scoring Criteria: In alignment with the stipulations of the Chinese undergraduate art professional training program, it is anticipated that 10% of the students will achieve an excellent performance, defined as scoring 90 points or above. Additionally, another 10% of the students are expected to attain a passing grade, which is categorized as scoring between 60 and 70 points.

The AI programmed used: GPT-4o (“o” for “omni”) is a step towards much more natural human-computer interaction—it accepts as input any combination of text, audio, image, and video and generates any combination of text, audio, and image outputs. It can respond to audio inputs in as little as 232 milliseconds, with an average of 320 milliseconds, which is like human response time (opening in a new window) in a conversation. It matches GPT-4 Turbo performance on text in English and code, with significant improvement on text in non-English languages, while also being much faster in the API. GPT-4o is especially better at vision and audio understanding compared to existing models.

（5）Method of Analysis:

The analysis employed a quantitative approach, wherein the data provided by both the artificial intelligence and the instructor were subjected to statistical evaluation. This involved assigning scores and assessing the students' artworks, with particular emphasis on the influence of generative AI on the efficiency, accuracy, and quality of feedback within the assessment process. The effectiveness of AI applications in the domain of subjective art was evaluated by comparing the discrepancies between the scores assigned by the AI and those given by the instructor.

（6）Standards for assessing students' performance:

The classroom assessment standards of the Chinese education system are generally divided into the following: 60 per cent of the usual grade: a comprehensive assessment based on class attendance, class performance, and post-course assignments in accordance with the five-grade system of excellent, good, intermediate, passing and failing. The final examination grade accounts for 40 per cent: separate scores and comprehensive assessment based on coursework; grades are calculated on a percentage basis. The data are shown in Appendix A, Table 10.

（7）Data Analysis and Findings

The data are shown in Appendix A, Table 11. The data collected from Sichuan Fine Arts Institute, Henan Normal University, and Luoyang Institute of Science and Technology established a varied basis for assessing the role of artificial intelligence in the evaluation of fine arts. This dataset encompassed both AI-generated scores and those assigned by professors, spanning various artistic styles, with a particular emphasis on abstract and realistic artworks. The comparative analysis concentrated on several critical parameters: technical proficiency, stylistic consistency, creativity, and innovation.

a. Technical Proficiency and Stylistic Consistency:

AI exhibited a notable capacity for accurately assessing technical components. For instance, the algorithms consistently evaluated aspects such as line work, symmetry, color theory, and proportion with a high degree of precision. In assignments focused on realistic art, AI feedback was particularly congruent with instructor assessments when evaluating form accuracy, shading techniques, and color blending.

Stylistic consistency was another domain where AI assessments aligned closely with instructor evaluations. When analyzing works that conformed to specific styles, such as impressionism or realism, AI effectively identified established patterns, color schemes, and techniques characteristic of those styles. For example, realistic artworks from Henan Normal University demonstrated an

average score alignment of 85% between AI and instructor assessments, indicating that AI could reliably evaluate elements governed by fixed technical standards.

b. Creativity and Innovation:

Conversely, creativity emerged as a challenging aspect for AI to accurately assess. In the context of abstract works, such as those emphasizing expressionism or conceptual art from Sichuan Fine Arts Institute, AI evaluations were less precise. Creative and innovative interpretations frequently diverged from AI's conventional criteria for form and color harmony, resulting in significant discrepancies between AI scores and instructor ratings. For instance, in a series of abstract pieces, AI assigned lower scores to unconventional applications of asymmetry and color, which human evaluators rated highly for originality and emotional impact.

These findings indicate that while AI can effectively analyze technical and stylistic parameters, its capacity to recognize and reward creative risk-taking and artistic innovation is limited. This limitation is partially attributable to AI's dependence on historical data, which may not adequately represent contemporary or avant-garde styles, thereby constraining AI's ability to evaluate non-traditional aesthetics.

c. Emotional Resonance and Cultural Context:

Emotional expression and cultural relevance are vital components of fine arts evaluation, particularly in works that address social or personal themes. In this regard, AI exhibited clear limitations; it struggled to interpret and assess the emotional depth and cultural symbolism inherent in artworks. For example, in pieces from Luoyang Institute of Science and Technology that incorporated traditional Chinese motifs and symbolism, AI evaluations frequently overlooked cultural references deemed significant by human evaluators.

Faculty members at these institutions noted that current AI models lack the contextual understanding necessary to appreciate subtle cultural symbols, which are essential for evaluating the depth and resonance of certain art forms. This gap highlights a significant challenge in employing AI for fine arts assessments: the inability to fully comprehend the subjective and cultural dimensions of art.

（8）Efficiency and Feedback

Despite its limitations, AI markedly improved assessment efficiency by providing immediate preliminary scores and detailed technical feedback. In large classroom settings, AI assessments enabled professors to concentrate more on in-depth critiques and individualized guidance, rather than on initial technical evaluations.

The efficiency gains were particularly pronounced in environments with substantial student populations or online art courses. By automating technical feedback on elements such as line quality, contrast, and balance, AI assessments

significantly reduced grading time across these institutions. This efficiency allowed instructors to redirect their time towards offering personalized critiques, mentoring, and discussing creative processes with students. Furthermore, AI feedback provided students with structured guidance on enhancing technical skills, facilitating the rapid identification of areas requiring improvement, such as color harmony or brush technique.

However, limitations were noted in AI's feedback concerning expressive and artistic dimensions. While students appreciated the prompt feedback on technical execution, they reported that AI feedback lacked the depth necessary for meaningful artistic development. Instructors also observed that while AI could streamline certain technical aspects of grading, it did not support creative growth and critical thinking essential to fine arts education, which heavily relies on subjective human interpretation and feedback.

（9）Limitations and Challenges:

This study reveals that while AI can efficiently evaluate technical parameters, it encounters significant challenges in assessing subjective qualities that are central to fine art:

a. Data Bias and Stylistic Limitations: The AI's evaluations are influenced by its training data, which often reflect biases towards conventional and mainstream art forms. This bias restricts the AI's capacity to accurately assess non-traditional and experimental art. For instance, students at Henan Normal University who engaged with mixed media and unconventional compositions reported lower scores in AI assessments, as the AI struggled to categorize and appreciate their distinctive stylistic choices. To mitigate this limitation, it is essential to continuously update AI algorithms to incorporate diverse data sources, including avant-garde and culturally significant art forms, thereby encompassing a broader range of artistic styles.

b. Algorithmic Transparency and Ethical Considerations: The application of AI in fine art assessment raises ethical concerns, particularly regarding algorithmic transparency and the potential for bias against certain artistic expressions. Faculty members at the Sichuan Fine Arts Institute express apprehension that students may alter their artistic styles to align with AI preferences, thereby compromising their creative autonomy. Ensuring transparency in AI grading methodologies is crucial to avoid unintended consequences, such as the suppression of originality and innovation. Future AI models should incorporate mechanisms that allow students and educators to comprehend the rationale behind each assessment, thereby fostering a fairer evaluation process that honors creative diversity.

c. Subjective Interpretations and Cultural Nuances: AI lacks the cultural and emotional comprehension necessary to evaluate artworks imbued with symbolic or

contextual significance. In traditional Chinese art, for example, symbolism often conveys specific cultural meanings that AI is unable to discern. This limitation can be addressed by integrating culturally aware models or training datasets that encompass a wide array of cultural and emotional contexts, thus enabling AI to better recognize cultural nuances in fine art assessment.

d. Implications and Future Research Directions: The findings of this study suggest that AI is most effective as a supplementary tool rather than as an independent evaluator in fine art assessment. Its strengths in providing rapid, objective technical feedback can enhance grading efficiency, particularly in large-scale or remote educational settings; however, human oversight remains essential to achieve a balanced evaluation that considers creativity and expression.

Based on experimental insights, the following suggestions for future research are proposed to enhance the role of AI in fine art assessment:

a. Development of Emotion Recognition Algorithms: The creation of algorithms capable of recognizing emotions could improve AI's ability to interpret expressive works and assess pieces designed to evoke specific emotional responses. Emotionally attuned algorithms would be able to evaluate the emotional impact of artworks, thereby contributing to a more nuanced understanding of their effects.

b. Multimodal AI Models: The integration of multimodal AI models that can concurrently analyze visual elements and textual components (such as artist statements) may yield a deeper comprehension of creative intent and context. This approach would enable AI to more effectively assess artworks that convey intricate personal or cultural narratives, resulting in a more thorough evaluation.

c. Hybrid Assessment Models: Hybrid models that merge AI-based technical assessments with human evaluations of creativity, emotional depth, and cultural context may represent the most effective path forward. Such models leverage the efficiencies of AI while preserving the essential human perspective that is critical in arts education.

d. Enhancing Data Diversity: Expanding the training dataset to include a variety of artistic styles and cultural art forms is vital for developing AI that facilitates more equitable and inclusive assessments. Collaborations with artists and cultural organizations can enrich AI's understanding of diverse art forms and mitigate biases towards specific styles.

While AI has transformed certain aspects of fine art assessment by providing technical support and enhancing efficiency, it cannot supplant the subjective and interpretive skills of human evaluators. A hybrid approach that integrates AI technical assessments with human judgment can foster a balanced and inclusive assessment environment that values both skill and creativity.

In conclusion, the integration of Artificial Intelligence within higher

education institutions in China presents a myriad of opportunities and challenges for the educational sector. While AI tools demonstrate significant potential in enhancing teaching efficiency, diversifying learning resources, and facilitating personalized education, they concurrently raise concerns regarding academic integrity, usage standards, and dependency on technology. Empirical findings indicate that a considerable number of students heavily rely on AI tools for academic writing and everyday learning. Although these tools can enhance efficiency, excessive reliance may undermine students' independent critical thinking and creativity. Furthermore, the trend of students opting for AI-generated content over original work poses a substantial threat to academic integrity. This issue not only hampers the academic progress of individual students but also adversely affects the reputation of educational institutions and the overall quality of education.

Given the challenges highlighted by these findings, there is an urgent need to prioritize the establishment of laws and regulations, as well as to standardize management practices within higher education. Institutions of higher learning should develop explicit policies and guidelines regarding the use of AI, delineating the rights and responsibilities of both students and faculty in relation to AI technology. Concurrently, it is essential to enhance educational initiatives that guide students in appreciating the value of originality and the significance of academic integrity. It is imperative to ensure that the deployment of generative AI fosters educational equity and enhances quality, rather than producing adverse outcomes. This approach not only safeguards the academic environment but also fulfills the responsibility of nurturing the future development of students.

CONCLUSION

The incorporation of generative artificial intelligence into higher education in China signifies a significant transformation in the conceptualization, delivery, and management of educational practices. This thesis investigates the evolving function of AI in enhancing learning experiences, optimizing pedagogical strategies, and streamlining administrative operations within Chinese universities, and gave some suggestions on policy development.

The principal findings of this study reveal the substantial contributions of generative AI to personalized learning, wherein AI-driven systems can customize educational content and feedback to meet the specific needs of individual students, thereby promoting inclusivity and engagement. Furthermore, AI has demonstrated potential in automating repetitive administrative tasks, thereby increasing efficiency and enabling educators to concentrate on pedagogical innovation. Additionally, the utilization of AI in assessment has introduced more precise and scalable methodologies for evaluating student performance, facilitating timely and constructive feedback that supports ongoing learning.

Nonetheless, the integration of generative AI in higher education presents several challenges. The study identifies critical issues related to data privacy, algorithmic biases, and ethical considerations. These concerns highlight the necessity for robust regulatory frameworks and guidelines to ensure the responsible and equitable implementation of AI. Moreover, the risk of excessive dependence on AI tools necessitates the development of critical AI literacy among educators and students, ensuring that technology serves as a complement rather than a replacement for human interaction and creativity in educational contexts.

The implications of these findings for the future of higher education in China are significant. As the nation advances its digital transformation, the strategic application of AI technologies can assist in addressing urgent challenges such as population decline, regional disparities in educational resources, and the demand for innovative talent in an increasingly dynamic global economy. Further enhancement of regulatory frameworks and policies for artificial intelligence in higher education will undoubtedly facilitate the integration of AI into national initiatives, such as China's Education Modernization 2035. This will improve the competitiveness of higher education institutions and promote a more equitable and inclusive educational environment.

Future research should concentrate on several critical areas to deepen understanding and improve the implementation of AI in education. First, longitudinal studies are essential to evaluate the long-term effects of AI on student

outcomes, teaching methodologies, and institutional effectiveness. Second, interdisciplinary research should examine the intersection of AI, ethics, and policy, particularly in addressing challenges related to data security and algorithmic fairness. Third, experimental studies could explore innovative applications of AI in hybrid learning environments, assessing their effectiveness in integrating online and offline educational experiences. Finally, localized research is necessary to comprehend the unique cultural and institutional contexts of AI adoption in Chinese higher education, ensuring that technological solutions are tailored to meet diverse needs.

In conclusion, generative AI presents transformative opportunities for higher education in China; however, its successful integration necessitates a balanced approach that considers both its potential benefits and limitations. By fostering collaboration among policymakers, educators, and technologists, and by prioritizing regulatory framework and policy, China can harness AI to develop a more dynamic, inclusive, and forward-thinking educational system. The findings and recommendations articulated in this thesis aim to contribute to the ongoing discourse surrounding AI in education, providing a foundation for future innovations and advancements in this critical domain.

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APPENDIX A

SUPPLEMENTARY DATA

Case1：

QR code for questionnaire tool 1

Table 1 Basic composition of the questionnaire

Questionnaire section	Content			
Student basic information	Gender, grade, class, use of learning terminals, main online learning methods, etc. (4 questions in total)			
Basic student use of generative AI	Students' familiarity with generative AI, when they started using it, tools for using generative AI (multiple choice), techniques for using generative AI (multiple choice), frequency of using generative AI, most commonly used generative AI functions (sorting question), frequency of learning generative AI knowledge or skills (7 questions)			
Status of typical scenarios using generative AI	Scenarios	Question number	Sample question	Levels
	Learning & Classes	4	I will use generative AI to answer questions from the teacher in class.	1=Not at all 3=Mostly 5=Exactly
	Research activity	5	I will use generative AI to assist me in selecting research questions.	
	Daily lives	5	When I encounter difficulties in life (e.g., eating, managing money, socialising), I will turn to generative AI.	

Continuation of table 1

	Seek employment	3	I would let generative AI help create or rewrite the CV.	
Open question	What are your suggestions for better use of generative AI?			

Table 2 Status of generative AI use by university students

Genre	Items	N	Percent(%)
Using generative Tools for Artificial Intelligence (Multiple choice)	ChatGPT	99	30.94%
	New Bing	36	13.44%
	文心一言（ERNIE Bot）	43	11.25%
	讯飞星火（SparkDesk）	11	2.81%
	ChatGLM	4	2.50%
	Gamma	3	2.50%
	Notion	8	3.44%
	Other	8	1.25%
	unfilled	9	0.94%
Generative Artificial Intelligence using techniques (multiple choice)	Text Generation	107	33.44%
	Image Generation	41	12.81%
	speech generation	10	2.19%
	Video Generation	6	3.13%
	Other	2	1.88%
	unused	7	0.63%
The Most Commonly Used Generative AI Functions (Sorting)	Text Generation	51	15.94%
	Information Search	43	13.44%
	language translation	8	3.75%
	Dialogue and interaction	5	1.88%
	grammar check	6	2.50%
	debugging code	12	1.56%
	unused	1	0.31%
	Other	1	0.31%

Table 3 Status of university students' use of generative AI in four typical scenarios

	Not at all(%)	not exactly(%)	accurate in general(%)	accurate(%)	Particularly accurate(%)	**average**	**standard deviation**
Courses of Study							

Continuation of table 3

1. I will use generative AI to answer teacher questions in the classroom	89(32.7%)	21(18.2%)	21(18.2%)	25(19.8%)	25(19.8%)	36.2	26.5
2. I will use generative artificial intelligence to assist in completing coursework	19(16.3%)	18(15.6%)	18(15.6%)	69(22.6%)	69(22.6%)	38.4	20.8
3. I will use generative artificial intelligence to access information relevant to course content	15(12.6%)	52(12.8%)	52(12.8%)	24(20.5%)	24(20.5%)	33.4	12.7
4. I will allow generative AI to evaluate assignments and give feedback	44(37.0%)	24(20.2%)	24(20.2%)	19(18.4%)	19(18.4%)	26	10.3
research activity							
1. I will use generative artificial intelligence to assist me in selecting research questions	19(16.6%)	11(11.0%)	11(11.0%)	27(22.8%)	27(22.8%)	19	8
2. I will use generative artificial intelligence to assist in writing	86(15.6%)	22(17.0%)	22(17.0%)	25(21.1%)	25(21.1%)	36	24.3
3. I will use generative artificial intelligence to revise a paper or report	31(26.6%)	16(18.2%)	16(18.2%)	22(19.2%)	22(19.2%)	21.4	5.1
4. I will use generative AI to help extract key information from reading literature	26(22.0%)	18(15.1%)	18(15.1%)	23(19.6%)	23(19.6%)	21.6	3.2
5. I will use generative artificial intelligence to translate foreign-language academic articles or materials	24(20.3%)	18(15.5%)	18(15.5%)	22(18.7%)	22(18.7%)	20.8	2.5
daily life							

Continuation of table 3

1. I will turn to generative AI when I encounter difficulties in my life (e.g., eating, managing money, socialising).	53(43.1%)	262(22.0%)	262(22.0%)	172(14.5 %)	172(14.5%)	33.4	14.6
2. I will ask generative AI questions about general life, society, history, geography, culture, etc.	33(27.7%)	21(18.2%)	21(18.2%)	23(19.7%)	23(19.7%)	26	4.8
3. When I'm bored, I interact and chat with the generative AI.	49(41.3%)	24(20.7%)	24(20.7%)	88(15.8%)	88(15.8%)	19	10.8
4. I will let the generative AI design a variety of entertainment content (e.g., quizzes, games, etc.) to relax me.	62(52.5%)	21(18.4%)	21(18.4%)	47(12.4%)	47(12.4%)	36	20.6
5. I will let generative AI provide counselling	68(57.2%)	21(17.8%)	21(17.8%)	37(11.5%)	37(11.5%)	21.4	20
studying and seeking employment							
1. I'll let generative AI help plan the event	41(33.7%)	86(15.6%)	86(15.6%)	29(18.4%)	13(12.9%)	51	25.26
2. I will let generative AI help create or rewrite CVs	45(38.5%)	26(18.2%)	26(18.2%)	25(17.2%)	13(11.3%)	27	8.6
3. I will have interactive mock interviews with generative artificial intelligence	58(49.5%)	56(21.5%)	56(21.5%)	92(7.7%)	57(4.8%)	63.8	13.54

Case2:

Table 4 The Interview Information

1. Usage of Generative AI
Q1: Have you utilized generative AI tools (e.g., ChatGPT, Midjourney) in your teaching or administrative duties? If so, please describe the specific contexts of their application.

Continuation of table 4

Q2: In what primary areas has generative AI supported your teaching efforts? (e.g., lesson planning, student feedback, assessment, etc.)
Q3: In terms of administration, is generative AI employed in data processing, student management, or other administrative functions? Please provide examples.
2. Specific Applications and Effects in Teaching and Learning
Q4: How do you perceive the impact of generative AI on student learning in the classroom? For instance, does it enhance students' learning efficiency and engagement?
Q5: Has generative AI played a distinctive role in collaborative projects, interdisciplinary lessons, or creative endeavors (e.g., design and art courses)? Please share relevant experiences.
Q6: How would you evaluate the applicability of generative AI across different disciplines or courses? Are there specific applications or limitations within certain courses?
3. Specific Applications and Effectiveness in Management
Q7: Has generative AI contributed to increased productivity in your administrative tasks? If so, in what areas has work efficiency improved?
Q8: Are there instances where institutions have employed AI for performance analysis, attendance tracking, or monitoring student behavior? Have these applications influenced the effectiveness of management processes?
4. Advantages and Challenges of Using Generative AI
Q9: What do you consider to be the most significant advantages of generative AI in teaching or management? (e.g., efficiency improvements, resource personalization, immediate feedback, etc.)
Q10: Have you encountered any challenges or difficulties in utilizing generative AI? For example, issues related to the accuracy of generated content, data privacy, or student reliance on AI?
Q11: In your view, has the introduction of generative AI raised any concerns regarding academic integrity or students' capacity for independent learning?
5. Thoughts on Future Developments
Q12: In what ways do you envision the future development of generative AI in teaching and administration? (e.g., enhancing AI intelligence in specific domains, improving AI's cultural and emotional understanding, etc.)
Q13: What are your expectations for future collaboration between AI and human educators? Do you believe generative AI can fully replace certain teaching or administrative functions?

Continuation of table 4

Q14: Do you think educational institutions should provide training for teachers or policy support to facilitate the integration of generative AI? If so, what type of support would be beneficial?

QR code for interview recording 1 QR code for interview recording 2 QR code for interview recording 3

Figure A.1 - interview recording

Case3：

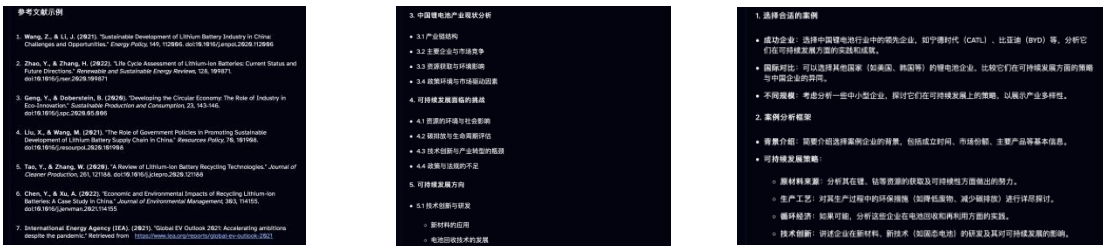


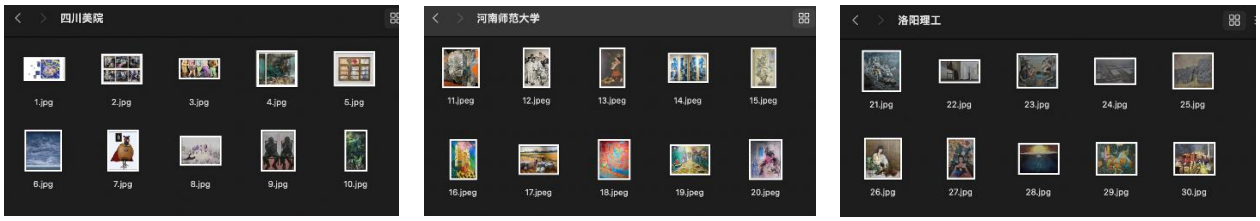
Figure A.2 - Screenshot of the steps of Ai assisted thesis research

Case4：

Figure A.3 - Oil Painting Still Life Sketching Course Pictures

Figure A.4 - Generating oil still life assignments with AI

Case5：



Sichuan Fine Arts Institute Student Work No. 1-10

Henan Normal University Student Work No. 11-20

Luoyang Institute of Science and Technology Student Work No. 21-30

Figure A.5 - Student Performance

Table 5 Student Performance Assessment Form

Assessment method	Ordinary grades			mid-term exam	final
	attendance	homework	classroom performance		
	√	√	√		√
proportion %	10	20	10	0	60

Excellent	Good	Moderate	Pass	Fail
100-90	98-80	79-70	69-60	60-0

Table 6 AI and Professor Ratings Data

Universities	**Type of work**	**No.**		**Creativity**	**Technical performance**	**stylistic**	**Average score**
Sichuan Fine Arts Institute	abstraction	1	AI	80	75	85	**80.0**
			Professor	80	82	75	**79.0**
Sichuan Fine Arts Institute	abstraction	2	AI	90	88	92	**90.0**

Continuation of table 6

			Professor	87	90	88	**88.3**
Sichuan Fine Arts Institute	realistic	3	AI	70	65	75	**70.0**
			Professor	95	84	93	**90.7**
Sichuan Fine Arts Institute	abstraction	4	AI	85	80	78	**81.0**
			Professor	79	90	77	**82.0**
Sichuan Fine Arts Institute	realistic	5	AI	75	70	76	**73.7**
			Professor	88	89	98	**91.7**
Sichuan Fine Arts Institute	realistic	6	AI	82	85	80	**82.3**
			Professor	95	99	97	**97.0**
Sichuan Fine Arts Institute	realistic	7	AI	88	90	89	**89.0**
			Professor	78	90	89	**85.7**
Sichuan Fine Arts Institute	abstraction	8	AI	78	72	74	**74.7**
			Professor	97	80	98	**91.7**
Sichuan Fine Arts Institute	abstraction	9	AI	92	91	95	**92.7**
			Professor	90	92	95	**92.3**
Sichuan Fine Arts Institute	abstraction	10	AI	77	78	76	**77.0**
			Professor	80	97	91	**89.3**
Henan Normal University	abstraction	11	AI	81	83	79	**81.0**
			Professor	80	90	93	**87.7**

Continuation of table 6

Henan Normal University	realistic	12	AI	86	84	87	**85.7**
			Professor	77	90	90	**85.7**
Henan Normal University	realistic	13	AI	74	70	73	**72.3**
			Professor	93	92	91	**92.0**
Henan Normal University	realistic	14	AI	90	88	91	**89.7**
			Professor	77	75	74	**75.3**
Henan Normal University	realistic	15	AI	72	67	70	**69.7**
			Professor	77	81	88	**82.0**
Henan Normal University	abstraction	16	AI	89	85	90	**88.0**
			Professor	77	67	79	**74.3**
Henan Normal University	realistic	17	AI	82	80	81	**81.0**
			Professor	60	65	65	**63.3**
Henan Normal University	abstraction	18	AI	76	73	75	**74.7**
			Professor	81	68	80	**76.3**
Henan Normal University	abstraction	19	AI	91	90	93	**91.3**
			Professor	82	77	77	**78.7**
Henan Normal University	abstraction	20	AI	80	78	79	**79.0**
			Professor	95	82	90	**89.0**

Continuation of table 6

Luoyang Institute of Science and Technology	realistic	21	AI	75	72	74	**73.7**
			Professor	80	68	77	**75.0**
Luoyang Institute of Science and Technology	realistic	22	AI	84	82	83	**83.0**
			Professor	76	77	81	**78.0**
Luoyang Institute of Science and Technology	realistic	23	AI	88	86	87	**87.0**
			Professor	65	67	71	**67.7**
Luoyang Institute of Science and Technology	realistic	24	AI	70	65	69	**68.0**
			Professor	60	88	85	**77.7**
Luoyang Institute of Science and Technology	abstraction	25	AI	93	92	94	**93.0**
			Professor	70	69	66	**68.3**
Luoyang Institute of Science and Technology	realistic	26	AI	78	76	75	**76.3**
			Professor	60	70	78	**69.3**
Luoyang Institute of Science and Technology	abstraction	27	AI	82	81	80	**81.0**
			Professor	89	78	80	**82.3**
Luoyang Institute of Science and Technology	abstraction	28	AI	85	83	84	**84.0**
			Professor	80	60	76	**72.0**
Luoyang Institute of Science and Technology	abstraction	29	AI	79	75	77	**77.0**
			Professor	69	60	63	**64.0**
Luoyang Institute of Science and Technology	abstraction	30	AI	88	89	90	**89.0**
			Professor	70	90	90	**83.3**