Strategies for Knowledge Production and Skill Transformation in New Liberal Arts Education Driven by Artificial Intelligence

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Abstract

With the rapid development of artificial intelligence (AI) technology, its application in the field of education has become increasingly widespread, especially playing a significant role in the construction of new liberal arts disciplines. This paper aims to explore the strategies for knowledge production and skill transformation in new liberal arts education driven by AI. By analyzing the current status and challenges of new liberal arts construction, it proposes a new model of knowledge production and a path for skill transformation based on AI technology. By citing multiple related literature, this paper delves into the connotation of new liberal arts construction, the application of AI in education, and how to achieve innovative development in new liberal arts education through technology empowerment.

Keywords

Artificial Intelligence (AI); New Liberal Arts Education; Knowledge Production; Educational Innovation

1 INTRODUCTION

New liberal arts education represents a profound transformation of traditional liberal arts education in the context of the new era, aiming to cultivate high-quality talents who can adapt to future societal needs through interdisciplinary integration and technological innovation. The rapid development and widespread application of artificial intelligence (AI) technology have brought unprecedented opportunities and challenges to new liberal arts education. Firstly, AI provides powerful technical support for educational practice, such as in student evaluation[1] and curriculum customization[2]. However, generative AI has also significantly influenced human learning experiences[3]. The question of how to achieve knowledge production in new liberal arts education driven by AI remains unresolved.

The digitization of education presents new opportunities for the development of new liberal arts disciplines[4]. Through modern information technology, digitization not only opens up digital spaces for liberal arts education but also greatly enriches teaching content and enables personalized teaching. The application of digital technology has revolutionized traditional teaching modes, providing learners with a more flexible and convenient learning experience. At the same time, the digitization of education has facilitated rapid iteration and widespread dissemination of knowledge production, providing new impetus for the knowledge production of new liberal arts education.

However, new liberal arts education faces numerous challenges in its rapid development. The construction of new liberal arts disciplines needs to address issues such as imperfect evaluation systems, the difficulty of interdisciplinary integration, and the innovation of talent training models[5]. Traditional liberal arts education evaluation systems often focus on the assessment of theoretical knowledge while neglecting the evaluation of practical and innovative abilities. Additionally, barriers and differences between different disciplines pose many obstacles to cross-disciplinary collaboration, making the difficulty of interdisciplinary integration significant. Therefore, how to establish a scientific and reasonable evaluation system for new liberal arts education has become a crucial challenge. Promoting interdisciplinary integration is also essential for the development of new liberal arts education.

New liberal arts education needs to clarify the key abilities and comprehensive qualities that composite and innovative talents should possess in future society[6]. Driven by AI technology, new liberal arts education should not only focus on the transmission of theoretical knowledge but also cultivate students' innovative thinking, critical thinking, and interdisciplinary thinking abilities. Meanwhile, with the widespread application of technologies such as big data and cloud computing, data literacy and information technology application abilities have become essential skills for new liberal arts talents. Therefore, new liberal arts education needs comprehensive reform and innovation in teaching content, teaching methods, and evaluation systems to meet the demands of future society for talents.

In summary, the rise of AI technology has provided powerful technical support and new development opportunities for new liberal arts education. However, how to achieve knowledge production in new liberal arts education driven by AI remains an urgent issue to be addressed. This study aims to explore the application paths of AI technology in new liberal arts education, analyze its impact on knowledge production, and propose corresponding implementation pathways.

2 THE INTEGRATION BACKGROUND OF AI AND NEW LIBERAL ARTS EDUCATION

2.1 The Connotation and Characteristics of New Liberal Arts Education

The connotation of new liberal arts education transcends the confines of traditional liberal arts fields, emphasizing the organic integration of interdisciplinary fusion, technological innovation, and humanistic concern. It aims to cultivate high-quality liberal arts talents with innovative spirits, practical abilities, and a sense of social responsibility. New liberal arts education not only focuses on the production and dissemination of knowledge but also emphasizes the application of knowledge and the realization of social value. By transforming and upgrading traditional liberal arts, new liberal arts education breaks down disciplinary barriers, fosters the cross-integration of humanities, natural sciences, and social sciences, and thereby forms a new disciplinary system and educational model. Young educators play a pivotal role in the construction of new liberal arts. With interdisciplinary thinking and international perspectives, they are key drivers of systematic and comprehensive reforms in discipline establishment, training models, project design, and faculty development.

2.2 The Development of AI Technology and Its Impact on New Liberal Arts Education

The rapid development of AI technology has introduced brand-new technological tools and teaching models to new liberal arts education. Through technologies such as big data, machine learning, and natural language processing, AI can achieve personalized customization of teaching content, intelligent management of the teaching process, and precise evaluation of teaching effectiveness. The application of these technologies not only enhances teaching efficiency and quality but also provides powerful data support and analytical tools for new liberal arts research, thereby driving innovation and development in knowledge production. The integration of AI technology and new liberal arts education offers new ideas and methodologies for the construction of new liberal arts education. Technology-enabled new liberal arts construction should proceed from three levels: perception-and-visualization-based scenario construction, dynamically shared instructional design, and finely tuned implementation methods[7]. These three levels correspond to innovations in the teaching environment, teaching process, and teaching methods, respectively, providing strong technical support for the advancement of new liberal arts education. Meanwhile, the application of AI technology in ideological and political education can foster intelligent innovation in this field, forming a new form of "technology-empowered ideological and political education" characterized by precise supply, panoramic education, and intelligent analysis[8].

The integration trend of new liberal arts education represents an innovation in educational models. It is not merely a simple amalgamation of technology and humanities but involves interdisciplinary integration, the updating of educational philosophies, and the transformation of teaching methods. For new liberal arts to truly achieve breakthroughs, it is necessary to strike a balance between its instrumental and value-oriented aspects, particularly focusing on the fundamental issue of humanities education: namely, cultivating what kind of people. New liberal arts are closely aligned with society, leading social values through language and methods that are easily accepted by society, thereby restoring a clean and upright social atmosphere and avoiding the pitfalls of educational utilitarianization.

The goals, connotations, and pathways of new liberal arts education are grounded in the understanding and enhancement of its disciplinary connotations, including interdisciplinary integration, service capabilities for the nation, the organic fusion of basic and applied theories, and the inheritance and promotion of humanistic spirits. The fundamental objectives of new liberal arts education are to strengthen the ideals, beliefs, comprehensive qualities, and innovative capabilities of talent cultivation. The "new" in new liberal arts education signifies innovation rather than merely distinguishing between old and new. The discourse of new liberal arts encompasses both connotations and extensions, with its scope and range significantly broadened. The construction of new liberal arts education holds significant theoretical and practical importance, as it reinforces the development of basic disciplines, emerging disciplines, and interdisciplinary studies, accelerating the construction of world-class universities and dominant disciplines with Chinese characteristics.

Thus, the integration background of new liberal arts education and AI technology signifies not only a profound transformation of traditional liberal arts education but also a comprehensive renewal of educational models, educational philosophies, and teaching methods. This integration provides new impetus and direction for the development of new liberal arts education, laying a solid foundation for cultivating high-quality talents who can meet the demands of future society.

3 KNOWLEDGE PRODUCTION MECHANISMS IN NEW LIBERAL ARTS EDUCATION DRIVEN BY AI

3.1 Constructing an Interdisciplinary Knowledge System

New liberal arts education should emphasize the integration and consolidation of interdisciplinary knowledge, breaking

down traditional disciplinary barriers to build an interdisciplinary knowledge system. This strategy aims to adapt to complex and ever-changing societal demands, nurturing liberal arts talents with comprehensive qualities and innovative capabilities. The core of new liberal arts construction lies in promoting the cross-integration of philosophy, social sciences, and the new technological revolution, leveraging deep integration of multidisciplinary knowledge to better respond to the new issues and demands emerging in China in the new era.

Driven by artificial intelligence, the knowledge production model can be constructed as a multi-factor interactive system encompassing AI, educational environment, and collaborative networks. This model can be represented by the following formula:

$$K = f(AI, E, C) \tag{1}$$

where, K represents knowledge production, AI represents artificial intelligence technology, E represents the educational environment, and C represents collaborative networks. This model underscores the application of AI technology in the educational environment and the importance of facilitating knowledge production through collaborative networks.

AI includes machine learning algorithms, deep learning algorithms, etc., which simulate and extend human learning behaviors and decision-making processes through mathematical models and algorithms. The educational environment involves educational goals, content, methods, and evaluation systems. The application of AI technology needs to be integrated with educational goals to ensure that technology serves the realization of these goals. Collaborative networks refer to interdisciplinary and cross-sectoral cooperation networks formed in education and research, which promote knowledge innovation and dissemination by sharing resources, knowledge, and technology.

Figure 1 illustrates an interdisciplinary knowledge production platform built on artificial intelligence, demonstrating the interactions and influences among AI technology, the educational environment, and collaborative networks, as well as how they jointly drive the process of knowledge production.

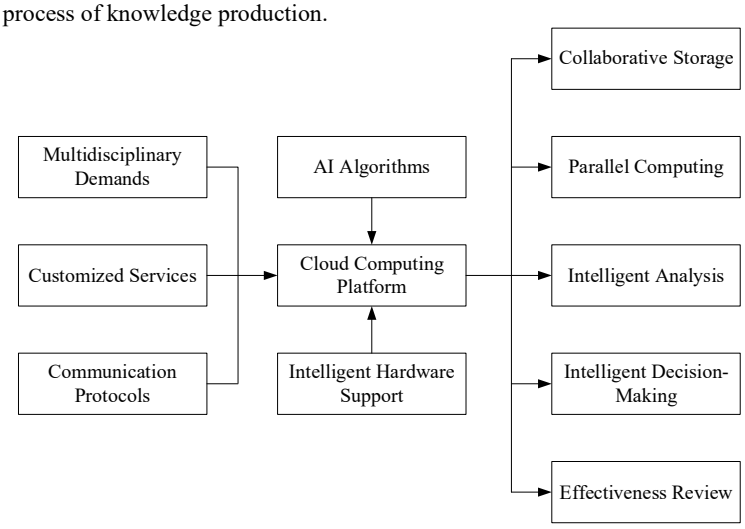

Fig.1 Interdisciplinary Knowledge Production Platform

3.2 Leveraging Big Data for Knowledge Mining and Analysis

Big data technology provides abundant data resources and powerful analytical tools for new liberal arts education. Through mining and analyzing massive data, new knowledge connections and patterns can be discovered, offering new perspectives and methodologies for academic research. In the context of new liberal arts construction, the paradigm of knowledge production in Chinese education is undergoing a transformation, shifting from the "Mode I" of disciplinary specialization to the "Mode III" of transdisciplinary intelligent media integration. This shift underscores the increasingly prominent role of big data technology in new liberal arts education. To leverage big data for knowledge mining and decision analysis, relevant evaluation mathematical models must first be established.

1) Demand Model

To precisely manage the demands and dependencies involved in big data analysis execution, a demand matrix $R_{need} \in \mathbb{R}^{m \times n}$ is first constructed, integrating both the insightful and practical experience of teachers' wisdom and the automated

processing capabilities of artificial intelligence. Teachers' wisdom plays a central role in this process, linking the knowledge vector $I \in \mathbb{R}^n$ of functional demands (such as skill modules, enterprise demands, etc.) with the required dependent projects $T \in \mathbb{R}^m$ and their iterative version requirements based on previous knowledge teaching experience and current knowledge demands $I = R_{need} T$. This linkage process leverages the functional and dependency knowledge accumulated during project development. Let $X(k)$ and $X(k+1)$ denote the knowledge levels generated at time k and time $k+1$.

2) Achievement Model

In the field of educational quality assessment, particularly when measuring the achievement of knowledge production goals, it is crucial to construct an achievement level model. This model aims to quantify the level of knowledge and skills that the knowledge production platform can provide, covering all areas involved in the demand matrix R_{need} while also considering students' actual performance after learning. Within this framework, teachers' wisdom also plays a central role in assessing and optimizing the platform's performance in achieving knowledge production. The achievement level model is based on a comparison between the actual level that should be achieved during the knowledge production process and the demand matrix, incorporating students' attitudes and ability development during the learning process.

The model formula is as follows:

$$L_{AC} = R_g - SP \tag{2}$$

where, L_{AC} is the knowledge achievement level matrix, reflecting the platform's achievement on various demand goals; $R_g \approx R_{need}$ is the set of ideal target matrices, representing the knowledge and skill levels that students should achieve during the learning process; and SP is the students' actual performance matrix, reflecting students' actual performance in various learning areas.

Furthermore, to more comprehensively assess the achievement level of the platform's knowledge production, the time factor and external influences are also considered, introducing the following dynamic model formula:

$$G(k) = \beta E(k-1) + \left(R_g^* - F\eta SP^*\right) \tag{3}$$

where, $G(k) = X(k)/X_{\max}$ is the learning achievement level index at time k ; β is the time decay coefficient of achievement, reflecting the stability of students' learning achievement level over time; F is the external factor matrix affecting the learning achievement level, including teaching resources, family environment, students' health status, etc.; η is the weight of these factors' impact on the learning achievement level; R_g^* is the adjusted teaching goal, considering the impact of external factors on students' learning; and SP^* is the adjusted actual performance of students, reflecting their adaptability and the effectiveness of learning strategies in the face of external factors. This model dynamically considers the changes in students' learning achievement level over time and the impact of external factors and teaching strategies on it, providing an important basis for schools to continuously improve teaching quality and enhance students' learning outcomes.

The knowledge production process assisted by AI is illustrated in Figure 2, where both the aforementioned Demand Model and Achievement Model are applied.

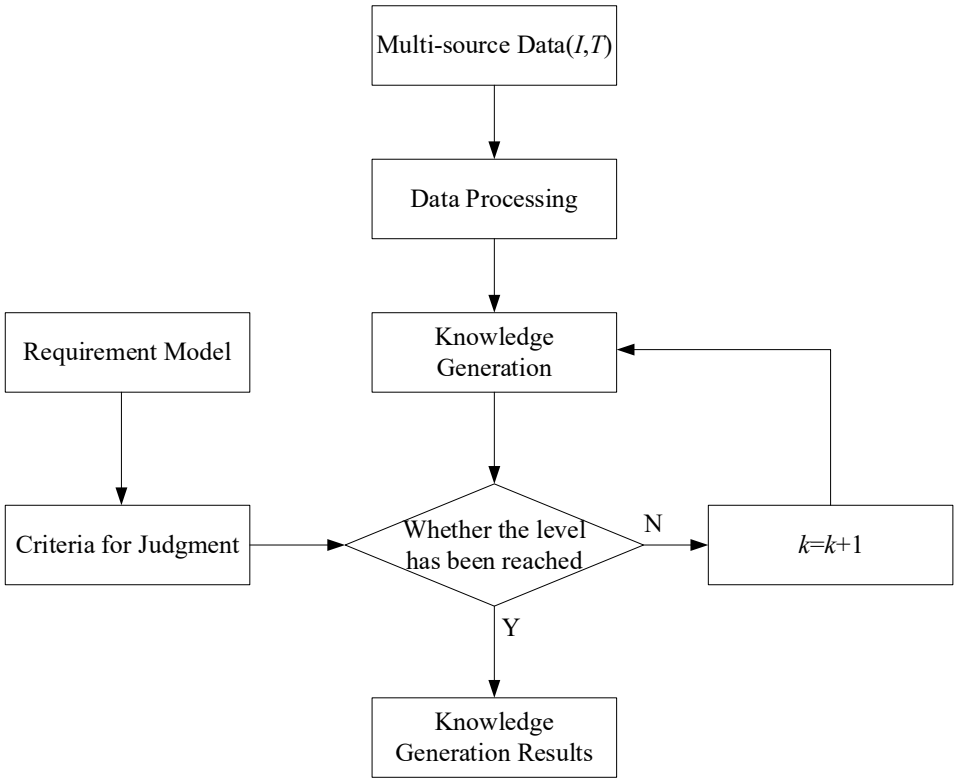

Fig.2 The knowledge production process assisted by AI

3.3 Case Study

Taking the "World History" course as an example, the data encompasses a historical literature database, which includes ancient documents, modern and contemporary historical books, academic papers, and more. It also includes network resources such as Wikipedia, historical websites, online libraries, and other online educational platforms. Additionally, it incorporates archaeological data like archaeological discoveries and excavation reports from ancient sites. Student learning data, such as learning behaviors, grades, and interests in history courses, are also considered. The first step is data processing, which mainly includes: 1) Data Cleaning: Removing duplicate, invalid, and erroneous data to avoid unnecessary waste of efficiency. 2) Data Integration: Integrating data from different sources to form a unified dataset. 3) Data Annotation: Annotating historical events, figures, locations, and other elements to facilitate subsequent analysis.

Using the Apriori algorithm and the FP-Growth algorithm, the associative relationships between historical events are mined, as shown in Figure 3.

Event Correlation Analysis During the French Revolution

Dataset: Assuming a historical event database concerning the French Revolution, it contains the following events:

1789 - The Fall of the Bastille

1789 - The Convocation of the Estates-General

1792 - The Establishment of the First French Republic

1793 - The Execution of Louis XVI

1794 - The Thermidorian Reaction

The processing procedure is as follows:

Data Preprocessing: Convert historical events into transaction data format, where each transaction represents a set of events occurring within a specific time period.

For instance, the transaction for 1789 might include {The Fall of the Bastille, The Convocation of the Estates-General}.

Set Minimum Support Threshold: Determine a minimum support threshold of 30%, meaning we only focus on event

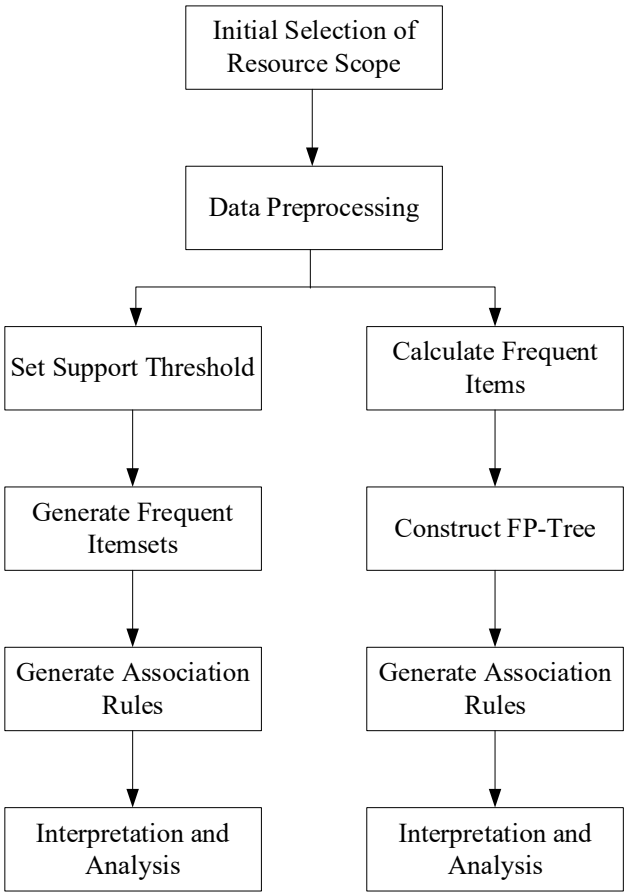

Fig.3 Algorithm execution process

combinations that appear together in at least 30% of transactions.

Generate Frequent Itemsets: Use the Apriori algorithm to generate all frequent itemsets that meet the minimum support threshold.

For example, {The Fall of the Bastille, The Convocation of the Estates-General} might be a frequent itemset because they occurred together in the same year.

Generate Association Rules: Generate association rules from frequent itemsets, which can indicate the correlation between the occurrence of one event and another.

For instance, a rule is: "If The Fall of the Bastille occurs, there is a high probability that The Convocation of the Estates-General will occur."

Through the Apriori algorithm, we discovered the following associations:

1) The Fall of the Bastille and The Convocation of the Estates-General: These two events occurred together in 1789, indicating a strong correlation between them. This might be because the Fall of the Bastille was a symbolic event of the French Revolution, while the Convocation of the Estates-General was held to address the political crisis at that time.

2) The Establishment of the First French Republic and The Execution of Louis XVI: These two events occurred in 1792 and 1793 respectively, but their correlation suggests that the establishment of the republic paved the way for the execution of Louis XVI, as the establishment of the republic marked the end of monarchy.

3) The Thermidorian Reaction and The Establishment of the First French Republic: The Thermidorian Reaction, which occurred in 1794 and ended the reign of the Jacobins, is related to the establishment of the First French Republic, as the coup led to a shift in political power and changes in the internal power structure of the republic.

Using the FP-Growth algorithm, similar conclusions can also be drawn, but there are differences in performance aspects

between the two algorithms, as shown in Table 1.

Table 1: Performance comparison of Apriori and FP-Growth algorithms

Comparison Item	Apriori Algorithm	FP-Growth Algorithm
Calculation Time (ms)	865.13	12.40
Number of Scans	1211	246
Number of Intermediate Items	62419	/

4 SKILLS TRANSFORMATION STRATEGIES FOR NEW LIBERAL ARTS EDUCATION DRIVEN BY AI

1) Cultivating interdisciplinary thinking ability in new liberal arts education

New liberal arts education emphasizes the development of students' interdisciplinary thinking abilities, equipping them to apply knowledge across various disciplines to address complex, real-world problems. This approach is crucial for adapting to the ever-changing societal demands. To achieve this, universities are encouraged to offer interdisciplinary courses, adopt project-based learning models, and conduct thinking training workshops. These strategies aim to foster an environment where students can transcend disciplinary boundaries, integrate knowledge from different fields, and develop comprehensive problem-solving skills.

2) Enhancing data literacy and information technology application ability

In the context of AI-driven education, enhancing students' data literacy and information technology application abilities is essential. This involves integrating data literacy into the curriculum, offering courses on data analysis and visualization, and providing training in information technology applications. By doing so, students can effectively manage and analyze data, and utilize technological tools proficiently for learning and research. Implementation strategies include incorporating data literacy education, organizing IT application training sessions, and designing data-based practical projects to bridge the gap between theoretical knowledge and practical application.

3) Strengthening the cultivation of innovation and practical ability

Strengthening the cultivation of innovation and practical ability is vital for enhancing students' overall quality and competitiveness, preparing them for future academic and professional challenges. This can be achieved through offering innovative education courses, increasing practical teaching sessions, establishing innovation and entrepreneurship platforms, and organizing interdisciplinary competitions. These strategies aim to stimulate students' innovative consciousness, provide them with practical experience, and support them in transforming their innovative ideas into tangible outcomes, thereby laying a solid foundation for their future success.

In summary, the skills transformation strategies for new liberal arts education focus on cultivating students' interdisciplinary thinking ability, data literacy and information technology application ability, as well as innovation and practical ability. Through the implementation of these strategies, new liberal arts education can better adapt to the demands of the digital era, cultivating high-quality talents with innovative thinking and practical abilities. Table 2 presents the achievements of Chinese universities in leveraging AI to enhance teaching skills in recent years.

Table 2 Some successful application cases

Institution	**Achievement**	**Case**
Peking University	Launched an intelligent teaching platform	"Peking University Wenxue - Intelligent Teaching Platform" enhances students' learning outcomes through data analysis and personalized learning suggestions.
Dongbei University of Finance and Economics	Developed an intelligent finance education platform	"OpenEdu4Fin" has developed an intelligent finance education platform based on large language models, greatly facilitating students' learning and teachers' teaching.
Guangdong Polytechnic College	Promoted the "AI+ Action Plan" to create a new digital and intelligent education ecosystem	Led the development of the "ZhiXing Da XianSheng" vocational education-specific large model, providing innovative intelligent application scenarios for teachers and students in four aspects: AI-assisted learning, AI-assisted teaching, AI-assisted training, and AI-assisted

		management.
Tsinghua University	Built a dedicated AI engine	Constructed a dedicated AI engine for environmental disciplines to better support scientific research and teaching.
Beihang University	Utilized AI to improve teaching quality	Achieved a comprehensive improvement in teaching quality through AI, including monitoring and evaluation of classroom teaching.
Shandong University of Art & Design	Achieved deep integration of AI with professional development	1. Established an AI Design Research Center. 2. Offered a general education course on "Introduction to Artificial Intelligence" and a series of AIGC+ design textbooks. 3. Introduced and trained teachers with backgrounds in digital media technology and artificial intelligence. 4. Built the "Tiangong Kaiwu" Shandong AI Design Service Platform. 5. Initiated the construction of an AI Design Modern Industry College and established cooperation with multiple renowned enterprises. 6. Implemented the "AI for Design" teaching reform, deeply integrating AI technology into the curriculum system of design disciplines.
Southern Medical University	Developed an AI-empowered medical imaging teaching and research innovation platform	Applied AI technology to clinical teaching and research, leading a new direction in medical education.

5 CONCLUSION

The rapid development of AI technology has brought unprecedented opportunities and challenges to new liberal arts education. The transformation of knowledge production in new liberal arts education can be achieved through measures such as constructing an interdisciplinary knowledge system, utilizing big data for knowledge mining and analysis, and fostering innovations in intelligent teaching content and methods. The skill transformation of new liberal arts education can be realized by cultivating interdisciplinary thinking abilities, enhancing data literacy and information technology application skills, and intensifying the cultivation of innovation and practical abilities. In the future, universities should continue to bolster the construction of the teaching staff, propel the reform of curriculum systems and teaching methods, and establish interdisciplinary cooperation and exchange mechanisms. These efforts will provide a robust guarantee for the sustained and healthy development of new liberal arts education.

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