Original Research Article

AI-driven collaborative development of industry-academia-research under the perspective of new quality productive forces

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Abstract: This paper explores the AI-driven collaborative development of industry, academia, and research from the perspective of new productive forces. It highlights how AI transforms traditional models through data analysis, machine learning, and intelligent decision-making, enhancing efficiency in technology transfer and innovation capabilities. The study also discusses the role of AI in aligning education with industry needs, improving curriculum relevance, and fostering interdisciplinary collaboration. Challenges such as data security and privacy protection, as well as the need for continuous talent cultivation, are also addressed.

Keywords: Artificial intelligence (AI); Industry-academia collaboration; New quality productive forces; Technological innovation; Knowledge capital

1. Introduction

With the deepening of the global technological revolution, artificial intelligence (AI) technology has rapidly developed and been widely applied across various fields, becoming a crucial force driving economic growth and social transformation. AI, as a form of new productivity, not only changes traditional production methods but also plays a key role in the integration of education, research, and industry. New productivity refers to productive elements that, under the promotion of new technologies, new knowledge, and new models, can significantly enhance production efficiency and innovation capabilities. Currently, industry-university-research collaboration has become an important pathway for promoting technological innovation and economic development (She, Zhang, & Wang, 2020). Traditional models of industry-university-research collaboration primarily rely on the research capabilities of universities and the market resources of enterprises; however, these models often face challenges such as low efficiency in technology transfer and insufficient depth of cooperation. The introduction of AI technology provides new solutions to these issues. On one hand, AI, through data analysis, machine learning, and intelligent decision-making, offers new momentum and innovative models for the collaborative development of industry-university-research, promoting the optimal allocation of resources and the efficient dissemination of knowledge. On the other hand, it also makes precise connections between education and industry possible, fostering innovation in educational content and teaching methods. To better utilize AI technology to promote the collaborative development of industry, universities, and research, it is necessary to innovate not only at the technological level but also to deeply reform educational philosophies and teaching models. With the proliferation of intelligent education, traditional teaching methods and curriculum content are being restructured, with education placing greater emphasis on cultivating practical skills, innovative spirit, and interdisciplinary abilities.

2. The theoretical framework of new productivity

2.1. Definition of new productivity

New productivity is a form of productivity based on new technologies, new knowledge, and new models,

primarily relying on the accumulation and development of knowledge capital and innovation capabilities. Compared to traditional productivity, new productivity focuses more on the efficient integration of information flow, knowledge flow, and value flow. Through the application of emerging technologies and the transformation of knowledge capital, it promotes the digitalization and intelligent upgrading of industries. This new type of productivity has significant implications in the field of higher education, as it can help educational institutions enhance the efficiency of research output, promote the transformation of scientific and technological achievements into practical applications, and strengthen competitiveness in economic and social development (Xiaolin, 2024).

In the context of contemporary globalization, new productivity has become a key factor for countries and regions to enhance economic resilience and drive sustainable development. Higher education plays an important role in this process by cultivating innovative talents and driving knowledge innovation, providing a solid foundation for new productivity. Higher education not only needs to impart the latest scientific knowledge but also continuously drive innovation in teaching and research models to adapt to the constantly evolving technological environment and societal demands.

2.2. Key elements of new productivity

The formation and development of new productivity mainly rely on the following two key elements: technological innovation and knowledge capital. Technological innovation is the core driving factor of new productivity, including the development and application of new technologies, as well as the optimization and upgrading of existing technologies. In the field of higher education, technological innovation is not limited to laboratory research but also manifests in the modernization of teaching methods and learning tools (Wang et al., 2024). By integrating AI technology, educational institutions can significantly enhance the efficiency of research and teaching. For example, AI can analyze vast amounts of data to identify new research trends, optimize research processes, and accelerate the output of research results. Moreover, AI can assist educators in designing personalized learning paths, enhancing student engagement and learning effectiveness.

Technological innovation also manifests in the close cooperation between higher education and industry. Through industry-university-research collaboration, universities and research institutions can quickly transform cutting-edge scientific achievements into practical applications, promoting economic and social development. The research capabilities of higher education combined with the practical needs of enterprises effectively drive the development of new productivity. The application of AI technology makes such collaboration deeper and broader, further enhancing the efficiency of knowledge transfer and technological application.

Knowledge capital, as a crucial foundation of new productivity, refers to the knowledge and information accumulated in the processes of scientific research, education, and technological development. Higher education institutions are the main platforms for knowledge production and dissemination (Wang, 2024). Through teaching and research activities, they continuously expand knowledge capital, providing intellectual support for economic and social development. The accumulation of knowledge capital is not limited to traditional academic publications and research projects; it also includes organizing, analyzing, and optimizing knowledge through big data and AI technology, forming a more systematic and utilizable knowledge base. Such knowledge bases can accelerate the dissemination and application of research results, promote interdisciplinary research and innovation, and provide continuous momentum for new productivity.

In the framework of new productivity, higher education institutions are not only transmitters of knowledge

but also creators and disseminators (Jie, 2024). By strengthening research and application of emerging technologies, educational institutions can dynamically update and continuously expand knowledge capital. This capability allows higher education to maintain its foresight in a rapidly changing technological environment, providing society with a continuous stream of innovative ideas and solutions, further solidifying the foundation of new productivity. Therefore, understanding and leveraging the interaction between technological innovation and knowledge capital is key to promoting the continuous development of new productivity. This theoretical framework provides a solid foundation for subsequent exploration of the specific applications of AI in education and industry-university-research collaboration.

3. Application of AI in industry-university-research collaboration

3.1. The role of AI in promoting industry-university-research collaboration

AI, as an emerging technology, is profoundly changing traditional models of industry-university-research collaboration. Firstly, AI technology, through data analysis, machine learning, and intelligent decision-making, can enhance the efficiency of converting research achievements into practical applications. By mining and analyzing big data, research institutions can more accurately identify industry needs, aligning research directions closely with industry realities. For example, using AI technology, companies can quickly access cutting-edge research results, develop products rapidly in response to market demand, and iterate technologies, thereby shortening research and development cycles and reducing costs. This precise matching not only increases the practical application rate of research outcomes but also enhances the innovation capabilities of industries.

Secondly, the application of AI technology significantly promotes deeper and broader collaboration among universities, research institutions, and enterprises. Traditional industry-university-research collaboration often suffers from information asymmetry and inefficient resource allocation. However, the intervention of AI technology can effectively overcome these obstacles. For example, through the construction of AI-based collaborative innovation platforms, all parties can share data resources and research outcomes, achieving real-time information exchange and promoting in-depth collaboration. Moreover, the optimization and application of AI algorithms can assist researchers in experiment design and data analysis, enhancing research efficiency and the quality of results.

In practical applications, virtual reality (VR) and augmented reality (AR) technologies have been widely used in industry-university-research collaboration, especially in education and research fields. For instance, in medical education, VR technology can simulate real surgical environments, allowing students to practice surgery in a virtual world, enhancing their practical skills and clinical thinking abilities. In engineering education, AR technology overlays virtual mechanical parts on actual machinery, enabling students to better understand the internal structures and working principles of equipment, thereby enhancing learning outcomes. These technologies not only enhance the interactivity and practicality of education but also allow enterprises and universities to share resources more effectively, achieving deeper integration in industry-university-research collaboration.

3.2. Innovative models of industry-university-research collaboration from the perspective of AI

Under the perspective of AI, the models of industry-university-research collaboration are undergoing profound transformations. Traditional collaboration models are mainly project-based, which are periodic and somewhat limited. However, the development of AI technology allows industry-university-research collaboration to proceed in a more flexible and diversified manner. The virtual laboratory is a typical example;

using AI technology, virtual laboratories break the limitations of physical space, enabling researchers to conduct experiments and simulations in a virtual environment, thus enhancing the flexibility and efficiency of research. For instance, materials science researchers can use virtual laboratories to simulate material performance tests, thereby reducing the cost and risks of actual experiments (She, Zhang, & Wang, 2020).

Moreover, AI technology also promotes the development of open innovation models. In this model, universities, research institutions, and enterprises collaborate through open platforms, breaking down traditional disciplinary and organizational boundaries. AI can assist in data analysis and intelligent recommendations, helping participants find the most suitable partners and research directions, improving the precision and effectiveness of collaboration. For example, many tech companies and universities have co-established open AI labs, promoting the interactive development of both basic research and applied research, thereby achieving simultaneous progress in technological innovation and commercial value.

AI also promotes the deep integration of smart manufacturing and education. By applying AI technology, universities and enterprises can jointly develop intelligent manufacturing systems and apply these systems in education and research. Such collaborations not only enhance teaching quality and research capabilities but also provide innovative technological solutions for enterprises. For instance, the development and application of industrial robot technology have rapidly advanced through deep collaborations between universities and companies, enabling widespread adoption.

3.3. The role of AI in connecting education and industry needs

AI, through data-driven and intelligent methods, makes the connection between education and industry more precise and efficient. Firstly, AI technology can analyze market trends and technological developments to help educational institutions better understand current and future industry needs. For example, through big data analysis, AI can identify which skills and knowledge will be most in demand in the future labor market, guiding universities in adjusting their curricula and research directions to ensure that students' skills and knowledge remain aligned with market needs. This data-driven decision-making approach helps educational institutions produce highly skilled graduates who meet industry demands (Qihua, n.d.).

Secondly, AI can also provide personalized learning suggestions and career planning, helping students better prepare for their professional careers. By analyzing students' learning data, interests, and abilities, AI systems can recommend courses and practical opportunities related to their career goals, helping students gain relevant experience and skills during their studies. This not only increases students' employability but also ensures that education serves industry needs more effectively.

AI serves not only as a technological tool to link educational and industrial needs but also as a bridge for communication and collaboration between the education sector and industries. Through the widespread application of AI technology, universities can better grasp industry trends and produce more competitive graduates, while enterprises can access the latest research results and technological support from universities, forming a beneficial interaction between education and industry.

4. The impact of AI on the collaborative development of industry-university-research

4.1. Enhancing students' practical skills and innovative capabilities

The application of AI technology in the education sector not only changes traditional teaching methods but

also significantly enhances students' practical skills and innovative capabilities. Through AI technology, students have access to more diverse learning resources and practical opportunities. For instance, intelligent experimental platforms and virtual reality (VR) technology provide students with safe and controlled experimental environments, allowing them to perform hands-on operations and experience real scientific research processes in virtual experiments. This approach not only reduces the risk and cost of experiments but also greatly improves students' hands-on skills and innovation awareness.

Additionally, AI technology, through personalized learning platforms, can recommend customized learning content and practical activities based on students' interests and abilities. This personalized learning approach helps students better develop their areas of interest, increasing their initiative and creativity in learning. Meanwhile, AI can also provide timely feedback and guidance by analyzing students' learning behavior and data, helping them identify problems and improve methods, thus cultivating critical thinking and problem-solving skills.

4.2. Facilitating the alignment between education and industry needs

The application of AI technology in industry-university-research collaboration has significantly facilitated the alignment between education and industry needs (Race et al., 2022). Traditional education models often struggle to quickly respond to the changing demands of industries. However, AI technology, through big data analysis and machine learning algorithms, can monitor and predict market demands in real-time. This provides educational institutions with the basis for dynamically adjusting curricula and research directions, making education more aligned with industry development needs.

For example, by utilizing AI technology, educational institutions can analyze big data in the job market to identify the industries and job roles with the greatest growth potential in the foreseeable future, and accordingly set up relevant courses and research projects. This way, educational institutions can more effectively produce graduates who meet market demands, improving students' employability and career prospects. Additionally, AI can help universities and enterprises establish closer cooperative relationships, promoting the deepening of industry-academia partnerships. Companies can provide universities with real industry challenges and data through AI platforms, while universities can utilize these resources to conduct targeted research and educational activities, creating a mutually beneficial situation.

4.3. Challenges and opportunities in industry-university-research collaboration

Despite the numerous opportunities AI technology brings for the collaborative development of industry, universities, and research, there are also significant challenges. First, data security and privacy protection have become important issues in industry-university-research collaboration (Kettunen, Järvinen, Mikkonen, & Männistö, 2022). The application of AI technology often requires large amounts of data, which may involve personal privacy and trade secrets. Therefore, how to effectively protect data security and privacy in industry-university-research collaboration is an urgent problem that needs to be addressed. Universities, enterprises, and research institutions need to jointly establish norms for data usage and protection to ensure the safety and legality of data.

Secondly, the rapid development of AI technology sets higher requirements for talent cultivation. The fast iteration of technologies in the AI field demands that universities keep pace with technological advancements, continually updating teaching content and research directions. However, many educational institutions currently lack sufficient faculty and technological facilities to fully meet the educational demands of emerging

technologies. To address this, universities need to increase investment in AI, strengthen cooperation with enterprises and research institutions, and jointly train interdisciplinary talents with both theoretical knowledge and practical skills.

At the same time, AI technology offers new opportunities for the collaborative development of industry, universities, and research. Through intelligent platforms and tools, universities, enterprises, and research institutions can communicate and cooperate more conveniently. For instance, AI-driven collaboration platforms can automatically match suitable partners and provide real-time project updates, enhancing the efficiency and effectiveness of collaboration. Furthermore, AI technology can be used to explore potential demands in research and markets, helping stakeholders plan future research directions and market strategies in advance.

4.4. The impact of AI on future education models

The proliferation of AI technology is reshaping future education models, pushing education towards personalization, intelligence, and lifelong learning. The traditional "classroom + teacher + textbook" model is being replaced by more flexible and diverse educational forms. In the future, AI technology will become the core driving force of education, providing comprehensive learning support and services through intelligent learning platforms, virtual classrooms, and intelligent tutoring systems.

Firstly, AI will promote the development of personalized education. Through intelligent learning systems, students can choose the most suitable learning paths and content according to their interests, abilities, and progress, truly achieving individualized instruction. Additionally, AI technology can provide teachers with precise teaching feedback and suggestions, helping them better understand students' learning situations and needs, and adjust teaching strategies and methods in a timely manner.

Secondly, AI will facilitate the intelligence of education. Intelligent education platforms can automatically collect and analyze students' learning data, generating personalized learning reports and suggestions to help students better plan their learning paths and goals. At the same time, AI can assist teachers in managing and evaluating teaching, reducing their workload and improving teaching efficiency and quality.

Finally, AI will promote the proliferation of lifelong learning. With technological advancement and societal progress, the speed of knowledge updates is accelerating, requiring individuals to continually learn and enhance themselves to adapt to the rapidly changing social and professional environment. AI technology can provide learners with flexible and diverse learning resources and methods, making lifelong learning possible. Whether at school, the workplace, or at home, learners can engage in continuous learning and improvement through intelligent platforms.

5. Conclusions and outlook

In the context of rapid global technological development, AI, as a form of new productivity, is profoundly influencing and promoting the collaborative development of industry, universities, and research. This study systematically analyzes the applications of AI technology in industry-university-research collaboration from the perspective of new productivity, elucidating its significant role in enhancing students' practical skills and innovative capabilities, aligning education with industry needs, and optimizing industry-university-research collaboration models. By analyzing practical cases of AI technology in higher education and industry cooperation, the study reveals how AI, through data analysis, intelligent decision-making, personalized learning, and virtual reality, significantly improves educational quality and research efficiency, promoting deep integration between

education and industry.

However, as AI technology continues to develop and expand its applications, challenges in the collaborative development of industry-university-research are also becoming more prominent. Issues such as data security and privacy protection, the contradiction between talent cultivation and technology iteration, and the fairness and accessibility of educational resources are all key problems that need further exploration and resolution in the future. Meanwhile, advancements in AI technology also bring new opportunities for the innovation of future education models. By building intelligent, personalized, and lifelong learning systems, AI will further drive the integration and development of education and industry.

Funding

This work was supported by:Guangdong association for Non-Goverment Education-2024 private university research project (GMG2024019).

Guangzhou college of commerce-2024 higher education teaching reform project (2024JXGG49).

China association of higher education-2023 higher education scientific research planning project (23SZH0416).

Project

Research on the Evaluation System for the Effectiveness of 'Four-Dimensional' Ideological and Political Construction in Sino-foreign Cooperative Education Programs: A Quality Teaching and Educational Reform Project for Guangdong Province's Undergraduate Institutions (2023JXGG07)

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