ISSN 2522-6398 Vol. 8, Issue 6: 63-70, DOI: 10.25236/FER.2025.080609

The Transformation of Artificial Intelligence Education under the Guidance of Vocational Skills Competitions: Practices and Reflections Based on the BRICS Skills Competition

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Abstract: *The dynamic evolution of competition event design in vocational skills competitions plays a guiding role in higher vocational education reform. Taking the artificial intelligence track of the BRICS Skills Competition as a case study, this research analyzes competition data from 2022-2024 through an analytical framework connecting competition event design, talent cultivation, and industry demands. The research reveals three distinct evolutionary characteristics of AI-related competitions: the structural transition from rigid classification to cross-domain convergence, the technological progression from conventional applications to cutting-edge innovation, and the pedagogical transformation from curriculum-based approaches to industry-academia integration. These changes have fostered the formation of a new paradigm in higher vocational artificial intelligence program development, providing theoretical reference for both the digital transformation of vocational education and artificial intelligence program construction.*

Keywords: *Skills Competition; Artificial Intelligence; Program Development; Industry-Education Integration; BRICS Skills Competition*

1. Introduction

Vocational skills competitions serve as crucial links connecting educational reform and industrial development, with their event settings reflecting technological trends and guiding professional development directions. In 2019, the Ministry of Education established the Artificial Intelligence Technology Service major in higher vocational education, which was renamed to Artificial Intelligence Technology Application in 2021 [1]. By 2022, 520 vocational institutions across the country had successfully registered this emerging specialty [2]. Against this backdrop, the BRICS Skills Development and Technology Innovation Competition (hereinafter referred to as "BRICS Skills Competition") provides a platform for practical innovation in educational reform of the AI Technology Application major through dynamic adjustments in competition events.

With the rapid development of artificial intelligence technology, the BRICS Skills Competition has gradually incorporated AI-related events, with the number and technical depth of AI competitions increasing significantly during the past three years (2022-2024). Students majoring in AI Technology Application in higher vocational education consequently have more opportunities and challenges for participation.

This research, based on an analytical framework of competition design-talent cultivation-industry demand, examines the evolutionary characteristics of AI events in the BRICS Skills Competition from 2022 to 2024 and their driving role in higher vocational education reform. The study focuses on three core issues: the transformative features of competition events, the interactive mechanisms of industry-education integration, and innovative approaches to talent cultivation. Through quantitative analysis of competition data and qualitative research on development trends, this study explores how skills competitions drive educational reform in AI specialties, providing theoretical basis and practical reference for vocational education reform in the new era.

ISSN 2522-6398 Vol. 8, Issue 6: 63-70, DOI: 10.25236/FER.2025.080609

2. Overview of BRICS Skills Development and Technology Innovation Competition

2.1 Background and Development History of the Competition

The BRICS Skills Development and Technology Innovation Competition was launched in 2017 and has held eight editions to date. With "Industry 4.0" as its core theme, the competition focuses on talent cultivation in cutting-edge fields such as intelligent manufacturing, artificial intelligence, and digital technology. The competition aims to cultivate future technical and skilled talents with international perspectives and high technical proficiency, while promoting exchange and cooperation among BRICS countries in technological and cultural domains. After years of development, the BRICS Skills Competition has become an important platform for promoting technological innovation and skills enhancement, especially in the fields of artificial intelligence and digital technology, gradually leading new trends in skills competitions.

With the continuous development of the BRICS Skills Competition, event settings have been adjusted annually, with significant changes in technology application events related to Industry 4.0. Beginning in 2021, the competition first encouraged enterprises to participate in event applications, particularly for events involving intelligent manufacturing, digital technology, artificial intelligence, and future technologies. According to notices issued by the organizing committee, event application units are primarily composed of enterprises and institutions engaged in relevant industries, aiming to attract industry forces to participate and promote deep integration between industry and education. Applicant units need to possess technological advantages in relevant fields, provide technical support, and ensure high quality of events and close alignment with industry needs. This change ensures that event content better aligns with industry requirements, providing higher vocational colleges with more authentic industry application scenarios, enabling students to enhance their technical practice and capabilities in environments more closely integrated with technology and industry.

2.2 Evolution of Competition Events

Since its establishment, the BRICS Skills Competition has continuously expanded in both scale and content, growing from 5 events in the inaugural 2017 competition to 194 events in 2024, demonstrating the competition's rapid response capability to technological innovation and industry demands.

In the first BRICS Skills Competition, only 5 events were established, covering traditional areas such as welding, CNC, 3D printing, maker activities, and intelligent manufacturing. These events primarily focused on basic skills and applications of traditional industrial technologies, with overall event settings being relatively traditional, covering narrow technological domains mainly concentrated in traditional manufacturing and basic technical training. However, with industrial upgrading and technological innovation, the competition gradually introduced events in cutting-edge fields such as artificial intelligence and digital technology, driving the transformation of competition content toward emerging industries.

By 2024, the number of events in the BRICS Skills Competition had reached 194, including many newly introduced events such as "Artificial Intelligence Engineering Application" and "Intelligent Connected Vehicle Application Technology." The establishment of these emerging technology events marks a significant shift in the competition's technological focus, with event content gradually transitioning from initial traditional technologies to cutting-edge technologies, particularly expanding in the fields of artificial intelligence and intelligent manufacturing. Through the introduction of these new events, the competition continuously promotes technological innovation, actively responds to the urgent industry demand for high-tech skilled talents, and demonstrates the "new" characteristics in event settings.

By comparing the number of events over the years (as shown in Figure 1), the significant expansion of the BRICS Skills Competition's event scale can be clearly observed. The period from 2022 to 2024 was critical for event expansion, with 55, 78, and 122 newly established events respectively, reflecting the competition's continuous innovation and updates in event settings. This large-scale expansion of events not only reflects the competition's active response to new technological developments but also provides participating students with richer and more diverse opportunities for technical practice.

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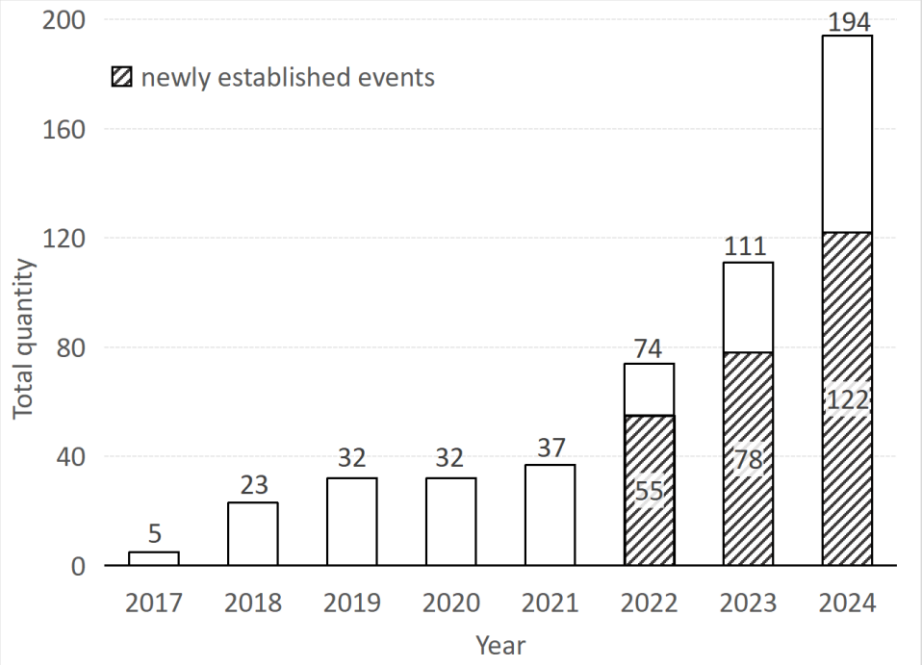

Figure 1: Stacked Chart of Changes in the Number of BRICS Skills Competition Events.

3. Evolution of AI-Related Competition Events

Since its inception in 2017, the BRICS Skills Competition has gradually aligned its event setup with industry development trends and technological advancements. In 2020, the BRICS Skills Competition established its first AI-related event—"The First Artificial Intelligence Training and Application (AI Trainer) Competition," marking the official inclusion of artificial intelligence technology into the competition system. This initiative created a synergistic effect with the Ministry of Education's 2019 policy establishing AI-related majors, jointly promoting the popularization and application of AI technology. As a result, the BRICS Skills Competition and the Ministry of Education formed a positive collaborative effect in the field of artificial intelligence technology, fostering close connections between technological innovation and industry demands in the AI sector.

With the rapid development of artificial intelligence technology, especially the widespread application in fields such as deep learning, computer vision, and speech recognition, the competition's event setup has undergone corresponding changes, with an increasing number of AI technology application events gradually being introduced into the BRICS Skills Competition. AI-related events in the BRICS Skills Competition have experienced a gradual expansion from traditional skills to artificial intelligence application technology domains. Since 2022, AI events have increased year by year, with continuous improvements in event content and technical requirements. From the perspective of event classification, the BRICS Skills Competition has gradually formed a three-dimensional event system comprising technical depth, technical integration, and industry integration categories (as shown in Figure 2). The evolution of this classification system reflects the competition's deep understanding of AI technology development: technical depth events maintain a relatively stable number, providing continuous attention to fundamental AI technology innovation; the steady growth of technical integration events demonstrates the emphasis on cross-technological domain integration and innovation; while the significant increase in industry integration events highlights the competition's deepening layout in industrial practice and application scenarios. This changing trend in classification structure indicates that while maintaining a technology innovation orientation, the BRICS Skills Competition increasingly focuses on cultivating versatile talents with technical integration capabilities and industry practical experience, aiming to better meet the actual demands of industrial intelligent transformation.

ISSN 2522-6398 Vol. 8, Issue 6: 63-70, DOI: 10.25236/FER.2025.080609

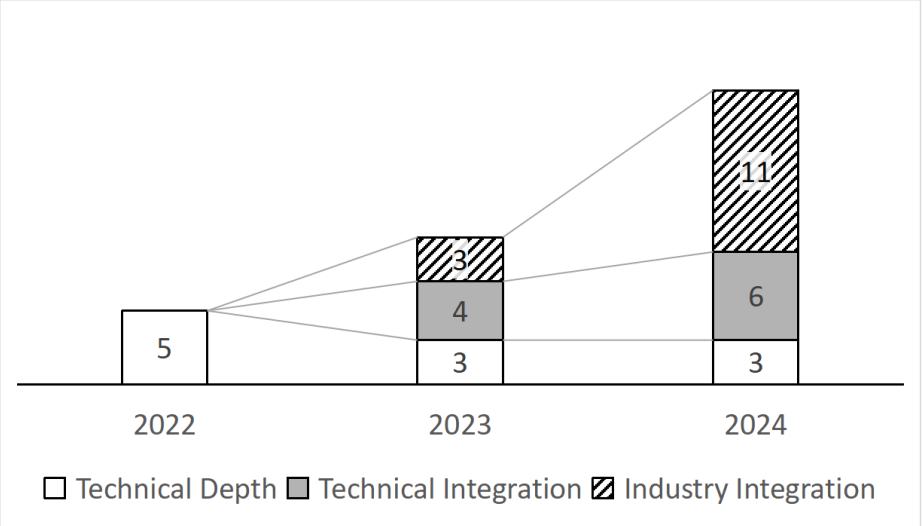

Figure 2: Stacked Chart of Changes in the Number of BRICS Skills Competition Events

In 2022, the competition notice [3] explicitly categorized AI-related events systematically, listing events such as Artificial Intelligence Training and Application (AI Trainer), Artificial Intelligence Engineering Technology (Edge Computing), Artificial Intelligence Technology Application (Natural Language Processing), Artificial Intelligence and Edge Computing Application, and Artificial Intelligence Computer Vision Application. The classification of these events clearly delineated different technical fields within artificial intelligence, such as computer vision, natural language processing, and edge computing. Through this segmentation, participants were provided with clear professional directions, helping students select competition projects based on their individual strengths.

Since 2023, AI-related events in the BRICS Skills Competition [4] are no longer strictly categorized but are presented in a broader and more open manner. For example, AI technology application events are no longer separately divided into specific technical fields like "deep learning," "natural language processing," or "computer vision," but rather exhibit a more comprehensive event design. This change indicates that the competition encourages an interdisciplinary and open competitive environment, allowing participants to showcase their innovation and practical abilities in a wider range of technical fields. This shift not only reflects the rapid development of artificial intelligence technology, especially its widespread application in multi-domain cross-integration, but also signifies the competition's inclusive and open attitude towards future technologies. For instance, the newly established "Artificial Intelligence Engineering Technology (Comprehensive Algorithm and Industry Scenario Development)" event in 2023 is based on the actual needs of industrial intelligent transformation, with competition content designed based on real job skill requirements and work tasks. The event is no longer limited to a single technical dimension but comprehensively assesses participants' integrated capabilities in multiple aspects such as AI application development, comprehensive algorithm application and development, and hardware-software integration. In addition, AI-related events in the BRICS Skills Competition not only continued the development direction of previous years but also added some cutting-edge technology application events, such as the "Artificial Intelligence Generated Content (AIGC)" event.

In 2024, while continuing to promote the application of artificial intelligence technology, the BRICS Skills Competition further expanded events in AI cross-disciplinary fields [5]. The newly established events not only respond to the cutting-edge development trends of artificial intelligence technology but also closely align with the urgent industry demand for highly skilled AI talent. Particularly in the integration of AI technology with traditional and emerging industries, the BRICS Skills Competition has added a series of events, such as the "First AIGC Internet Marketing," "First Digital Content AIGC Creation and Application," "Mental Health and Career Development (AI-Empowered)," "First AI + Intelligent Production Line Digital Technology Application," and "AI and Big Data Financial Services." The introduction of these events not only showcases the innovative applications of artificial intelligence in multiple fields but also reflects the gradual expansion of industry demand for AI talent, extending from technological depth to cross-industry integration.

Furthermore, the 2024 competition also introduced several new events closely related to cutting-edge artificial intelligence technologies, such as "Industrial Development and Application of Large AI Models" and "Intelligent Agent Construction and Application": (1) Industrial Development and

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Application of Large AI Models: This event focuses on the development and industrial application of large-scale artificial intelligence models. With breakthroughs in deep learning and large-scale data processing technologies, the application of large models (such as GPT, BERT, etc.) has shown enormous potential in multiple industries, including healthcare, finance, and autonomous driving. Participants are required to demonstrate how to develop and apply these large models in specific industries to solve practical problems. The introduction of large models not only promotes the depth of AI technology application but also facilitates the widespread adoption of AI technology by the industry. (2) Intelligent Agent Construction and Application: This event focuses on the construction and application of artificial intelligence agents, especially in practical applications in fields such as automated decision-making, intelligent control, and autonomous learning. Innovations in agent technology are driving development in multiple industries, including autonomous driving, robotics, and intelligent customer service. Through this event, participants need to demonstrate how to build intelligent agents with autonomous decision-making and learning capabilities and apply them in specific scenarios. This not only showcases cutting-edge applications of AI technology but also promotes the practical implementation of agent technology.

The establishment of these new events not only responds to the cutting-edge development trends of artificial intelligence technology but also helps students keep pace with industry technologies, enhancing their application capabilities in innovative technology fields.

4. Shaping of Talent Cultivation Models by Competition Events

Through its event design and competition mechanisms, the BRICS Skills Competition has had a systemic impact on the talent cultivation models of higher vocational colleges. This impact is primarily manifested in three dimensions: cultivation of versatile skills, enhancement of practical abilities, and development of innovative thinking, forming a complete talent cultivation system.

In terms of cultivating versatile skills, the event design of the BRICS Skills Competition has broken through the limitations of traditional single-technology domains, establishing a multi-layered interdisciplinary integration system. Since 2023, the competition, through events such as "AI Converged and Innovative Technology Application," has organically integrated core AI technologies with multiple professional fields. For example, in the data processing stage, participants need to master fundamental skills such as data collection, cleaning, and annotation; in the model development phase, they need to understand the principles of deep learning algorithms and apply them in practice; and during the terminal deployment process, they are required to possess hardware and software system integration capabilities. The AI-related events in the BRICS Skills Competition showcase a complete AI stack [6], spanning various levels from basic model components to infrastructure, covering the entire process including model training and system operation and maintenance. This requires contestants to master technical knowledge across multiple modules, from dataset processing and code development to model weights. These multi-dimensional, full-stack technical requirements not only reflect the industry's urgent demand for versatile talents but also drive relevant institutions to continuously adjust and optimize their curriculum systems to better align with industry needs and the actual requirements of the competition, providing significant reference for curriculum reform in higher vocational colleges.

Innovation in the pathway for enhancing practical abilities is another important feature of the BRICS Skills Competition. Since 2023, the competition has adopted a more open and flexible competition mechanism, no longer strictly categorizing AI events by technology. This change allows participants to showcase their technical strengths in broader application scenarios. Specifically, participants need to propose solutions to real industry problems, such as quality inspection in intelligent manufacturing, auxiliary diagnosis in the medical field, and risk warning in the financial industry. This practice mode based on real scenarios effectively enhances students' ability to transform theoretical knowledge into practical applications, while also deepening their understanding of different industry needs.

Regarding the mechanism for cultivating innovative thinking, the BRICS Skills Competition primarily adopts an individual competition format. This setup places comprehensive demands on participants' abilities. Participants need to possess capabilities in multiple dimensions, including technology development, problem analysis, and innovative solution design. Through this comprehensive competition mechanism, students' innovative thinking abilities and problem-solving skills are effectively cultivated. For example, the innovative application of artificial intelligence technology in multiple industry scenarios such as intelligent transportation, finance, and healthcare not only increases the technical depth of the competition but also cultivates participants' innovative thinking.

The shaping effect of the BRICS Skills Competition on talent cultivation models essentially reflects

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new trends in vocational education reform. Through continuous optimization of event design, the competition not only provides a practical platform for talent cultivation in higher vocational colleges but, more importantly, constructs a new talent cultivation paradigm characterized by "technology integration, practice orientation, and innovation drive." This paradigm holds significant guiding significance for promoting the deepening of education and teaching reform in higher vocational colleges and improving the quality of talent cultivation.

5. Interaction Mechanism between Competition Events and Industry Demands

The event design of the BRICS Skills Competition and industrial development have formed a dynamic interactive relationship, primarily manifested at three levels: guidance by industrial technology demands, promotion of industrial upgrading, and integration of emerging business formats.

Firstly, the demand for industrial digital transformation directly guides the establishment and updating of competition events. According to the "Digital China Development Report (2023)" [7] released at the 7th Digital China Summit, China's digital economy maintained steady growth in 2023, with the added value of core digital economy industries accounting for 10% of GDP. The report emphasizes the "deep integration of digital technology and the real economy." This huge market demand is reflected in the event design. For example, the "Mental Health and Career Development (AI-Empowered)" event reflects the service industry's demand for innovative applications of AI technology, requiring participants to develop intelligent psychological assessment and career planning tools. The "First AI + Intelligent Production Line Digital Technology Application" event targets the needs of manufacturing digital transformation, covering multiple dimensions such as intelligent transformation of production lines and process optimization.

Secondly, the trend of industrial technology integration has driven innovation in competition event design. Cross-domain technology integration has become a core characteristic of AI industry development, especially in the Industry 4.0 context, where the integration of AI and XAI methods has significantly enhanced innovation and efficiency in smart cities, manufacturing, healthcare, transportation, and other fields [8]. According to the "China New Generation Artificial Intelligence Technology Industry Development Report (2024)" [9], intelligent manufacturing and intelligent connected vehicles account for 8.89% and 8.07% of AI application areas, respectively. This trend is fully reflected in event design, such as the "AI + Intelligent Production Line Digital Technology Application" event, which covers modules like intelligent transformation of production lines, process optimization, and fault prediction, directly addressing technical pain points in manufacturing digital transformation.

Thirdly, the rapid development of emerging business formats has spurred the creation of cutting-edge technology application events. McKinsey's report, "The state of AI in 2023: Generative AI’s breakout year," [10] indicates 40% of organizations will increase overall AI investment due to generative AI, making it a key investment driver. This technological wave directly influenced the event design of the 2024 BRICS Skills Competition, leading to the addition of "AIGC Internet Marketing" and "Digital Content AIGC Creation and Application" events. These events focus on practical applications in the digital creative industry, requiring participants to use AIGC technology for content generation and marketing planning tasks, fully demonstrating the competition's rapid response to emerging technological trends. Additionally, the demand for AI applications in the fintech sector has also driven innovation in competition events. According to the "Pulse of Fintech H2 2023" report published by KPMG, fintech companies focusing on artificial intelligence attracted $12.1 billion in investment in 2023, with AI becoming a key area of interest for investors in the fintech market, particularly in products and services related to cybersecurity and regulatory technology. This industry trend provides an important reference for the BRICS Skills Competition. For instance, the establishment of the "AI and Big Data Financial Services" event responds to the widespread application needs of AI technology in areas such as risk control and intelligent investment advisory within the financial industry. Participants are required to complete tasks like risk warning and precision marketing in financial scenarios using big data and machine learning technologies.

The competition-led talent development approach of the BRICS Skills Competition directly prompts relevant vocational colleges to continuously adjust and optimize their curriculum systems to better align with industry needs and competition requirements. The specific pathways for curriculum system restructuring are mainly reflected in three aspects: First, the organic integration of foundational courses with cutting-edge technologies, such as adding emerging courses like large model application development and multimodal fusion technologies on top of traditional machine learning and deep

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learning courses; Second, the deep integration of theory and practice by transforming competition tasks into course practice content through project-based teaching; Third, modular and flexible design of course content, with timely adjustments based on technological developments and competition changes. Taking the "AI Large Model Industrial Development and Application" competition event as an example, its cutting-edge technical nature has pushed vocational colleges to add innovative course modules such as distributed computing and AI large model application development on top of traditional courses. This curriculum restructuring not only enhances students' interdisciplinary application abilities but also ensures synchronization between talent development and industrial technological advancement. Through competition-led approaches, vocational colleges have gradually achieved curriculum upgrades from traditional applications to technological innovation.

This interactive mechanism of "demand-driven, technology-led, and innovation-integrated" not only provides a practical platform for technological innovation for industrial development but also cultivates technical talent with practical combat capabilities for industrial transformation and upgrading. By deeply integrating cutting-edge technologies with industry application scenarios, the competition event design ensures relevance and practicality. It is the continuous evolution of industry demands that constitutes the fundamental driving force behind the ongoing update and enhancement of competition events, ensuring the competition's alignment with industry needs and the forward-looking nature of talent cultivation. This mechanism holds profound significance for promoting industrial intelligent transformation and innovative talent cultivation, laying a solid foundation for the long-term development of the BRICS Skills Competition.

6. Conclusions

Through the analysis of artificial intelligence competition events in the BRICS Skills Development and Technology Innovation Competition, this study reveals their impact on the educational reform of AI technology application majors in higher vocational education. The research finds that AI competition events demonstrate distinct evolutionary characteristics: the event structure is evolving from single technical domains toward multidimensional cross-disciplinary integration; the technical content is deepening from basic applications to innovative frontier areas; and the cultivation model is transforming from school-based curriculum teaching to deep industry-education collaboration. These three transformations have driven the innovative reconstruction of AI professional teaching systems in higher vocational colleges. Based on competition outcomes, institutions can improve curriculum standards, optimize talent cultivation plans, and enhance teaching quality mechanisms. By promoting education through competitions and learning through competitions, these events facilitate adjustments in teaching strategies, improve talent cultivation quality, and support the development of artificial intelligence technology application majors.

Acknowledgements

This research was funded by Foundation of Shanwei Institute of Technology (Grant number SWKT23-004) and Guangdong Education Science Planning Project (special project for Higher Education) (2023GXJK948)

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