

AI-Enabled Science Popularization Services: Technological Innovation, Risks, and Countermeasures

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Abstract: Starting from the key technologies of artificial intelligence, this paper systematically reviews the application of AI in the field of vocational education, analyzes the challenges that AI brings to vocational education, explores the opportunities that AI creates for vocational education, and proposes implementation pathways for vocational education in the AI context, covering six aspects: adjusting the specialty layout and curriculum structure, strengthening practical teaching and skills training, cultivating innovative thinking and entrepreneurial ability, improving teachers' artificial intelligence literacy, focusing on cultivating students' capacity for sustainable development, and integrating social resources to enhance students' overall quality.

Keywords: artificial intelligence; vocational education; digitalization; large models

1 Introduction

Artificial intelligence, abbreviated as AI, is a discipline that studies the use of computers to simulate certain human thought processes and intelligent behaviors. It involves computer science, psychology, graphics and image science, linguistics, and philosophy. As a fusion of the natural sciences and the social sciences, it is an important driving force of the new round of technological revolution and industrial transformation. In 1997, the computer Deep Blue developed by IBM defeated the international chess grandmaster Kasparov in a man-machine match. While marveling at the robot's extraordinary layout and logical thinking, people were astonished by the development prospects of artificial intelligence and, more than that, full of expectations for it. In 2022, OpenAI officially released the chatbot ChatGPT, which was put into market use through the Microsoft Edge browser and other channels. In 2024, the company released Sora, a short-video large-model software, which can generate a one-minute video according to the requirements expressed in text, deeply simulating the real world and producing complex scenes with multiple characters and specific motions, thereby bringing unlimited creative space to artists, filmmakers, and teachers and students who need to produce videos. With the marketization of ChatGPT and Sora, AI large models have become the technical support for the digital and intelligent transformation of industries, and will also exert a profound impact on vocational education.

2 Analysis of the Mechanism of Artificial Intelligence

Artificial intelligence is a technology in which a computer acquires contextual data from information collected by sensors or entered manually, and then performs analysis, reasoning, and decision-making according to algorithms and models to form solutions. It can be applied to search and problem solving, knowledge and reasoning, learning and discovery, and domain scenario applications. It mainly includes five key technologies, large-model technology, and AIGC technology.

2.1 Key Technologies of Artificial Intelligence

AI has five key technologies. The first is machine learning, the core technology of artificial intelligence, which learns from and is trained on large amounts of data through algorithmic models to form patterns and regularities and to continuously improve performance and accuracy. The second is deep learning, a branch of machine learning that processes and analyzes data through multi-layer neural networks to accomplish complex tasks. The third is natural

language processing, a technology that analyzes and understands human language and generates results, involving speech recognition, semantic analysis, and syntactic analysis. The fourth is machine vision, a technology that enables computers to simulate the human visual system for analysis and understanding, and can be used for image recognition, object detection, and face recognition. The fifth is algorithms, including decision trees, naive Bayes, and support vector machines; different algorithms are applicable to different scenarios and tasks.

2.2 Large-Model Technology of Artificial Intelligence

An AI large model is a large-scale neural network system built on deep learning technology. Possessing hundreds of millions of parameters, it can be trained on massive amounts of data, thereby demonstrating powerful language understanding, generation, and reasoning capabilities across various tasks and domains [1]. Its main characteristic is that it acquires broad-spectrum linguistic knowledge and comprehension ability through pre-training on large-scale datasets, and is then fine-tuned on specific tasks to meet concrete application requirements. Large models are usually based on the Transformer adaptive architecture and use self-attention mechanisms to process sequential data such as text or speech. They are widely used in natural language processing (NLP), where they can focus on different parts of an input sequence and establish associations between contexts. ERNIE Bot, a knowledge-enhanced large language model of Baidu; Spark, a cognitive large model of iFLYTEK; and Zidong Taichu, a multimodal pre-training model integrating vision, text, and speech developed by the Institute of Automation, Chinese Academy of Sciences, are all typical representatives of domestic large models.

2.3 AIGC Technology

AIGC, namely AI-generated content, is an intelligent decision-making system based on artificial intelligence and big data analytics. Through the collection, analysis, and mining of various global data, as well as deep learning and adaptive optimization of various policies, laws, regulations, and rules, it realizes intelligent management and decision support for global governance. Based on artificial intelligence technologies such as generative adversarial networks (GANs) and large pre-training models, it generates relevant content with appropriate generalization ability through learning from and pattern recognition of existing data [2]. Its core idea is to use artificial intelligence algorithms to generate content with a certain degree of creativity and quality. Products such as ChatGPT, ERNIE Bot, and Sora all belong to AIGC. They can be used not only for question answering, article abstract generation, machine translation, automatic classification, code generation, and human-machine dialogue, but also in the field of vocational education, such as the implementation of personalized education, the mining and analysis of educational data, the assessment of vocational skills, and teacher evaluation and incentives. They can further be applied to educational environments such as smart classrooms and virtual laboratories, realizing the digitalization, networking, and intelligentization of educational resources [3].

3 Application of Artificial Intelligence in the Field of Vocational Education

AI is linked to resource foundations such as big data platforms, the Internet, cloud computing, and digital audio-visual resources. Through deep learning and big data analytics, it can precisely capture students' learning habits, behaviors, and interests, provide differentiated learning resources and paths for different students, and realize student-centered personalized growth so as to teach students in accordance with their aptitude [4]. AI technology can assess students' learning progress and degree of comprehension in real time, providing data-based timely feedback and strategic references for teachers' one-to-one guidance, which helps teachers adjust their teaching strategies. At the same time, AI's inherent advantages in autonomous learning, deep learning, and computing power enable it to continuously adapt to social and technological changes and to maintain the frontier and completeness of information at all times. In other words, the content and methods of vocational education bound to AI technology will also be continuously updated with technological development, always maintaining seamless alignment with industry needs. The application of artificial intelligence in vocational education is mainly manifested in five aspects.

3.1 Implementation of Personalized and Tiered Education

Based on information such as students' learning data, interests and hobbies, and ability levels, artificial intelligence technology can provide each student with personalized learning paths and resource recommendations, which helps stimulate students' interest in learning, improve learning outcomes, and cultivate students' capacity for autonomous and lifelong learning.

3.2 Mining and Analysis of Vocational Education Data

Artificial intelligence can mine and analyze large amounts of educational data, reveal educational phenomena and patterns, and predict future trends, which helps educational institutions and educators better understand students' learning situations and needs and formulate more scientific and effective educational policies and teaching strategies.

3.3 Intelligent Application of the Vocational Education Environment

Artificial intelligence technology can be applied to the construction of educational environments such as smart classrooms and virtual laboratories, realizing the digitalization, networking, and intelligentization of educational resources. It provides students with a more convenient and efficient learning experience, and at the same time provides educators with more flexible and diversified teaching means and tools [5].

3.4 Assessment and Predictive Analysis of Vocational Skills

Based on students' learning data and occupational demands, artificial intelligence can assess and predict students' vocational skills and provide guidance for their career planning and employment. This helps improve students' vocational competitiveness and employment quality, and also provides enterprises with more precise talent recruitment and cultivation plans.

3.5 Evaluation and Incentives of Teachers' Teaching and Research Capabilities

Artificial intelligence technology can be applied to the evaluation and incentive mechanisms for teachers. Based on information such as teachers' teaching data and student feedback, it evaluates and ranks the quality and effectiveness of teaching, which helps stimulate teachers' work enthusiasm and innovative spirit and improve their teaching level and quality.

4 Opportunities Brought by Artificial Intelligence to Vocational Education

Artificial intelligence technology imitates human thinking and judgment, handling tedious routine labor and innovative work involving intelligent decision-making. As the mainstay of cultivating technical and skilled talents, teachers who make full use of artificial intelligence technology can rapidly improve their own educational and teaching capabilities and advance high-quality development and digital transformation.

4.1 Helping Teachers Improve Their Teaching and Research Capabilities

AIGC software can help teachers generate course syllabi, course content, teaching activities, and assessment and evaluation schemes; assist in designing teaching resources; produce courseware; grade assignments; and answer questions. According to different students' learning progress and habits, it recommends targeted learning resources for students and generates personalized guidance plans for teachers, thereby improving teaching quality. AIGC can also support teachers in graduation design, comprehensive professional guidance, and course practice. Through multiple interactions with human-machine keywords and prompts, it automatically seeks theoretical grounds, organizes market research and historical statistical data from massive data, constructs project outlines, group task assignments, and implementation frameworks, writes part of the code and workflow, stimulates students' innovative thinking, provides writing outlines, and creates work scenarios that immerse project teams in the situation [6]. AIGC can obtain the latest industry information on selected topics, design market research questionnaires, statistically analyze results, consult research progress and domestic and international academic literature, and establish theoretical and practical frameworks for relevant topics [7]; it can even draft research outlines, build research frameworks, and write high-level academic reports.

4.2 Advancing the High-Quality Development of Vocational Education

The high-quality development of vocational education is reflected in aspects such as high-level planning, high-quality teachers, high-quality learning, high-skill training, high-level resources, high-level achievements, highly evaluated talent cultivation quality, and highly contributive social service capacity [8]. Informatization is an inevitable trend and an important opportunity for the future development of vocational education [9]. Artificial intelligence is a key pathway for vocational education to move from extensive scale growth onto the fast track of high-quality development, providing technical and data support for high-level construction and high-efficiency governance [10]. It has become possible to let data speak and to make intelligent decisions based on statistical information and model predictions. It is more convenient for the government, industries and enterprises, society, parents, and other parties to participate in the talent cultivation process, and their ties with schools have become closer and their interactions smoother. In the AI environment, teaching scenarios with high fidelity and strong interactivity [11], together with the embedding of VR/AR/XR, digital twin, and metaverse technologies, effectively promote the formation of process-based outcomes and phased conclusions. Whether for students' self-diagnosis and improvement of learning effectiveness or for teachers' formulation of teaching strategies and reconstruction of teaching processes, these technologies provide visualized interface presentation and data analysis and effectively meet students' diverse needs. One-to-one personalized guidance by teachers, one-to-many tiered education, and many-to-many team collaboration have become possible; dynamic monitoring of students' learning, process visualization, and real-time early warning mechanisms, along with adaptive content pushing and result tracking, have become the guidance systems for teaching students in accordance with their aptitude.

4.3 Advancing the Digital Transformation of Vocational Education

Artificial intelligence technology is profoundly changing the educational philosophy of vocational education and driving its digital transformation. Artificial intelligence technology can optimize the allocation and utilization of teaching resources. Through big data analytics and intelligent recommendation systems, it is possible to understand students' professional demands and interests more accurately, provide customized learning resources and courses, allocate educational resources reasonably, and improve learning outcomes [12]. Through intelligent teaching platforms and learning management systems, schools can grasp students' learning progress and feedback in real time and adjust teaching strategies and implementation plans in a timely manner. Through technologies such as virtual reality, augmented reality, mixed reality, and digital twins, AI creates immersive project scenarios and human-machine interactive virtual environments, enabling users to switch seamlessly between the virtual and real worlds and obtain an immersive experience. Students can more realistically simulate occupational environments and practical operations, improving their vocational skills and information literacy. Through smart education platforms, resources from all parties involved in talent cultivation are gathered, deep industry-academia-research integration is achieved, new concepts, new technologies, and job specifications of industries and enterprises are grasped in a timely manner, governance mechanisms are optimized, and the digital and intelligent upgrading of school management is promoted.

5 Challenges Brought by Artificial Intelligence to Vocational Education

The advent of ChatGPT and various AIGC products marks the arrival of the era of artificial intelligence and has injected new vitality into talent cultivation. The writing of lesson plans and documentary materials, the production of courseware and teaching resources, the generation of graphics and images and videos, the synthesis of sound, audio, and music, and the production of instructional designs and implementation plans can all be completed quickly, greatly facilitating the transmission of knowledge and skills while also bringing unprecedented challenges to vocational education [13].

5.1 Faster Technological Replacement and Updating

AI machine learning algorithms can automatically analyze and process large amounts of data, help educators

discover new teaching patterns and development trends, and accelerate the iteration and optimization of talent cultivation models. The introduction of automated production lines and intelligent robots has improved production efficiency, reduced usage costs, and made it easier for new technologies to achieve market promotion. Traditional education and teaching models often rely on teachers' inspiration and experience, whereas AI can provide more choices for innovation through data analysis and machine learning. Big-data-based innovation models are more objective and efficient, which helps accelerate the improvement of the emergence and application of new technologies. Because the speed of technological updating usually outpaces the adjustment progress of the educational system and of teachers' adaptation, vocational education workers must keep learning and stay charged in order to keep pace with the times.

5.2 More Thorough Transformation of Educational Concepts

By promoting personalized learning, intelligent teaching, cross-boundary integration, lifelong education, and competency-based approaches, artificial intelligence profoundly influences the conceptual transformation of vocational education. Traditional vocational education often adopts a unified teaching model and neglects students' individual differences. Artificial intelligence can provide personalized learning paths and resources according to factors such as students' learning habits, interests, and ability levels, enabling each student to learn at their own pace and in their own way, so that teaching students in accordance with their aptitude becomes easy to realize. Artificial intelligence promotes the cross-boundary integration of vocational education with other fields. Vocational education is no longer confined to traditional classroom teaching but can engage in deep cooperation with industries, enterprises, communities, and other parties, which helps cultivate students' comprehensive quality and innovative ability. It helps them continuously optimize their learning paths and outcomes; through simulated practice, project cooperation, and other approaches, it cultivates students' practical operation ability, teamwork ability, and innovation ability, paying more attention to students' ability development and enabling them to better adapt to future occupational demands.

5.3 More Differentiated Resource Utilization

On the one hand, artificial intelligence helps, to a certain extent, to break the problem of imbalanced educational resources. Combined with big data, it greatly expands the reach of high-quality educational resources. Student groups can be placed on an equal footing without discrimination; through artificial intelligence smart education platforms, high-quality digital vocational education courses, textbooks, and other resources can be easily shared across the province, the country, and even the world, promoting ubiquitous education and learning and making education more liberalized and personalized. On the other hand, artificial intelligence makes the use of educational resources more differentiated. At present, most AIGC adopts a paid model—through free registration but paid shopping-style access, annual or monthly subscriptions, and star-rated membership systems—setting different tiers for different users. High-level and high-version resources are expensive; high-performance service platforms, high-quality computing machines, and high-priced educational resources leave many financially constrained institutions and users standing still, unable to enjoy the dividends brought by AI. Furthermore, the extent to which AI-assisted teachers improve work efficiency and quality depends on users' familiarity with the subject content and their questioning skills, that is, it follows the principle of reciprocity: the more professional and in-depth the questioner, the more accurate and useful the answer. For the same question, professionals and non-professionals get very different answers. It is not difficult to see that for poor students, those with weaker information capabilities, and non-professionals, the use of AI technology cannot achieve essential improvement; on the contrary, it will aggravate the gap in educational development.

5.4 Blurrier Occupational Positioning

First, the widespread application of artificial intelligence technology has blurred the boundaries of many traditional occupations. Positions such as traditional customer service, translation, and data analysis will be replaced by intelligent robots and automated systems, while new occupational roles such as AI trainers and data annotators have emerged as the times require, so that occupational positioning is no longer limited to traditional, fixed roles and responsibilities but requires constant adaptation and adjustment. Second, artificial intelligence promotes cross-

domain cooperation and innovation, making the intersection and integration between different occupations the norm. Cooperation and innovation require practitioners to possess broader knowledge and skills, and occupational positioning is no longer limited to a single field or industry. In addition, artificial intelligence has also promoted the development of remote work and freelance work, enabling people to choose their career paths and working styles more flexibly. Through online platforms, people can easily find projects and job opportunities that suit them, thus achieving cross-regional and cross-industry career development. This flexibility further aggravates the ambiguity of occupational positioning.

5.5 More Diversified Teachers' Roles

The development of artificial intelligence has transformed the role of teachers from a single imparter of knowledge into diversified roles, including teaching assistants, intelligent tutors, and precise teaching researchers. This diversification of roles not only improves teaching quality and efficiency but also promotes teachers' professional growth and development. Teachers not only need to impart knowledge but also need to guide students in how to correctly use artificial intelligence technology and cultivate students' innovative thinking and practical ability. This places higher demands on teachers' professional competence and teaching methods. With the support of AI, teachers can free up more time and energy to pay attention to students' individual needs, conduct more in-depth instructional design and research, and provide students with precise learning suggestions and personalized guidance plans. AI has changed the teacher–student interaction model, making the classroom smarter. Through technologies such as somatosensory interaction, 3D, and AR augmented reality, “immersive experience” education approaches real three-dimensional scene presentation, overcoming the drawback that traditional education methods cannot directly perceive, experience, and practice, making the classroom vivid and image-rich, greatly stimulating students' interest in learning and promoting the improvement of skills.

6 Basic Pathways for Vocational Education to Respond to the Challenges of Artificial Intelligence

With the popularization of artificial intelligence, some traditional occupations may gradually disappear or be replaced, while new occupational positions will emerge accordingly, making the occupational positioning of vocational education more complex and the cross-integration of specialties more common, and placing higher demands on teachers' teaching capabilities. Learning ability, comprehensive analytical ability, innovation ability, and guidance ability have become essential skills for teachers in vocational colleges. Teachers and administrators in the field of vocational education need to conduct in-depth research on future occupational development trends and provide students with appropriate career guidance and training, guiding and acting according to the situation, seizing opportunities, and actively responding to the challenges that AI brings to vocational education.

6.1 Keeping Pace with Industrial Changes and Adjusting the Specialty and Curriculum Structure in a Timely Manner

It is an irresistible trend for AI to penetrate into all fields of society, and it will certainly profoundly affect students' work, study, and lifestyle. Vocational education should pay close attention to the development trends of artificial intelligence technology. Vocational colleges should keep pace with industrial development and changes, adjust their specialty settings in a timely manner, shorten the cycle of specialty optimization, infiltrate the latest AI technology of industries and enterprises into the knowledge and courses of all specialties, and build a technical and skilled talent training system of “AI + specialty.” The curriculum structure and content also need corresponding adjustments, emphasizing interdisciplinary and multi-specialty integration, integrating artificial intelligence knowledge into professional teaching practice, and cultivating interdisciplinary compound talents.

6.2 Continuously Updating Educational Concepts and Improving Teachers' AI Literacy

The key to vocational education's response to the challenges of artificial intelligence lies in teachers. Teachers cannot be satisfied with existing knowledge; they must change with the times, strengthen their learning, and

continuously update their educational concepts and knowledge systems. They should take the lead in exploring the ways and methods of modern educational technology in the cultivation of technical and skilled talents, and boldly experiment with the reform of AI technology in curriculum development, the development of new-format textbooks, and theoretical and practical teaching, so as to improve their classroom organization ability and professional research level. They should lead by example, master AIGC application technology, become experts in the field of vocational education and guides for students in improving their information literacy, and, by applying the latest concepts, cultivate digital and intelligent craftsmen who keep pace with the times, providing professional guidance for cultivating high-quality AI-oriented talents.

6.3 Making Full Use of Various Resources to Improve Knowledge and Technical Skills

The emergence of AIGC large models provides convenient conditions for teachers and students in vocational colleges to generate various teaching and learning resources. Facing massive data, it is necessary to master the ability to judge the validity of resources in order to improve personal knowledge and technical skills, especially practical hands-on ability. AI deeply integrates technologies such as big data, the metaverse, and AR/VR, facilitating the construction of fully scenario-based virtual simulation practical teaching environments and the production of audio, video, and image resources. Schools need to cooperate with leading enterprises in the industrial chain, introduce advanced technologies and high-quality resources, and establish virtual simulation practice bases or practice platforms, so that students can master artificial intelligence technology in immersive environments and apply it to the education and teaching process, enhancing students' employment competitiveness.

6.4 Focusing on Cultivating Core Competencies and Enhancing Capacity for Sustainable Development

Artificial intelligence technology makes occupational positioning more blurred. Many positions, even clusters of positions, are gradually dying out; after integrating into professional fields, they can in turn give rise to quite a few new positions and comprehensive interdisciplinary specialties. The specialized knowledge and skills learned from school textbooks are insufficient to support the sustainable development of a career. Therefore, attention should be paid to cultivating students' learning methods and interdisciplinary self-learning ability, encouraging students to enrich their knowledge through cross-specialty communities, cultivating students' innovative spirit, teamwork ability, and sense of social responsibility, combining artificial intelligence technology with their specialties and integrating other relevant knowledge to form interdisciplinary and multi-specialty adaptability, consolidating core competencies, and better adapting to the development needs of the era of artificial intelligence.

6.5 Striving to Improve Information Technology and Actively Adapting to Changes of the Times

The development of artificial intelligence technology requires continuous innovation and breakthroughs. The application of AI technology helps cultivate innovative ability. Teachers in vocational colleges should continuously improve their information technology literacy, actively embrace technological change, overcome indoctrination-style, rote-memorization-style, and standard-answer-style teaching methods, focus on cultivating students' innovative thinking and creative ability, make full use of smart education and intelligent heuristic teaching models, transform from imparters of knowledge into learning guides, innovation facilitators, and skill-integration coaches, make full use of AI-assisted teaching, provide personalized guidance to students, act as students' guides and good teachers and helpful friends, and cultivate their keen thinking about new things, new concepts, and new technologies so as to adapt to future workplace demands.

7 Conclusion

The emergence of AI large-model software such as iFLYTEK Spark, Doubao, Tongyi Qianwen, Zhipu Qingyan, and Pangu has brought many advantages to vocational education and provided methods and pathways for the digital transformation of traditional education models. The deep integration of artificial intelligence technology and vocational education will surely promote the upgrading of education models and cultivate more technical and

skilled talents with greater innovative thinking and creative ability for social and economic development. This study, from the perspective of higher vocational colleges, analyzes the opportunities and challenges that artificial intelligence technology brings to talent cultivation and designs corresponding implementation pathways. Although the penetration of artificial intelligence into the field of education cannot be achieved overnight, its impact on educators is unprecedented. There must be sufficient psychological preparation: one needs to strengthen learning with a positive attitude, plan early, and update one's knowledge system in a timely manner, so that AI becomes a powerful weapon for promoting the reform and innovation of education and teaching models.

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