Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 17, No. 3, 2026

Research on the Development Path of Vocational Education Teachers Enabled by Generative AI

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Abstract: Currently, vocational education is in a critical stage of transformation and development. With the rapid advancement of generative AI technology and its initial application in the field of education, vocational education teachers are facing unprecedented impacts and challenges. Against this backdrop, how to achieve the coordinated development of teachers and technology, and jointly promote the growth of students, has become a focus of widespread attention. In this context, seeking common ground in the teacher's subjectivity, teaching model transformation, and development paradigm in the application of generative AI in vocational education, fully exploring the current factors that restrict teachers' development in terms of teaching, ability, and ethics, and focusing on discussing the development path of vocational education teachers from three aspects: personalized teaching design, improvement of practical ability, and clarification of ethical norms, with the aim of providing useful references for the professional growth of vocational education teachers in the new era.

Keywords: Generative Artificial Intelligence; Vocational Education; Teacher Development; Path.

1. Generative AI and New Opportunities for Teacher Development in Vocational Education

1.1. The Return of Subjectivity: From a Teaching Professional to a Person with Humanistic Spiritual Care.

The introduction of generative artificial intelligence is profoundly reshaping the role positioning of teachers in vocational education. As AI takes over most repetitive tasks, teachers' subjectivity in educating people can truly return. Teachers can focus their energy on the irreplaceable core human-centered domains that AI cannot fulfill [1]. In the classroom, teachers not only impart knowledge but also closely monitor students' emotional states, timely provide psychological counseling and guidance on life challenges, integrate professional ethics, craftsmanship spirit and professional identity into the whole teaching process, and achieve the deep integration of value guidance and personality shaping. Freed from repetitive labor, teachers have more time to design and implement creative teaching activities, such as organizing complex interdisciplinary team projects, guiding students to participate in authentic industrial innovation competitions, and adopting scenario simulation, case analysis and other diversified teaching methods. These approaches help students move beyond tedious rote memorization and cultivate comprehensive abilities including teamwork and problem-solving through practice. Therefore, the introduction of generative AI is far more than a mere superposition of teaching tools; it further drives teachers to transform from mere knowledge transmitters to advanced educators as mentors of student development. In this transformation, education truly returns to its essential nature of nurturing people, committing to cultivating well-rounded individuals with comprehensive literacy who can meet the challenges of future society.

1.2. The Transformation of Teaching Models: From a Single Lecture Approach to Personalized Learning

The rapid development of generative AI technology is reshaping the educational ecosystem in an unprecedented way. The one-size-fits-all educational model in traditional education cannot effectively meet the needs of students' personalized learning and growth. Since 2010, China's educational policies have been deeply pursuing "quality education equity", and the "National Medium and Long-Term Education Reform and Development Plan Outline (2010-2020)" first clearly stated that "each student should be provided with suitable education", marking the beginning of a new stage of comprehensive and in-depth development of personalized education policies. Subsequently, the Ministry of Education issued the "Opinions on Comprehensively Deepening Curriculum Reform and Implementing the Fundamental Task of Cultivating Virtue and Developing People" in 2014, and the 2019 "China Education Modernization 2035" and other series of documents all had regulations on personalized education. It can be seen that China pays more attention to and actively responds to the individual differences and needs of students. The personalized education policies have developed comprehensively and rapidly. However, due to reasons such as a large number of students, insufficient technology, and a lagging team of innovative teachers, truly personalized teaching has not been fully implemented.

With the introduction of generative AI, personalized teaching has been revolutionized. A "proficient learning" model that ensures each student truly masters the knowledge before advancing the progress has gradually entered the public eye [2]. This model supported by generative AI teaching not only can generate highly personalized learning content in real time, but also can dynamically adjust the learning progress based on the real-time analysis of students'

learning data. For vocational school students with diverse learning foundations and styles, it can also generate more in-depth learning resources based on students' learning styles and interests. This flexibility enables personalized education not only to become a reality but also to change the operation mode of the traditional education system to a certain extent.

1.3. Transformation of Development Paradigm: From Stage-Based Training to Accompanying Intelligent Advancement

The traditional teacher development model is mostly of the "discrete stage-based" type, mainly relying on regular training sessions and encouraging teachers to participate in teaching competitions to achieve personal growth. Under this model, the training content often fails to precisely match the actual needs of each teacher, and the training intervals are long, resulting in lag in teacher development and making it difficult to flexibly respond to real-time challenges in the teaching process. The emergence of generative AI is giving rise to a new type of "co-mingled development" paradigm, which integrates teacher professional growth with daily teaching practice, achieving continuous support through on-demand supply and immediate feedback. Under this new paradigm, teachers can adjust teaching strategies and improve professional skills at any time based on classroom progress and teaching outcomes, achieving immediate growth [3].

One of the significant advantages of the co-mingled development model is its instant learning function. Teachers can seek help from AI at any time during lesson preparation or teaching, obtaining ideas, cases, and methods, embedding learning into real teaching tasks, which is highly efficient and targeted. In addition, generative AI can intelligently connect teachers with common development needs, forming a smart teaching and research community across schools and regions. Vocational education teachers can intelligently search for relevant professional information, promoting the exchange of resources and knowledge between vocational school teachers and enterprise engineers, ensuring that teaching content is in sync with industrial development and avoiding a disconnect between what students learn and social needs.

2. Generative AI Empowers the Development Challenges of Vocational Education Teachers

2.1. Teaching Aspect: The Student Source Structure Becomes More Diverse, and The Challenges in Teaching and Management Intensify.

Students at vocational colleges come from a wide range of backgrounds, which directly results in huge disparities in their academic foundations [4]. Specifically, students in vocational schools can generally be divided into three categories according to their learning status. First, a relatively large proportion of students struggle to adapt to the exam-oriented education model; they not only have weak academic knowledge but also obvious deficiencies in learning habits and self-confidence, thus urgently needing systematic guidance. Second, some students show little interest in theoretical learning but possess strong practical and hands-on skills, with great enthusiasm and even natural talent for technical and vocational learning. Third, a large number of students fall into the “middle group,” with average academic foundations and unclear perceptions of their future development paths. Such wide gaps in foundational levels make it difficult for teachers to set a unified teaching starting point and progress suitable for all students. Consequently, the traditional “one-size-fits-all” teaching model inevitably falls into the dilemma where “some students are unchallenged while others cannot keep up.”

Meanwhile, students’ original intentions and goals for choosing vocational education are also diversified. Some students have clear plans for their future careers and strong learning initiative, with the core demand of mastering solid professional skills to gain a foothold in society. Others aim to pursue higher education through the vocational college entrance examination and therefore focus more on exam-oriented theoretical preparation. Still, some students choose vocational education passively due to limited senior high school entrance examination scores or family suggestions, lacking internal learning motivation and even holding a negative attitude of “muddling through.” Such diversification in learning motivation imposes higher requirements on instructional design and student management. Teachers must abandon the rigid one-size-fits-all approach and strike a balance among skills training, further-education tutoring, and motivation stimulation to meet diverse student needs.

2.2. Capability Aspect: The Practical Abilities of Dual-Qualified Teachers are Weak, and the Effectiveness of Enterprise Resource Integration is Not High.

As the core feature of vocational education, "dual-qualified" teachers are the key force determining the quality of teachers in vocational colleges and even the entire vocational education. However, the current construction of "dual-qualified" teachers still faces various constraints.

On one hand, influenced by the continuous implementation of the vocational education college entrance examination policy, the focus of teacher training in vocational colleges has overly leaned towards teaching skills, while neglecting the enterprise internship training for themselves, resulting in the lag of teachers' industry cognition and skill updates behind the development rhythm of the industry; at the same time, the channels for talent flow between enterprises and colleges have not been fully connected, the construction of the teacher cultivation and development system has been slow, and enterprises are unable to conduct systematic practical ability training for teachers, the training content still focuses on traditional work processes and theoretical knowledge, and is seriously insufficient in covering comprehensive practical skills, new processes and new technologies of enterprises. On the other hand, the practical innovation ability of vocational school teachers is difficult to meet the demands of industrial development and transformation and upgrading. Even if enterprises accept the practice of teachers, they may not allow teachers to access core technologies and key positions due to concerns about commercial secrets, and the cooperation often remains at the level of visiting and research, lacking in in-depth technical collaboration [5]. Moreover, the practical experience time of teachers in enterprises is generally short, schools have neither effective process supervision nor scientific assessment mechanisms, which leads to the practice being prone to be formalized, and the achievements are difficult to be transformed and applied to classroom teaching, ultimately making the construction of "dual-qualified" teachers mostly remain on the surface and fail to achieve

effective implementation [6].

2.3. Ethical Risk Aspect: Data Security and Professional Ethical Risks

Ethical risks are an important factor that cannot be ignored when generative AI is applied in vocational education teaching. While AI technology brings convenience to teaching, it also raises various ethical issues, specifically manifested in multiple aspects such as data security, content accuracy, and vocational ethics cultivation. [7]. Firstly, in terms of data security and privacy protection. When teachers use generative AI to conduct classroom interaction activities such as teaching generation, behavior evaluation, and information collection, they often need to upload students' learning data and teachers' teaching materials, which contain personal information of both teachers and students. This process has obvious risks of information leakage; at the same time, as AI is an intelligent system relying on the internet, it is prone to become a target of cyber attacks, which may cause a large amount of core teaching information and personal sensitive data to face the risk of loss, thereby affecting the normal conduct of teaching activities. Secondly, when teachers use AI to generate teaching content and design teaching plans, whether the generated content meets the professional standards of vocational education, whether the teaching plans can effectively adapt to the actual classroom learning situation and teaching objectives, and whether they can provide correct guidance for students' career development still require vocational educators to make further judgments based on the actual situation. Moreover, excessive reliance on AI may lead teachers to weaken their role of value guidance in teaching, thereby affecting the cultivation of students' independent thinking ability, problem-solving ability, and even causing students' lack of vocational ethics cognition, which is contrary to the goal of vocational education of "education for people and technical skills combined" [8].

3. Generative AI Empowers the Development Path of Vocational Education Teachers

3.1. Empowering Teaching Ability Upgrade: From Knowledge Transmission to Personalized Teaching Design

The focus of professional development for vocational education teachers should not only be on their theoretical knowledge of teaching and learning, but also on optimizing their teaching methods and solving practical problems in daily teaching. The experience of solving these problems is the core component of teachers' practical knowledge [9]. By using generative AI technology to analyze students' knowledge foundation, learning style, and vocational interests, and automatically generating personalized learning plans, teachers can scientifically guide students' learning progress and career planning, helping each student find a growth path suitable for their own development. For example, the system can recommend differentiated learning resources based on students' differences and set tasks of different difficulties, effectively solving the problem of varying starting points and diverse goals of students, and providing students with truly personalized learning suggestions and feasible goals, thereby supporting vocational school students to achieve the expected professional development upon graduation, ultimately fulfilling the core mission of vocational education to cultivate diverse talents and promote employment and entrepreneurship, and comprehensively improving educational quality and service effectiveness.

Action research emphasizes collecting qualitative data such as course recordings during the teaching process to deepen the understanding of past teaching experiences and teaching behaviors, thereby laying a solid foundation for the development of teachers' professional knowledge and abilities [10]. With the help of generative AI, teachers can systematically analyze students' learning behavior data, promptly alert students who have difficulties in learning or risk dropping out, and promote teaching management to shift from "post-event remediation" to "pre-warning, precise intervention", significantly improving management efficiency and academic support effectiveness, and helping individual student growth.

3.2. Empowering Practical Ability Enhancement: Breaking Down the Barriers between Teaching and Industry

Vocational education focuses on cultivating technical and skilled talents needed by society. This requires vocational school teachers not only to possess basic teaching and educational abilities, but also to have solid practical skills and professional expertise in their respective fields. Therefore, vocational school teachers, on the basis of solid basic information literacy, should also possess the ability to design and implement information-based teaching based on the characteristics of secondary vocational education [11]. The "Implementation Plan for Deepening the Reform of the 'Dual-Teacher' Team Construction in New Era Vocational Education" clearly states that a key focus should be on building an interdependent community of industry and education, promoting in-depth integration of the industrial chain and the education chain in terms of teacher training, and achieving the sharing of the achievements of "Dual-Teacher" teacher training [12]. Therefore, strengthening the practical ability of "digital + teaching" has become the key to improving the overall digital literacy of vocational college teachers.

Specifically, vocational schools can collaborate with industry and enterprises to integrate the latest technical specifications, process flows, case libraries, and other data into the AI system, jointly building a dynamic and updated enterprise knowledge graph. Teachers can use generative AI to quickly query industry front-line information, generate teaching cases and projects that meet the real needs of enterprises, and conveniently obtain the latest developments and data in the industry on the platform, effectively compensating for the lag in teachers' update of practical experience in enterprises, and narrowing the "skill gap" between the classroom and the workshop. Relying on the school-enterprise collaboration platform, generative AI can act as an intermediary hub, converting real enterprise projects into teachable project tasks; teachers then combine these project tasks to transform them into knowledge to be taught to students. This linkage form not only breaks the time and space barriers of school-enterprise cooperation, allowing teachers to interact with enterprise wisdom at a low cost and with high frequency, but also conveys the latest industry dynamics to students, filling their knowledge gaps in the industry. In addition, the generative AI system can analyze the content of teachers' classroom teaching, generate diagnostic

reports on teaching ability, provide suggestions for improvement and customized training resource recommendations, truly promoting teachers' growth from experience-based to data-driven reflective growth, and accurately enhancing their teaching design and classroom implementation abilities.

3.3. Establishing Ethical Norms: Clarifying The Primary Responsibilities of Teachers and the Boundaries of AI Application

Generative AI empowers the development of vocational education teachers, and it is necessary to always adhere to the basic principles of people-oriented, technology empowerment, and institutional protection. This process is not simply about prohibiting or avoiding AI; instead, it involves building a multi-dimensional guarantee system to enable teachers to confidently, responsibly, and efficiently utilize generative AI tools, laying the foundation for lifelong learning and career development.

First, strengthen the foundation of data security and improve the management mechanism. At the technical level, increase investment in data security and comprehensively enhance the school's data protection capabilities. Encourage vocational colleges with the necessary conditions to prioritize the purchase or deployment of locally operated AI large models to process data on campus servers, fundamentally reducing the risk of data leakage in the public cloud environment. At the same time, actively cooperate with professional data security enterprises to jointly carry out data security technology research and application projects, and explore data security solutions that are suitable for vocational education characteristics [13]. At the management level, schools should formulate and improve data security management systems, clearly define the entire process of data collection, storage, and use, establish a data classification and grading mechanism, and link different levels of data with corresponding AI usage permissions and approval processes. Regularly check the implementation of the system, conduct system log audits, formulate and practice data leakage emergency plans to ensure that security control measures are effectively implemented.

Second, establish the teacher's primary responsibility and strengthen content review. Always emphasize that teachers have the leading role and ultimate responsibility in AI application. In training, clearly state that AI is only an auxiliary tool, and all the content generated by AI must be reviewed, verified, and corrected by the teacher before being used in teaching. To support teachers' prudent judgment, an AI-generated content review checklist can be formulated, covering dimensions such as professionalism, accuracy, teaching adaptability, fairness, and diversity, and systematically evaluating the quality of the content.

Third, strengthen ethical boundary awareness and integrate it into the teacher development system. The rapid development of generative AI has profoundly changed the relationship between technology and ethics, and addressing the ethical risks in its educational application has become a cutting-edge issue [14]. First, teachers should play a leading role in key teaching stages such as value judgment, ethical analysis, and professional ethics cultivation, and use AI cautiously or avoid using it to replace human guidance. For example, in discussions on topics such as "engineering safety responsibility ethics", the core should be the case studies and debates organized by teachers, rather than relying on AI to generate standard answers. Secondly, AI ethics should be incorporated into the core training of teachers' professional development, not only focusing on "how to use", but also emphasizing "how to use responsibly", further clarifying the ethical red lines and behavioral guidelines for the educational application of generative AI. Only by placing technological application within the framework of ethical rules can it truly conform to the fundamental purpose of education.

4. New Directions for the Development of Future Professional Teachers

4.1. Become an AI-enabled Instructional Designer

Entering the era of AI, the role of vocational education teachers is no longer limited to being traditional knowledge transmitters. Vocational school teachers need to break away from the traditional notion that digital technology is merely an auxiliary tool, and establish a modern concept of using digital technology to innovate teaching methods and reshape the educational form. They should continuously enhance their abilities in designing, implementing, evaluating digital teaching, and collaborative education, promote the deep integration of digital technology and education, establish values that are in line with digital transformation requirements, and strengthen the awareness of enhancing digital literacy [15]. Relying on intelligent technology, educational managers and researchers in the vocational education field can deeply mine and systematically analyze the process and outcome data of teachers' digital literacy development, and use data as the core support to make the evaluation of teachers' classroom performance more objective and persuasive. Under this transformation, the focus of teaching evaluation is no longer limited to the single attention on teachers' "performative" classroom skills in the past, but truly shifts to the solid construction of students' knowledge systems and the effective acquisition of practical skills, promoting the transformation of teaching evaluation towards a data-driven, intelligent, and personalized and precise direction.

4.2. Become the Guardian of Emotional Value

As generative AI gradually takes on more knowledge-based and procedural tasks, the humanistic value of teachers will become increasingly prominent, and their role focus will gradually shift towards the core value areas that cannot be replaced by technology. The future curriculum design will break the boundaries between disciplines and life, and place greater emphasis on guiding students to establish deep connections with nature and social life. At the same time, we must clearly recognize that although generative AI technology provides convenience for students to achieve "learning anytime, anywhere", students, as individuals with both natural and social attributes, their growth is not merely a single improvement in cognitive abilities, but a comprehensive development of cognitive, emotional and behavioral coordination and unity [16].

In traditional education models, teachers' teaching is often oriented towards definite training goals, focusing on identifying students' weaknesses and conducting targeted teaching, even like a knowledge output machine, continuously infusing students with relatively fixed knowledge content, while students can only passively receive [17]. However, education is not merely about the transmission

of knowledge; rather, it promotes the all-round development of individuals and cultivates individuals with social responsibility. In the era of artificial intelligence, vocational education teachers need to actively enhance their teaching leadership, by guiding and stimulating the learning enthusiasm of different types of vocational education students, helping them achieve active learning and love for learning in the complex technical and information environment, and ultimately achieving the goals of improving learning ability and comprehensive growth.

4.3. Become a Role Model for Lifelong Learning

The research found that 62.7% of vocational school teachers spent more than 4 hours daily using digital devices, and almost all teachers were able to actively engage in digital learning and training based on their personal development needs. This indicates that vocational education teachers have generally recognized the importance of digital technology for their own professional growth [18]. In the current era of continuous and rapid knowledge iteration, the knowledge and skills possessed by vocational education teachers are facing unprecedented pressure for renewal. Traditional school education's static content is no longer able to adapt to the ever-changing industry changes. Only through lifelong learning can vocational educators maintain the cutting-edge nature of teaching and avoid disconnection from the actual industry.

With the wide sharing and integration of Internet educational resources, platforms such as MOOCs and open courses provide vocational education teachers with convenient and efficient channels for further education. Digital technology also provides solid technical support for personalized learning and lifelong learning, enabling them to continuously absorb new knowledge and master new skills [19]. Through generative AI, teachers can obtain the latest industry trends, advanced techniques, and enterprise practice cases in real time, promptly integrate frontline technologies into the teaching process[20], and help students break through textbook limitations, encounter real industrial problems, and expand solution thinking, promoting the continuous update of their knowledge systems and maintaining professional vitality.

In the learning network involving generative AI, vocational school teachers should clearly define their role positioning. Generative AI is not only an educational assistant but also a deeply involved learning partner; human educators must possess both "teacher" and "scholar" identities. In other words, teachers must first become lifelong learners in order to better fulfill the responsibility of guiding students' lifelong learning[21]. Therefore, teachers should not only be the cultivators of students' lifelong learning abilities but also the pioneers of lifelong learning, guiding learners to achieve free and comprehensive development through lifelong learning by their own practice.

Acknowledgments

Project Fund: Sichuan University of Science and Engineering Graduate Innovation Fund Project (Y2025117) in 2025.

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