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Exploring the Precision Teaching Model in Nursing Vocational Education under the Context of Digital Transformation

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Abstract: As the world advances into the digital age, the rapid development and deep integration of digital technologies are driving profound transformations across industries and education. The digital transformation of nursing vocational education has become an inevitable path for its future development. Emerging technologies such as big data, artificial intelligence (AI), and virtual reality (VR) are infusing nursing education with fresh dynamics and methodologies. With the support of big data, educators can collect and analyze vast amounts of educational data, gaining deeper insights into students' needs and learning progress. This enables the implementation of personalized teaching plans and the dynamic adjustment of instructional content and methods in line with students' actual conditions. Online education platforms facilitate active interaction and communication between teachers and students, further enhancing learning outcomes. Students, on the other hand, can study according to their individual learning needs, pace, and schedules, thus improving learning efficiency and results. Furthermore, pre-class and post-class practical exercises are supported through diverse digital resources, offering more flexible and comprehensive learning support to guide educational activities. The precision teaching model not only aligns with the demands of the era but also signifies a profound reform in educational approaches, impacting educational content, teaching methods, and assessment systems. This model places students at the core of teaching, emphasizing the development of personalized and practical skills, making nursing education more tailored and intelligent. Digital transformation not only enhances learning efficiency and outcomes but also paves the way for the future development of nursing vocational education.

Keywords: Digital transformation; Nursing; Vocational education; Precision teaching; Teaching model; Digital technology

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1. Introduction

With the rapid development of global information technology, the digital transformation of nursing vocational education has not only become an inevitable trend aligned with global educational reforms but also a pressing requirement for constructing a modern educational system in China. The China Education Modernization 2035 initiative emphasizes the need to leverage modern technology to accelerate reforms in talent development models, achieving an organic integration of large-scale education and personalized learning. It also calls for the accelerated development of modern vocational education and the deep integration of vocational education with industrial development [1]. The 2023 work agenda of the Department of Higher Education at the Ministry of Education highlights the urgency of advancing the digital transformation of higher education and fostering new forms of higher education teaching [2]. Furthermore, the 2022 work agenda of the Ministry of Education stresses the implementation of the Digital Education Strategy Action, advocating for the development of "Internet + Education" and accelerating the digital transformation and intelligent upgrading of education, as well as the deep integration and innovative fusion of information technology and education [3]. At the 2024 World Digital Education Conference, Huai specifically pointed out that promoting innovation in vocational education through digital transformation is not only the responsibility of vocational colleges in the new era but also an essential path for vocational education to actively respond to national strategic demands and contribute to the digital transformation of the economy and society [4]. The concept of "precision teaching" was first introduced by Lindsley in the 1960s, based on Skinner's behaviorist theory. Lindsley (1992) proposed that precision teaching relies on a series of relevant measurement processes to assess student performance, using data to guide educational decisions [5]. Traditional nursing education faces challenges such as limited teaching resources, single teaching methods, and difficulty in meeting the individualized needs of students. In the context of digital transformation, the core of the precision teaching model lies in the application of advanced technologies such as online learning platforms, virtual simulation technology, big data analytics, and AI to monitor and provide real-time feedback on students' learning behaviors and outcomes. This enables educators to adjust teaching strategies promptly, providing students with personalized learning resources and support, with the ultimate goal of enhancing teaching effectiveness, promoting students' comprehensive development, and improving their professional competencies.

2. Foundation of research on the digital transformation of precision teaching in vocational education

2.1. Domestic and international research trends

The precision teaching model is an educational approach based on individual learning characteristics and instructional needs, aimed at reducing the limitations of traditional subject-based teaching systems on the development of students' vocational skills and overall competencies. The theoretical foundation of precision teaching, along with its early practical applications, was initially designed to assess the learning performance and outcomes of special education students in the United States. Over time, its application expanded to include broader student populations for evaluating teaching effectiveness. At present, the precision teaching model in China is still in its nascent stage, with related research primarily focused on teaching decision-making and instructional design, and much of it concentrated in the field of primary and secondary education. In comparison, research on precision teaching within vocational education, especially in nursing vocational education, remains relatively scarce. Internationally, policies related to the digital transformation of vocational education aim to

accelerate this transformation, emphasizing the importance of digital literacy and advancing national and regional digital frameworks and strategies. These policies promote the digital transformation of educational systems, including vocational education. In China, research on the digital transformation of vocational education primarily focuses on the definition of its core concepts, comparative studies, and exploring practical implementation pathways [6]. According to scholars like Sun *et al.* (2023), educational digitalization is a process of continuous involvement and evolution of various instructional elements, including teachers, students, and teaching resources. Digitalization and informatization are not isolated concepts but are closely interconnected. While informatization aids in decision-making through the provision of information, digitalization guides concrete actions [7]. The integration of information technology into teaching allows educators to access a wide range of instructional data anytime and anywhere, enabling them to analyze data and make quick decisions. The rapid advancement of new technologies has facilitated the large-scale application of precision teaching [8].

2.2. Digital empowerment in precision teaching for nursing vocational education

The digital transformation of education refers to the comprehensive application of modern information technologies—such as the internet, big data, AI, cloud computing, and virtual reality (VR)—across the education sector. These technologies enable interactions between teaching and learning through digital platforms, integrating theoretical knowledge with practical skills in a way that enhances the efficiency and effectiveness of teaching, learning, and management. This shift leads to deeper reforms in educational methods, management practices, and service delivery. Research shows that the application of VR technology in nursing education offers several advantages, including enhancing students' sense of immersion in subject-specific learning, changing perspectives to expand professional nursing actions, supporting interdisciplinary writing, handling emergencies, and reducing decision-making pressure through observation and action [9]. Moreover, VR ensures high-quality teaching while lowering educational costs [10].

Additionally, Feng *et al.* (2023) conducted a cross-sectional study with 549 elderly care nursing students, exploring the impact of digital technology on career intentions in nursing education. The study confirmed that the use of digital technologies can positively influence career aspirations, supporting students in transitioning from school to clinical practice [11]. With the development of digital technology, China's nursing vocational education has made significant progress. Over 70% of nursing vocational colleges have smart classrooms or lecture capture classrooms, and more than 50% are equipped with digital human simulators and virtual simulation training rooms. While the current digital hardware infrastructure is well-established, further research should focus on building clinical case libraries, case-based ideological and political education libraries, and digital textbooks [12].

Digital empowerment in nursing vocational education provides nursing students with an immersive, interactive learning experience. AI and machine learning tailor training modules to individual students based on real-time clinical situations they may face in daily practice, providing timely feedback and saving both time and resources [13]. Immersive clinical scenarios offer more practice opportunities for students, without direct patient contact, thus addressing the limitations of teaching resources [14]. Furthermore, online platforms create a shared learning environment for teachers and students, enabling instructors to monitor student progress, track pre-reading activities, chapter quizzes, personal homework completion, and participation in synchronous online discussions. This allows for continuous adjustment of learning plans, enhancing learning efficiency. Through high-quality, effective interaction, digital platforms address challenges seen in traditional courses, such as students' reluctance to engage in class discussions due to communication anxiety, slow feedback, and low student satisfaction with instructors [15]. The application of digital technology fosters enthusiasm for learning, enhances

nursing students' sense of participation and mission, and stimulates their interest in self-directed learning [16].

2.3. Comparative study of traditional and digitally empowered precision teaching models in vocational education

Nursing vocational education is a vital component of higher education in China and plays a crucial role in cultivating talent for the nursing profession. Traditionally, higher vocational nursing education emphasizes students' mechanical mastery of textbook knowledge and proficiency in basic nursing skills. However, the assessment and evaluation methods lack systematic approaches, leading to a disconnect between students' learning experiences and the ideal outcomes post-graduation, which is closely related to the gap between theory and practice [17]. Currently, nursing education in China is undergoing a significant transition from traditional teaching models to digitally empowered precision teaching models [18,19].

Upon reviewing and analyzing relevant literature, the findings are summarized in **Table 1**. As indicated in **Table 1**, the traditional teaching model involves instructors strictly adhering to curriculum standards and teaching outlines, delivering planned instruction through methods such as PowerPoint presentations, often in a "cramming" style. In contrast, the digitally empowered precision teaching model integrates information technologies like big data, artificial intelligence, and virtual reality, allowing teachers to develop personalized teaching plans based on individual student differences and learning progress. Regarding teaching resources, the traditional model is constrained by time and space, relying heavily on printed materials and teaching aids, which results in slow resource updates and low utilization rates that fail to reflect the latest professional knowledge and practices. The digitally empowered precision teaching model enables access to teaching materials and videos through online platforms anytime and anywhere, facilitating online interaction between teachers and students. Additionally, virtual reality technology offers immersive simulations for practical training, significantly enhancing the utilization of teaching resources. In terms of assessment effectiveness, the traditional model depends on single-exam results, which do not accurately reflect students' overall abilities and practical skills. This model also suffers from long feedback cycles, delaying necessary adjustments in teaching strategies. Conversely, the digitally empowered precision teaching model employs intelligent assessment systems based on big data analysis, providing real-time feedback and monitoring of students' learning outcomes. This approach assists teachers in timely adjusting content and methods, as well as evaluating students from multiple dimensions, such as online tests, practical evaluations, and learning process data analysis, thereby comprehensively reflecting student learning results. Concerning classroom dynamics, the traditional model is teacher-centered, positioning the instructor as the primary knowledge disseminator, with limited opportunities for student interaction and engagement. In contrast, the digitally empowered precision teaching model adopts a student-centered approach, transforming teachers from knowledge providers to guides and facilitators of learning. By leveraging digital tools and platforms, this model supports self-directed learning, addresses individual differences among students, and enhances interaction and participation.

Digital transformation effectively addresses numerous issues inherent in traditional models, improving teaching effectiveness and students' learning experiences. This shift aligns with modern nursing education's demand for cultivating high-quality nursing professionals and contributes to enhancing the overall level of nursing vocational education.

Table 1. Comparison between traditional teaching model and digitally empowered precision teaching model

Items		Traditional teaching mode	Digital enabling precision teaching model
Teaching method		According to the curriculum standards and syllabus "cramming" concentrated explanation	Use information technology to develop personalized teaching plans
Teaching resources	Space-time	Offline, fixed, classroom teaching	Online, unrestricted, using teaching platforms, virtual reality technology and other ways of teaching
	Tool	Paper teaching materials, PowerPoint teaching and resource updating lag behind	Online platform, virtual reality technology and other teaching materials and videos, real-time updates
Effect evaluation	Evaluation method	Single: Test scores	Multidimensional: online testing, practical operation evaluation, learning process analysis, etc.
	Teaching strategy adjustment	The feedback period is long and hysteresis	Real-time feedback monitoring
Classroom subject		Teachers	Students
Teacher-student relationship	Teacher role change	Knowledge giver	Learning mentors and facilitators
	Student role change	Passive learning, low sense of participation, enthusiasm and initiative	Independent learning, the sense of participation, interaction, enthusiasm, initiative to enhance

3. Practice pathways for digitally empowered precision teaching in nursing vocational education

3.1. Employment-oriented construction of efficient nursing vocational education curricula

In today's competitive employment landscape, vocational education must align with the new trends of social development and adopt an employment-oriented approach. Beyond imparting traditional nursing knowledge and skills, it is essential to meet the demands of the job market by developing digital curricula that enhance overall employability. By leveraging technologies such as big data and artificial intelligence, a "school-enterprise co-construction and sharing platform" can be established to gain a deeper understanding of market needs and professional requirements. Through close communication and collaboration between educational institutions and relevant industries such as hospitals and healthcare organizations, schools can gain insights into the specific professional demands placed on nursing personnel by employers. Based on the hiring needs published on the platform, educational institutions can formulate talent training programs that align with the competency requirements of available positions. This approach enables educators to seamlessly connect clinical nursing practices with curricular content, keeping pace with developments in clinical practice.

Utilizing diverse teaching tools such as artificial intelligence, virtual reality technology, and online platforms, students can engage in nursing practice simulations within virtual environments, allowing them to familiarize themselves with operational settings and procedures, thus enhancing their clinical practice skills. Furthermore, by analyzing platform data through big data techniques to extract valuable insights, a "job capability" mapping for professional positions can be constructed. This map serves as the foundation for developing a curriculum framework that clearly defines the employability goals and training methods for each course [20]. The platform provides real-time feedback on students' learning progress, enabling teachers to offer personalized guidance based on learning data. This approach optimizes teaching strategies and methods, enhances

educational effectiveness, and motivates students' holistic development, ultimately supporting the enhancement of their employability skills.

3.2. Student-centered approach: Establishing personalized and digitally empowered precision teaching objectives

With the evolution of educational philosophies and digital technologies, the "student-centered" teaching model is increasingly replacing the traditional teacher-led approach, becoming a societal consensus. By applying big data techniques to analyze students' learning states, trends, and potential, educators can transform the often vague internalized learning behaviors of students into clear, measurable precision teaching objectives [21]. The teaching objectives can be converted from textual descriptions into quantifiable data formats, allowing for detailed specifications and the establishment of measurable indicators. Relevant data from students' assignments, quizzes, and examinations can be collected, cleaned, and standardized. Ultimately, through data analysis, teachers can achieve more precise monitoring and evaluation of the teaching process and student performance [22]. By digitizing both teacher and student behaviors, educators can refine relevant data reports through the platform. This analysis incorporates information about students' overall learning processes and preferences, enabling targeted assessments of learning conditions. Personalized learning tasks can then be matched to each student, and teaching methods can be designed to accommodate individual differences [23]. Personalized teaching objectives are established for each student, with the flexibility to adjust these goals dynamically based on their learning progress. This personalized, digital precision teaching model supports teachers in delivering data-driven instruction based on knowledge graphs, enabling timely insights into students' learning conditions and needs. It facilitates the provision of tailored support and guidance, thereby enhancing classroom teaching quality, improving students' overall competencies, and ultimately achieving personalized, intelligent, precise, and efficient education.

3.3. Innovative nursing teaching methods: Personalized, digital, and precision teaching

Teaching methods are a fundamental component of basic nursing education. Currently, the main teaching methods in higher vocational nursing education include lecturing, problem-based learning, case-based teaching, collaborative learning, situational simulation, guided interaction-based teaching, jigsaw teaching, integrated theoretical and practical teaching, and flipped classrooms based on micro-lectures [24]. While nursing educators master existing teaching methods, there is a growing need to explore and innovate new approaches to meet societal and technological advancements. Students begin their coursework on the platform, and teachers then tailor their instruction based on the questions raised during self-study and insights from platform data analysis that reflect students' learning characteristics and needs. This targeted teaching allows educators to accurately identify the difficulties and weaknesses students encounter, thus focusing on the essential and challenging aspects of the curriculum. The application of technology provides robust support for personalized teaching. The platform generates individualized learning plans and recommendations based on students' progress and performance. Teachers, utilizing their comprehensive assessments alongside platform suggestions, can offer holistic personalized guidance to students, enhancing learning efficiency, fostering students' self-directed learning capabilities, and developing their core competencies. The triadic approach of students, platforms, and teachers fosters a more integrated application in nursing vocational education, breaking away from the traditional perception of knowledge dissemination as the primary teaching function. Through personalized and digitally empowered precision teaching objectives, this model cultivates the development of students' competencies and

enhances their professional competitiveness.

3.4. Enhancing teachers' digital teaching competence and literacy to promote modern education

In clinical practice, nursing professionals need to possess certain digital competencies to effectively integrate and apply new technologies in response to the evolving demands of the era. Nursing educators play a critical role in this process. They must first have adequate digital skills to teach and train students effectively. In 2022, the Ministry of Education issued standards for "Teachers' Digital Literacy," aimed at enhancing teachers' awareness, capabilities, and responsibilities for optimizing, innovating, and transforming educational activities through digital technologies [25]. A cross-sectional study indicated that nursing educators recognize their digital technology competencies and exhibit a positive attitude toward incorporating digital technologies into their teaching activities, with an overwhelming 98% expressing a need for further training in digital skills [26]. In teaching practice, the initial step is to assess teachers' digital teaching competencies using a questionnaire based on current digital teaching needs. Following this evaluation, targeted training programs can be organized to help educators familiarize themselves with and apply digital technologies to improve their teaching. This includes participation in specialized training courses and collaborative digital teaching research. Additionally, leveraging the advantages of big data for comprehensive and continuous monitoring of teaching data can enhance the evaluation of teachers' digital literacy in a dynamic and precise manner. Big data can be utilized to collect and track various metrics throughout the teaching process in real-time, such as classroom performance, student grades, and interaction frequency. This multidimensional analysis provides a comprehensive evaluation of teachers' digital competencies [27]. Based on personalized reports, teachers can identify their strengths and weaknesses, allowing them to formulate targeted improvement plans to enhance their digital literacy and teaching proficiency. This approach offers robust support for the digital transformation of modern education. The specific platform construction is shown in **Figure 1**.

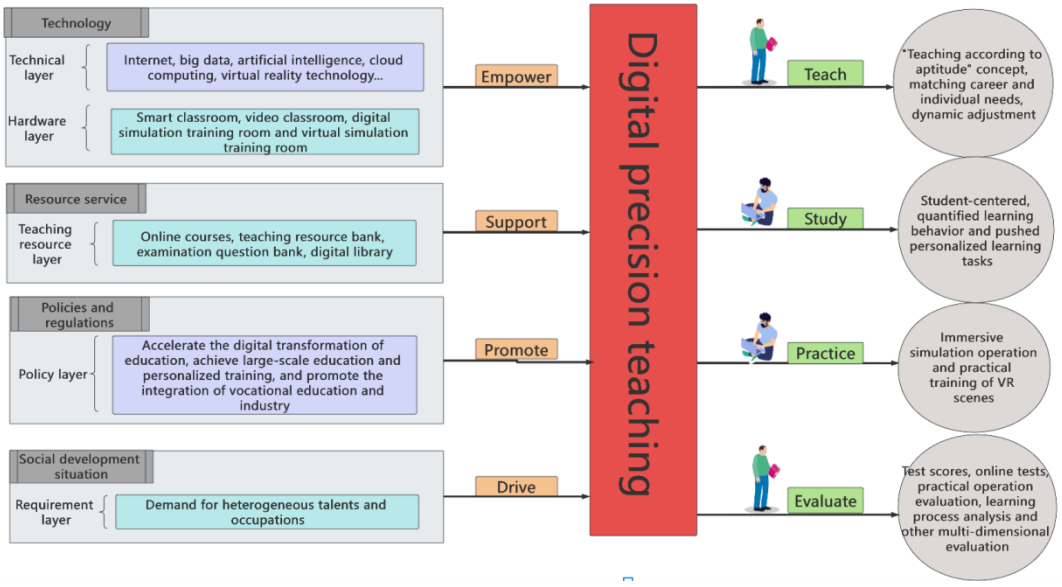

Figure 1. Digital teaching platform construction diagram

4. Conclusion

The digital transformation of nursing vocational education aligns with the significant trends of the information age. The digitally empowered precision teaching model demonstrates clear advantages in teaching methods, evaluation of educational effectiveness, meeting students' personalized learning needs, and fostering individual growth, significantly enhancing both teaching outcomes and the learning experience. Currently, precision teaching in vocational education in China is still in the exploratory research phase, facing both opportunities and challenges as digital technologies are integrated into nursing education. While universities have relatively advanced digital hardware infrastructure, there is a pressing need to enhance the development of digital resources such as textbooks and clinical case libraries. Beyond improving the quality and efficiency of nursing education, digital empowerment also enhances students' practical skills and career readiness. Moving forward, it is essential to conduct comprehensive, multidimensional assessments of the actual effects of digital transformation, providing a more holistic reference for the digital reform of nursing vocational education. This will elevate the modernization of nursing education and contribute to cultivating more nursing professionals with high levels of vocational competence and skills.

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