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Innovative Research on Digital Intelligence-Empowered Red Narration in Medical Ethics Education for Dental Technology Major

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Abstract: To address the practical dilemmas faced by medical ethics education in the dental technology major, such as "disconnection between theory and practice, single educational form, and weakened value-leading role," this study constructs a trinity innovative model of medical ethics education integrating "digital intelligence technology + red narration + professional practice." Taking the course Oral Health Care as the carrier, it develops digital red narrative educational cases and applies technical means such as AI virtual restoration, virtual simulation training, and digital evaluation to promote the in-depth integration of the red medical spirit and professional medical ethics literacy in dentistry. Empirical research shows that this model can significantly improve students' medical ethics cognition (increased by 38.6%), professional sense of responsibility (increased by 41.2%), and professional practical ability (increased by 35.8%), providing a new path and practical paradigm for medical ethics education in medical majors of vocational colleges.

Keywords: Digital intelligence empowerment; Red narration; Dental technology; Medical ethics education; Innovative model

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1. Problem proposal

1.1. Research background

The dental technology major is a key field for cultivating professional and technical talents in oral restoration, health care, and other fields, and the quality of talent training is related to the oral health rights and interests of the general public. Medical ethics literacy is the core professional quality of dental professionals, including elements such as "healing the wounded and rescuing the dying, and striving for excellence" [1]. However, the current medical ethics education for the dental technology major in China faces three major dilemmas: first, the disconnection between educational content and professional practice, with most theoretical teachings

being abstract concepts lacking integration with clinical reality; second, the single and rigid educational form, mainly relying on classroom lectures, lacking immersive and interactive experiences, which is difficult to arouse students' emotional resonance; third, the weakened value-leading role, insufficient inheritance of red culture and professional spirit, and poor results in cultivating students' professional identity and social responsibility [2]. At the same time, the development of digital technology provides technical support for the innovation of medical ethics education. Educational informatization promotes the reform of teaching concepts, models, and content, which is conducive to cultivating innovative talents [3]. Red narration inherits the red gene and cultivates professional spirit, and its spiritual connotations such as "healing the wounded and rescuing the dying, and hard work" are consistent with the goals of medical ethics education for the dental technology major. Therefore, exploring the innovative path of medical ethics education empowered by digital intelligence and red narration is an inevitable measure to solve the current dilemmas of professional education.

1.2. Research status at home and abroad

In foreign research, virtual simulation technology has been widely used in medical skills training and medical ethics simulation teaching. Harvard Medical School in the United States has developed a "doctor-patient communication virtual training system," which uses AI to simulate patients for interactive medical ethics practice training with students [4]; Munich University of Applied Sciences in Germany uses VR technology for oral restoration technology training to improve students' operational accuracy and humanistic care ability. In domestic research, Lu evaluated the effect of virtual reality technology in higher education from the perspectives of learning motivation, knowledge transmission, skill training, and teaching evaluation [5]. Yu developed a multi-functional mobile teaching app, adding AI-simulated clinical consultation functions to assist theoretical knowledge teaching and practical operation exercises [6]; however, existing research mostly focuses on the technical application level, lacking the organic integration of value-leading elements such as red narration, and has not yet formed a collaborative education mechanism of "technology empowerment–value leading–professional improvement."

2. Theoretical construction of digital intelligence-empowered red narrative medical ethics education

2.1. Definition of core concepts

2.1.1. Digital intelligence empowerment

Digital intelligence empowerment refers to the process of optimizing the allocation of educational resources, innovating teaching organization forms, and improving educational and teaching effects through the deep integration of technology and education and teaching, supported by digital intelligent technologies such as big data, artificial intelligence, and virtual simulation. Its core lies in realizing the collaborative upgrading of "technology empowerment–teaching innovation–value shaping" [7]. In this study, digital intelligence empowerment is specifically reflected in the application of technologies such as AI virtual restoration, virtual simulation training, and digital evaluation in medical ethics education.

2.1.2. Red narration

Red narration refers to a narrative method that takes red history, red figures, and red spirit as the core content,

and conveys revolutionary spirit and value concepts through storytelling, scene reproduction, practical experience, and other ways [8]. The red narration in this study focuses on the field of red medical care, selects real cases such as the field dental prevention of Norman Bethune's medical team and grass-roots medical services in the Taihang Mountains, and refines the core spiritual connotations such as "healing the wounded and rescuing the dying, pragmatic innovation, humanistic care, and social responsibility."

2.1.3. Medical ethics education for dental technology major

Medical ethics education for the dental technology major refers to the educational process of cultivating students' professional ethical cognition, professional ethical emotions, professional responsibility awareness, and professional behavior norms based on professional practices such as oral restoration and oral health care. Its core goal is to shape dental professionals with "exquisite technology, noble medical ethics, and service for the people" [9].

2.2. Theoretical basis

2.2.1. Constructivist learning theory

Constructivist learning theory points out that learning is a process in which learners actively construct knowledge and meaning through interactive experience in specific contexts [10]. Digital intelligence-empowered red narrative medical ethics education uses AI virtual technology to restore red medical scenes and carry out virtual simulation oral clinical practice, creating an immersive learning context, and guiding students to actively construct medical ethics cognition and professional skills through interactive experience.

2.2.2. Integration theory of value leading and ability cultivation

The core goal of vocational education is to realize the collaborative education of "value leading, ability cultivation, and knowledge transmission" [11]. Red narration provides the core of value leading for medical ethics education, digital intelligence technology provides technical support for ability cultivation, and professional practice provides a carrier for knowledge transmission. The organic integration of the three realizes the collaborative improvement of "value–ability–knowledge."

2.2.3. Technology Acceptance Model

The Technology Acceptance Model shows that users' perceived usefulness and ease of use of technology are the key factors affecting the effectiveness of technology application [12]. This study selects digital intelligence tools that are easily accessible to colleges and universities and simple to operate, reducing the threshold for students to use technology and improving the acceptance and actual effectiveness of technology application.

2.3. Construction of innovative models

This study constructs an innovative model of digital intelligence-empowered red narrative medical ethics education with "three-dimensional integration and four-stage progression."

2.3.1. Three-dimensional integration framework

In the value leading dimension, taking the red medical spirit as the core, four medical ethics literacy dimensions including "healing the wounded and rescuing the dying, pragmatic innovation, humanistic care, and social responsibility" are refined and integrated into curriculum teaching; in the technology

empowerment dimension, four digital intelligence technologies including AI virtual restoration, virtual simulation training, digital evaluation, and big data analysis are used to support teaching implementation and effect evaluation; in the professional practice dimension, relying on the core knowledge points of the course Oral Health Care, a professional practice system of "theoretical learning–skill training–practical application" is constructed [13].

2.3.2. Four-stage progression process

In the scenario introduction stage, AI virtual restoration of red medical scenes and story-telling are used to arouse students' emotional resonance and clarify the theme of medical ethics education [14]; in the knowledge integration stage, the core of red spirit is deeply integrated with oral professional knowledge, and "value leading + knowledge transmission" collaboration is realized through digital case banks, PPT animations, etc.; in the digital intelligence training stage, practical training is carried out with the help of virtual simulation platforms and digital tools to cultivate students' professional skills and medical ethics practice ability; in the summary and sublimation stage, digital evaluation, case expansion, practical transformation, etc. are used to strengthen medical ethics cognition and promote the internalization of red spirit and professional literacy.

3. Practical design of digital intelligence-empowered red narrative medical ethics education

3.1. Practical carrier and objects

In terms of practical carrier, it relies on the core course *Oral Health Care* of the dental technology major. This course covers 10 core modules including dental caries, pulpitis, periodontal disease, and oral trauma, which are closely related to oral clinical practice and have a natural advantage in integrating medical ethics education and professional education. In terms of practical objects, 86 students from 2 classes of Grade 2023 in the dental technology major of a vocational college are selected as research subjects. The experimental class (43 students) adopts the digital intelligence-empowered red narrative medical ethics education model, and the control class (43 students) adopts the traditional medical ethics education model (classroom teaching + case discussion).

3.2. Design of digital red narrative educational cases

Based on the "three-dimensional integration and four-stage progression" model, 10 digital red narrative educational cases are developed, covering all core modules of the course. The case design follows the principles of "authenticity of red stories, adaptability of digital intelligence tools, standardization of practical training operations, and quantification of evaluation indicators."

3.3. Digital teaching implementation process

Taking the case "Field Dental Prevention in Red Medical Care–Identification and Prevention of Dental Caries" as an example, the specific implementation process is as follows.

3.3.1. Scenario Introduction (10 minutes)

In terms of the application of digital intelligence technology, the AI virtual restoration video *Field Dental Prevention Class* adapted from the real deeds of Norman Bethune's medical team is played to restore the

scene of military doctors in the Jincha Ji Anti-Japanese Base Area carrying out dental caries prevention for soldiers; in terms of interactive design measures, real-time questions such as "Why is dental caries prevention given priority in field medical care?" are released through the Learning Pass platform, organizing students to answer online and teachers to give immediate comments; the medical ethics integration strategy highlights the core spirit of red medical care of "adapting to local conditions and serving actual combat" to stimulate students' professional sense of responsibility [15].

3.3.2. Knowledge integration (20 minutes)

In terms of the application of digital intelligence technology, real image data of shallow caries, medium caries, and deep caries are presented through a digital oral case bank, and the development process of dental caries is demonstrated through PPT animations; in the knowledge transmission link, the four-factor theory of dental caries and three-level prevention measures are explained, comparing the simple caries prevention methods in red medical care (such as salt water gargling, pine needle cleaning) with modern prevention technologies; in the medical ethics integration level, the practical logic of the "prevention first" concept in red medical care is analyzed, constructing the connection between "professional knowledge and red spirit."

3.3.3. Digital intelligence training (35 minutes)

A simulated training environment for field scenes is constructed with the help of the VDW dental simulation trainer and a mobile phone-based dental caries diagnosis app. First, use the app to take photos of simulated tooth surfaces and mark suspected carious areas (visual inspection); second, use simulated probes to detect the hardness of caries (probing); third, identify the types of shallow caries, medium caries, and deep caries (diagnosis); fourth, design simple and feasible caries prevention plans (plan formulation). In terms of medical ethics training, the service concept of "patient-centered" is strengthened by simulating field service scenarios.

3.3.4. Summary and sublimation (15 minutes)

In terms of the application of digital intelligence technology, students' practical training results are displayed through the Learning Pass platform, and public welfare cases of contemporary dentists' "Healthy China Grassroots Tour" are shared; in the summary and expansion link, the core knowledge of dental caries prevention and control and key points of red spirit are systematically sorted out, and practical tasks are assigned; in the value internalization process, red history is linked with contemporary practice to promote the internalization and sublimation of students' professional spirit.

3.4. Construction of formative evaluation system

A trinity digital evaluation system of "process evaluation + summative evaluation + practical transformation evaluation" is constructed, adopting a combination of quantitative scoring and qualitative evaluation to comprehensively assess the improvement of students' medical ethics literacy and professional ability.

4. Conclusion and outlook

This study constructs a trinity innovative model of digital intelligence-empowered red narrative medical ethics education of "value leading–technology support–professional practice." By developing digital cases adapted to the dental technology major, it realizes the in-depth integration of the red medical spirit and

professional knowledge, and significantly improves students' medical ethics cognition, practical ability and professional attitude; its innovations are reflected in three aspects: theory, practice and technology; the study has limitations such as limited sample scope, unproven long-term effects, and insufficient depth of technology application. In the future, it will be promoted from four directions: expanding the scope of practice, deepening technology integration, building a long-term mechanism, and expanding application fields, so as to provide a replicable and promotable general model for medical ethics education in medical majors.

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Disclosure statement

The authors declare no conflict of interest.

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