

**DEVELOPMENT AND EVALUATION OF A VIRTUAL SIMULATION EDUCATION
PROJECT FOR SELF-MANAGEMENT SUPPORT FOR NURSING STUDENTS CARING
FOR PATIENTS WITH TYPE 2 DIABETES MELLITUS**

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ABSTRACT

Objective: To construct and evaluate a virtual simulation education program for nursing students to cultivate self-management support ability in type 2 diabetes mellitus (T2DM) patients, explore its application effect in chronic disease nursing education, and provide an evidence-based basis for optimizing the training mode of chronic disease nursing talents. **Methods:** This study adopted a design combining evidence-based integration with empirical research. First, systematic reviews were conducted to retrieve relevant domestic and international literature, integrating the best evidence on self-management support and virtual simulation teaching for T2DM, and clarifying the core competency structure and instructional design elements. Based on this, a virtual simulation teaching project was constructed using Pamela R. Jeffries' Jeffries Simulation Theory as the theoretical framework, including learning objective setting, scenario script design, instructional implementation process, and evaluation system. Subsequently, a quasi-experimental study design was employed to intervene with nursing students, comparing differences in self-management support ability, self-efficacy, and learning satisfaction before and after intervention as well as between groups. **Results:** The systematic review identified the core dimensions of self-management support competence, including health education competence, behavior change support competence, communication and empathy competence, and individualized management competence. Empirical study results showed that the total score and each dimension score of self-management support competence in the intervention group were significantly higher than those in the control group ($P < 0.05$), with particularly notable improvements in communication competence and behavior change support competence. Additionally, the intervention group demonstrated significantly higher learning satisfaction and self-efficacy. **Conclusion:** The virtual simulation education program, based on evidence-based evidence and educational theory, significantly enhances the self-management support capabilities of nursing students in T2DM, demonstrating excellent educational

outcomes and promotion value. This study provides theoretical foundations and practical pathways for innovating chronic disease nursing education models, which holds significant importance for improving primary-level chronic disease management capabilities.

Keywords: Type 2 diabetes mellitus, Self-management support, Virtual simulation teaching, Nursing education

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a metabolic disorder caused by genetic and environmental factors. Due to its high disability and mortality rates, it has become a global health issue. A 2021 report by the International Diabetes Federation (IDF) indicated that approximately 537 million adults aged 20-79 worldwide suffer from T2DM, with China accounting for 140.9 million cases, making it the country with the highest number of diagnosed cases (Magliano et al., 2021). There are significant differences in the prevalence, awareness, treatment, and control rates of T2DM among rural Han and Bai ethnic residents in Yunnan. The study results showed that the overall self-management level of T2DM patients among rural Han and Bai ethnic groups in Yunnan is relatively low, and there are notable ethnic disparities in the prevalence of T2DM and self-management behaviors (Zuo Chunmei et al., 2021). Among them, the prevalence of T2DM among Bai elderly individuals aged 60 and above is as high as 17.2%, but the blood glucose control rate is only 26.6% (Chen Xiaoyun et al., 2017). The overall self-management level of patients is not optimistic, and improving their self-management capabilities is urgently needed.

Due to the scarcity of community health resources, 80% of urban healthcare resources are concentrated in large hospitals, with only 20% available in communities. Consequently, self-management of chronic diseases has yet to achieve widespread recognition and dissemination. In clinical nursing practice, nurses often serve as the primary agents of health education. However, due to their heavy clinical workload and lack of scientific educational methods, nurses further contribute to insufficient self-management support for patients with common high-incidence chronic diseases such as hypertension and diabetes. Undergraduate nursing students, constrained by various limitations during their academic training, rarely have in-depth exposure to clinical patients, resulting in poor communication skills, lack of confidence, and deficiencies in practical and hands-on abilities. Virtual simulation-based education can enhance the realism and practicality of nursing students' learning in this context, broaden and deepen their knowledge, and lay a solid foundation for their clinical internships and future careers, thereby preparing them more adequately.

OBJECTIVE

To develop a scientifically practical self-management support education program for patients with type 2 diabetes mellitus (T2DM); to enhance the capabilities of undergraduate nursing students in chronic disease health management; to improve the health guidance skills, proficiency, and confidence

of nursing students in ethnic minority regions; and to strengthen the support provided by nursing professionals for the self-management of T2DM patients. During this process, nursing students should clearly recognize the significance of supporting the self-management of chronic disease patients; be able to effectively assess the medical history, cultural background, and self-management level of chronic disease patients; develop effective self-management plans for chronic disease patients in ethnic minority regions; and implement scientific and effective "self-management" education, self-monitoring, and complication prevention guidance for patients based on feasible plans.

This research project first conducts a literature review to understand the current status of self-support virtual education for nursing students with T2DM, explores relevant influencing factors, and identifies existing issues. Based on the Jeffries nursing simulation theory, it designs a practical training teaching model framework and implementation process. Drawing on existing experience, it develops a promotion plan tailored for self-support virtual education among nursing students with T2DM, aiming to enhance the scientific rigor of teaching effectiveness evaluation. This provides robust data support for subsequent curriculum improvement and promotion.

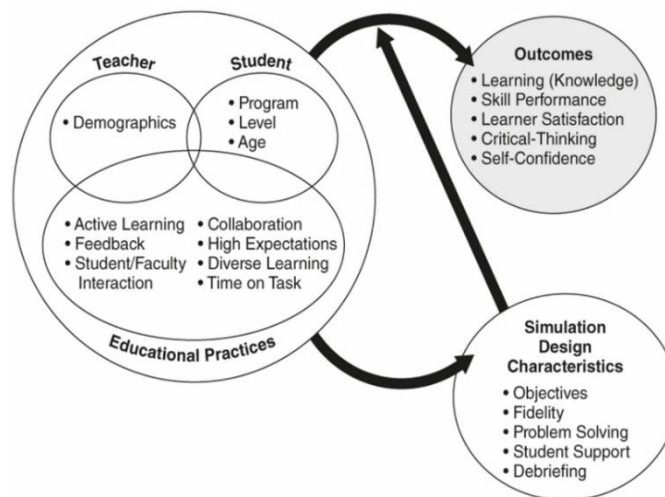


Figure 1: Research Conceptual Framework (The NLN Jeffries Simulation Theory, 2005)

LITERATURE REVIEW

Diabetes mellitus is a chronic disease that typically occurs when the pancreas fails to produce sufficient insulin or when the body cannot effectively utilize insulin. The World Health Organization (WHO) (1999) established the diagnostic criteria for diabetes as a fasting blood glucose level ≥ 7.0 mmol/L or a 2-hour post-glucose load blood glucose level ≥ 11.1 mmol/L (You Liming & Wu Ying, 2022). There are two primary forms of diabetes: insulin-dependent diabetes mellitus (type 1 diabetes, T1DM) and non-insulin-dependent diabetes mellitus (type 2 diabetes, T2DM). Type 2 diabetes is the most common form, accounting for 90%-95% of all diabetic patients (Tripathi & Srivastava, 2006).

The main driving factors of the global prevalence of T2DM are the increase in obesity, sedentary lifestyles, energy-dense diets, and population aging (Chatterjee et al., 2017). A report released by the IDF in 2021 indicated that approximately 537 million adults aged 20-79 worldwide suffer from T2DM (Magliano et al., 2021). With rapid socio-economic and lifestyle changes, the prevalence of diabetes in China has risen sharply over the past few decades, from 0.67% in 1980 (Zhao et al., 2011) to 11.2% in 2017 (Y. Li et al., 2020). In 2019, the total number of diabetes patients was 116.4 million, and it is projected to increase to 147.2 million among Chinese adults by 2045 (IDF, 2019). T2DM, often considered a disease of middle-aged and elderly individuals, is now increasingly affecting younger populations (Magliano et al., 2020). In China, the prevalence of diabetes among individuals aged 18-29 is 2.0%, and among those aged 30-39, it is 6.3% (Y. Li et al., 2020).

T2DM has become a significant global public health issue, with its prevalence and complications leading to substantial mortality and high disability rates worldwide (Zheng et al., 2017). Patients with T2DM often present with complications such as cardiovascular disease, diabetic neuropathy, nephropathy, and retinopathy. A study by Viigimaa et al. (2020) indicated that cardiovascular disease is the leading cause of death in diabetic patients. Diabetes and its associated complications reduce quality of life and impose significant economic and social burdens (Zhao et al., 2011). While various medications can effectively lower glycated hemoglobin (HbA1c) levels in T2DM patients, appropriate lifestyle interventions combined with comprehensive care can achieve glycemic targets (Gorter et al., 2012).

Self-management refers to the process by which individuals utilize their health-related beliefs and attitudes to adopt appropriate health behaviors for promoting or maintaining their well-being, while continuously monitoring, managing, and caring for disease symptoms (Hu et al., 2020). According to Koch et al. (2004), self-management encompasses three distinct categories of activities: (1) medical management, such as medication adherence; (2) behavioral management, such as adopting new behaviors; and (3) emotional management, such as coping with frustration and despair. Since T2DM is a chronic condition, patients typically visit healthcare professionals only a few times per year, requiring them to manage all these aspects independently. In diabetes management, self-management serves as an effective approach to reduce the risk of complications and improve quality of life.

Self-management behavior (SMB) refers to an individual's ability to manage their own behaviors over an extended period, including regular medication adherence, healthy diet, physical activity, foot care, smoking cessation, and self-monitoring of blood glucose (Alyami et al., 2019). Coleman et al. (2009) demonstrated that successful support for self-management in T2DM patients can positively influence their lifestyle and ultimately lead to improved health outcomes. However, a comparative international study by Elissen et al. (2013) revealed that self-management support remains relatively underdeveloped in most countries. Gonzalez et al. (2016) found that many T2DM patients do not adhere to recommended self-management activities. A study by Alrahbi (2014) revealed low levels of self-management behavior among diabetic patients, with only 1% monitoring blood glucose, 9.5% engaging in regular physical exercise, and 18% following recommended diets.

Nursing is highly practical, and nursing students must master systematic theoretical knowledge and practical skills to become qualified nurses. However, clinical internship time is limited, and legal restrictions on nursing students, along with patient safety concerns, make it difficult to meet learning demands through patient contact alone. Simulation teaching, which provides students with opportunities to experience real clinical scenarios while ensuring patient safety and without increasing psychological pressure, has become one of the primary teaching strategies to enhance nursing students' capabilities (Cui, J., & Qi, W. Q., 2024). Scholars define simulation teaching as an instructional approach that recreates near-real clinical settings to simulate the environmental and developmental processes of events or phenomena, facilitating knowledge acquisition, skill enhancement, and emotional engagement (Zhong, J., 2022).

METHODOLOGY

This study took third-year undergraduate nursing students from a university in Yunnan Province, China as research subjects, primarily exploring the improvement of self-supportive virtual education capabilities among nursing students with T2DM in minority regions through virtual simulation education. The study period was from March 2026 to December 2026, adopting a non-randomized simultaneous control design in quasi-experimental research. The scope of the study was limited to classroom teaching scenarios and did not involve online teaching or analysis of long-term learning outcomes.

Teaching Preparation Phase: This phase was conducted one week prior to the practical training session and was synchronized with the corresponding theoretical course content. The primary tasks included the development and provision of simulated cases, student grouping, task allocation for group members, preparation of practical training supplies and equipment, construction of a simulated environment, as well as the selection and training of standardized patients.

Phase of Constructing and Implementing Virtual Teaching Programs: This consisted of four main processes:

1. **Pre-simulation:** As the preparatory phase, this aimed to facilitate a smooth educational experience and reduce participant anxiety. This course design primarily adopted a group-based approach for virtual case discussions and analyses, utilizing video media to learn and observe typical symptoms, signs, or content-related specialized nursing skill demonstrations.
2. **Pre-briefing:** A targeted phase for constructing simulated program scenarios, this effectively alleviated participants' anxiety and stress by clarifying the objectives and expectations of simulation activities. The design was based on the HSSOBP™ Pre-briefing Standards of Healthcare Simulation Best Practice™ (INACSL Standards Committee, 2021), involving time allocation for instructors, case presentation, and classroom objective articulation.
3. **Simulation:** Students from each group entered standardized wards to conduct nursing assessments, document physical examinations, and collaboratively develop nursing plans. They

implemented basic and specialized nursing skills, as well as health education. Other groups observed the simulation activities through on-site video recordings.

4. **Debriefing:** A pivotal component of virtual teaching, this was a formal collaborative reflection process initiated by instructors in discussion rooms after simulated teaching activities. Based on Knoles' adult learning theory, this instructional design adopted a non-judgmental review approach to effectively cultivate students' self-reflection and evaluation skills. The review process was systematically planned based on the GAS model (Sawyer T. & Eppich W., 2016) steps (collecting-analyzing-summarizing) to ensure orderliness and efficiency.

Design of the Evaluation Scheme: According to Jeffries' simulation theory, the evaluation primarily focused on knowledge, skills, learner satisfaction, critical thinking, and self-confidence. Therefore, the design of teaching evaluation adopted professional virtual education assessment tools such as the Intrinsic Motivation Scale and the Seattle University Simulation Evaluation Tool, evaluating from both student and teacher perspectives to understand differences in students' pre- and post-virtual training aspects including interest, self-confidence, multiple skills, clinical thinking, teamwork ability, and professional behavior.

RESULTS

The systematic review identified the core dimensions of self-management support competence, including health education competence, behavior change support competence, communication and empathy competence, and individualized management competence. These findings provided a solid evidence-based foundation for project development.

Guided by Pamela R. Jeffries' Jeffries Simulation Theory (2005), this study developed a systematic virtual simulation teaching model encompassing learning objective design, scenario script development, instructional strategy configuration, teacher role definition, and evaluation metrics. The project focused on core competencies for self-management support in T2DM patients, incorporating culturally contextualized design tailored to minority regions to enhance situational relevance and practical guidance value.

Empirical study results showed that the total score and each dimension score of self-management support competence in the intervention group were significantly higher than those in the control group ($P < 0.05$), with particularly notable improvements in communication competence and behavior change support competence. Additionally, the intervention group demonstrated significantly higher learning satisfaction and self-efficacy. The results indicated that virtual simulation teaching effectively addresses the limitations of traditional classroom instruction in authentic interactive training, establishing it as an effective pedagogical model for cultivating core competencies in chronic disease nursing.

DISCUSSION AND CONCLUSION

This study, centered on the theme of developing and evaluating a virtual simulation education project for self-management support in nursing students for T2DM patients, was systematically conducted based on evidence-based evidence and educational theory guidance, involving evidence integration, project construction, and effectiveness evaluation.

The findings demonstrate that through systematic review methods, the study integrated domestic and international research evidence on self-management support and virtual simulation teaching for T2DM patients, identifying critical elements including a patient-centered framework for self-management support (diet, exercise, blood glucose monitoring, medication adherence, psychological support), emphasis on cultivating communication skills and behavioral change support capabilities, focus on situational authenticity and decision-making process training, and reinforcement of feedback and reflection mechanism design. The evidence demonstrates that virtual simulation teaching can significantly enhance nursing students' self-management support abilities, self-efficacy, and clinical decision-making skills.

Students in the intervention group demonstrated significantly higher total scores and dimension-specific scores in self-management support compared to the control group. Notable improvements were observed in communication skills, behavioral change support, and individualized education capabilities. Both learning satisfaction and self-efficacy showed significant enhancement. The results indicate that virtual simulation teaching effectively addresses the limitations of traditional classroom instruction in authentic interactive training, establishing it as an effective pedagogical model for cultivating core competencies in chronic disease nursing.

This study not only validated the educational efficacy but also developed a replicable and scalable virtual simulation teaching model for chronic disease self-management support, characterized by theory-driven, evidence-based, structurally complete, with a clear evaluation system, and sustainable for improvement. This model can be extended to other chronic disease areas, providing a practical pathway for nursing education reform.

In conclusion, this study successfully developed and validated a virtual simulation education program designed to enhance self-management support capabilities for T2DM patients. The findings demonstrate that the evidence-based and theory-driven virtual simulation teaching model effectively improves core self-management competencies among nursing students, representing a significant direction for the transformation of chronic disease nursing education. This research provides both theoretical foundations and practical evidence for the application of virtual simulation teaching in chronic disease management capacity development within nursing education, holding substantial implications for strengthening primary care capabilities in chronic disease management.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should conduct randomized controlled trials under multicenter and large-sample conditions to enhance the external validity and generalizability of the results. Simultaneously, the follow-up period should be extended to evaluate the long-term retention and clinical transfer effects of virtual simulation teaching on nursing students' self-management support capabilities. A mixed-method approach is recommended, combined with qualitative interviews to thoroughly explore the teaching mechanisms. Technically, virtual reality and intelligent feedback systems can be integrated to improve situational authenticity and personalized guidance levels. Additionally, a standardized framework and evaluation system for virtual simulation teaching in chronic disease care should be established, with its applicability and stability validated across other chronic disease domains.

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